



Ekonomická
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Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice

Proceedings of the 10th International Scientific Conference INPROFORUM

„Threatened Europe? Socio-Economic and Environmental Changes“



České Budějovice | November 3 – 4, 2016

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2016



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Faculty of Economics

České Budějovice, November 3 – 4, 2016

10th International Scientific Conference INPROFORUM

Threatened Europe? Socio-Economic and Environmental Changes

November 3 – 4 , 2016, České Budějovice

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Supported by Ministry of Education, Youth and Sports of the Czech Republic.

Publication was not subjected to a language check. All papers were reviewed in double-blind review process by external and internal reviewers and the Conference Committee.

Threatened Europe? Socio-Economic and Environmental Changes



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Preface

Dear readers,

The International Scientific Conference INPROFORUM is a traditional event held by the Faculty of Economics, University of South Bohemia in České Budějovice. It is focused on the research achievements in the fields of Innovations, Enterprises, Regions and Organizations. The conference offers the opportunity to discuss relevant topics among academic and practising economists.

The 10th Anniversary International Conference INPROFORUM 2016 was dedicated to the topic „Threatened Europe? Socio-Economic and Environmental Changes“. Aim of the conference was to respond to the Situation in Europe and instigate scholarly discourse which presents the current changes in this new context. “Threatened Europe? Socio-Economic and Environmental Changes“ has been discussed in following sections:

- Threatened Europe – Threatened Regions? New Challenges and New Solutions.
- Economic impacts of Changes and Policies in the fields of Finance, Accounting and Taxation
- Economics of Agriculture
- Causality of Socio-Economic Changes
- Mathematical-statistic Modelling and Optimization in Practice
- New Challenges for International Trade and Tourism
- Managing Changes and Innovations
- The Application of Private Law after the Legislative Changes in the Czech Republic

It is our pleasure to offer the INPROFORUM result in this form of reviewed contributions and hope you will find it useful and interesting for your academic development.

On behalf of organizing committee

Miloslav Lapka

Session 1

Threatened Europe – Threatened Regions?
New Challenges and New Solutions

Adjusted Net Savings in the Countries of the European Union

Magdaléna Drastichová

Abstract: Sustainable development (SD) is an overarching objective of the European Union (EU) enshrined in its primary law, governing all the EU's policies and activities. Adjusted Net Saving (ANS) as a macro level index of SD was used to evaluate SD in the EU countries and additional four developed countries for the purpose of comparisons. ANS was assessed according to the ANS ratio in % of GNI and the ANS per capita. Moreover, the ANS component indicators were investigated to complete the evaluation. Although the results differ between countries according to the applied ANS indicator, Norway has shown high levels of both ANS indicators. Although this country showed the highest sum of the negative ANS components after subtracting the positive component, it was evaluated as the best performing economy according to the combination of the monitored indicators. On the other hand, Greece is evaluated as the unsustainable country having shown negative ANS since 2008. Romania and Lithuania showed the significant improvements and moved from the unsustainable territory. The ANS of the monitored countries has significantly been affected by the economic crisis.

Key words: Adjusted Net Savings (ANS) · European Union (EU) · Sustainable Development (SD)

JEL Classification: Q51 · F56

1 Introduction

Sustainable development (SD) and achieving SD goals has gained great importance worldwide. Since the most quoted definition of the SD was adopted by the World Commission on Environment and Development (WCED) (WCED, 1987) a huge number of measurement methods and indicators of the SD has been developed. According to this definition, SD is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). SD is an overarching objective of the EU enshrined in its primary law, governing all the EU's policies and activities. The EU Sustainable Development Strategy (EU SDS) was launched in 2001 and renewed in 2006. This strategy provides an EU-wide policy framework to deliver SD (European Union, 2009). The Sustainable Development Indicators (SDIs), reflecting the key challenges of the EU SDS are used to monitor the EU SDS and presented in ten themes. However, there are other basic indicators that are useful to monitor SD aspects, such as the macro level index called Adjusted Net Saving (ANS). The aim of the Paper is to evaluate sustainability in the EU and its countries together with additional five developed countries. The evaluation is carried out by means of the ANS and its component indicators.

2 Methods

Advocates of weak sustainability argue that physical and natural capital are substitutes (Anderson, 2010). Thus, the basis for human welfare is not only natural capital but rather the aggregate level of capital. The concept aims to provide means for tracking that the total level of capital including natural, man-made, human and social capital of society is non-declining. Pearce and Atkinson (1993) put forward an index which is based on the Hicksian income concept. Particularly, they provided one of the earliest suggestions for an indicator for measurement of the (very) weak sustainability, according to which a country achieves very weak or weak SD path if the savings exceed the total depreciation of both material and natural capital. The human capital will not depreciate because it has public-good aspects and can be passed from one generation to another. The maintenance of the total capital stock depends on a national savings rate which is at least as great as the combined depreciation rate of natural and physical capital. The other forms of capital are difficult to measure. Following that an economy is sustainable if it saves more than the combined depreciation on the two forms of capital. Z is an Index of (Weak) Sustainability and the condition for sustainability is (Pearce and Atkinson, 1995):

$$Z = \frac{S}{Y} - \left[\frac{\delta_M}{Y} + \frac{\delta_N}{Y} \right] \geq 0, \quad (1)$$

where S is savings, δ_M is the value of depreciation on man-made capital, and δ_N is the value of depreciation on natural capital. All variables are divided by income Y .

In order to consider the depletion of natural capital in national income accounting, the World Bank has developed a composite indicator known as Genuine Savings or Adjusted Net Saving (ANS) which is based on the above mentioned Index of Weak Sustainability (Pillarsetti, 2005). The ANS is a macro level index of SD building on the concepts of green national accounts. It extends the conventional net saving by adding human capital accumulation and deducting natural resources losses (Gnègnè, 2009). It means that ANS measures the true rate of savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution (World Bank, 2012). Thus, the theoretical background is the idea that sustainability requires the maintenance of a constant stock of extended wealth that is not limited to natural resources but it also includes physical, productive capital, as measured in traditional national accounts, and human capital. Net ANS should represent the change in this total wealth over a given time period (a year). Such a concept can be understood as the relevant economic counterpart of the notion of sustainability. Namely, it does not include only natural resources but also, in principle at least, those ingredients necessary to provide future generations opportunities which are at least as large as those available to current generations (Fitouss et al., 2011). The derivation of ANS from standard national accounting measures of Gross National Savings (GNS) by making four types of adjustments can be seen in Table 1. Firstly, estimates of capital consumption of produced assets are deducted to obtain Net National Saving (NNS). Secondly, current Education Expenditures (EDE) are added to NNS as an appropriate value of investments in human capital. In standard national accounting these expenditures are treated as consumption. Thirdly, estimates of the depletion of particular natural resources are deducted to reflect the decline in asset values associated with their extraction and harvest. Estimates of resource depletion are based on resource rents calculation whereas an economic rent represents the *excess* return to a given production factor. These rents are derived as the difference between world prices and the average unit extraction or harvest cost, including a *normal* return of capital. Finally, pollution damages are deducted. Many pollution damages are local in their effects, and therefore difficult to estimate without location-specific data. So, to calculate the ANS indicator, health damages due to urban air pollution are estimated. As regards global pollution damages, the estimates include damages from carbon dioxide emissions (Redclift and Springett, 2015). The construction of the ANS is described in Table 1 in detail. The formula for the ANS calculation is summarized in the last field of Table 1.

Table 1 The method of calculating the Adjusted Net Saving in successive steps

Item	Definition and/or Formula	Item	Definition and / or Formula
GNS	$GNS = GNI - \text{Private Consumption} - \text{Public Consumption} + \text{Net Current Transfers}$	Mineral Depletion (MD)	$MD = PV (\text{Rent}, 4\% \text{ Discount Rate}, \text{Exhaustion Time}) / \text{Exhaustion Time}$ $\text{Rent} = \text{Production Volume} \times \text{Unit Resource Rent}$ $\text{Unit rent} = \text{Unit Price} - \text{Unit Cost}$ $\text{Exhaustion Time} = \min (25 \text{ years}, \text{Reserves} / \text{Production})$
Depreciation (CFC)	Replacement value of capital used up in the process of production (data taken directly from source or estimated)	Net Forest Depletion (NFD)	$NFD = (\text{Roundwood Production} - \text{Increment}) \times \text{Average Price} \times \text{Rental Rate}$
NNS	$NNS = GNS - \text{Depreciation}$	CO ₂ Damages (CO ₂ D)	$CO_2D = \text{Emissions (tonnes)} \times \text{Marginal Global Damages per ton of Carbon emitted (\$20)}$
Education Expenditure (EDE)	Public current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment (data taken directly from source or estimated)	Particulate Emissions Damage (PED)	Damages are calculated as foregone labour income due to premature death.
Energy Depletion (ED)	$ED = PV (\text{rent}, 4\% \text{ Discount Rate}, \text{Exhaustion Time}) / \text{Exhaustion Time}$ $\text{Rent} = \text{Production Volume} \times \text{Unit Resource Rent}$ $\text{Unit Rent} = \text{Unit Price} - \text{Unit Cost}$ $\text{Exhaustion Time} = \min (25 \text{ years}, \text{Reserves} / \text{Production})$	Adjusted Net Savings (ANS)	$ANS = NNS + EDE - ED - MD - NFD - CO_2D - PMD$

Source: World Bank (2016), Bolt (2002); Own processing

Note: data used for individual variables are extracted from different sources, see more in World Bank (2016); Bolt et al. (2002)

The ANS is an indicator of sustainability and it serves as a policy indicator as well. It reinforces the need to boost domestic savings and hence the need for sound macroeconomic policies, as well as the need to improve the environment and resource management. In addition, it makes the growth-environment trade-off quite explicit, since those countries planning to grow in recent times and to protect the environment later will show lower levels of ANS. This is an important aspect of SD. Negative values of ANS imply that total wealth of the economy is in decline and therefore policies leading to persistently negative ANS can be regarded as policies for unsustainability (Gnègnè, 2009). He showed that positive and significant relationship exists between ANS and aggregate welfare but weak in magnitude.

However, there are some methodological aspects which needs to be taken into account. The negative ANS value clearly indicates unsustainability. However, the ANS values generally are to some extent affected by pricing method used to estimate economic values of natural resource and environmental damages and therefore some subjectivity is present. Beyond that, the current prices are used to calculate ANS. As the savings are derived from GNI including the social and environmental effects evaluated by the particular methods the resulting ANS indicator is calculated in current prices. Therefore, to deepen the analysis in this Paper two forms of ANS indicator are used, i.e, the ANS ratio (ANS in % of GNI) and the ANS per capita. Subsequently, they are combined with additional two indicators to detect the extent of sustainability in the EU and the sample of 33 countries. Data on the ANS are taken from the World Development Indicators (World Bank, 2016). Regarding the sample, the EU as a whole and its countries together with five additional developed countries are investigated according to the data availability. These countries are Canada, Iceland, Norway, Switzerland and the USA. The overall monitored period is 1990 – 2014, but for many EU countries data are available starting from 2002 and therefore in the analysis of the countries this period is used. For Malta, data on the ANS are not available but the component indicators are available except for NFD and thus all the required indicators were calculated using the available component indicators.

3 Research results

The results of the sustainability assessment are presented in this section. Firstly, the ANS ratio (ANS in % of GNI) and the ANS per capita are used for the evaluation of 33 sample countries. Next, the component indicators of the ANS are examined in this sample.

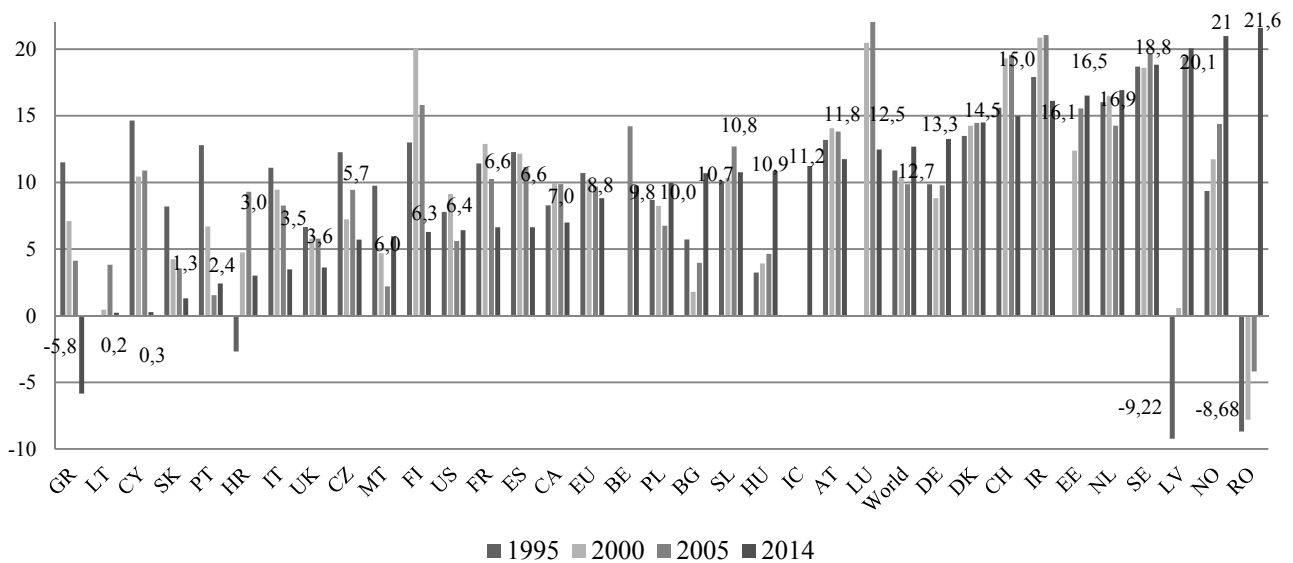
3.1 Adjusted Net Savings in the EU and its countries

Starting with the first part of the analysis, the Figure 1 shows the ANS ratio in the EU and other five developed countries in 1995, 2000, 2005 and 2014. When data in the last year 2014 are not available, those of 2013 for Iceland and Greece and of 2011 for Malta were used in all the Figures included. In 1995 and 2000 data are also unavailable for several countries. However, these are not replaced by the data of other years. In 1995, Lithuania, Romania and Croatia showed the negative ANS values of -9.223%, -8.683% and -2.677% of GNI respectively. Sweden showed the highest ANS ratio in 1995 (18.692%) and it was followed by Ireland, Netherlands, Switzerland and Cyprus. In 2000, only Romania showed the negative ANS ratio (-7.802%) but Latvia and Lithuania showed the levels below 1% of GNI. Ireland achieved the highest ratio (20.871% of GNI). It was followed by Luxembourg, Finland, Switzerland, Sweden and Netherlands. It can be confirmed again that the Northern countries showed the relatively high ratios and the remaining Northern country, Norway, showed the ANS of 11.74% of GNI. In 2005 Romania as the only country showed the negative ANS ratio of -4.181%. However, in comparison to the previous monitored years, the improvement occurred. In this year, it was followed by Portugal (1.539%), Malta (2.207%) and three countries showing ANS in the range 3–4% of GNI, i.e. Slovakia, Latvia and Bulgaria. Some of the best performing countries are similar to those achieving the highest ratios in the previous years. BENELUX countries, Northern countries, two Baltic countries, Ireland and Switzerland showed the highest ANS ratios.² Luxembourg was the best performing country with the ANS ratio of 24.289% of GNI, exceeding even that of Ireland (21.058%). Sweden, Switzerland and Lithuania showed the ANS ratio higher than 19%. It can be seen that Lithuania has increased its ANS ratio significantly while Latvia remained as one of the worse performing country.

In the last monitored year 2014 the significant changes occurred as well, which is predominantly the result of the economic crisis. Greece became a worst performing country having shown the negative ANS since 2008. Although there are not available data in 2014, this country still showed the relatively high negative ratio of -5.845% in 2013. Latvia and Cyprus followed this country with the ratios lower than 1% while the latter country showed the significant ANS drops as compared to previous years, especially before 2007. Slovakia and Portugal are also one of the worst performing countries. Some of the best performing countries remained the same as in 2005, but some significant changes, including those in the order of countries, took place. Especially, Luxembourg and Finland worsened their position markedly as compared to 2005 (-11.814 p. b. and -9,528 p. b. respectively). These countries together with Cyprus and Greece deteriorated their ANS score most significantly. On the other hand, Romania significantly increased its ANS ratio. It has showed the positive rates since 2007 and ended up as the country with highest ANS ratio in 2014. It is followed by Norway which also increased its ratio markedly and in 2014 this country showed its highest score as compared to the period starting from 1990. Lithuania further increased its ANS score and ended up as the country with the third highest ratio in 2014. The ANS of Sweden slightly dropped as compared to 2005, achieving the fourth highest ratio in the sample.

² For Belgium data have been available since 2002, for Iceland data are available only in 2011 – 2013.

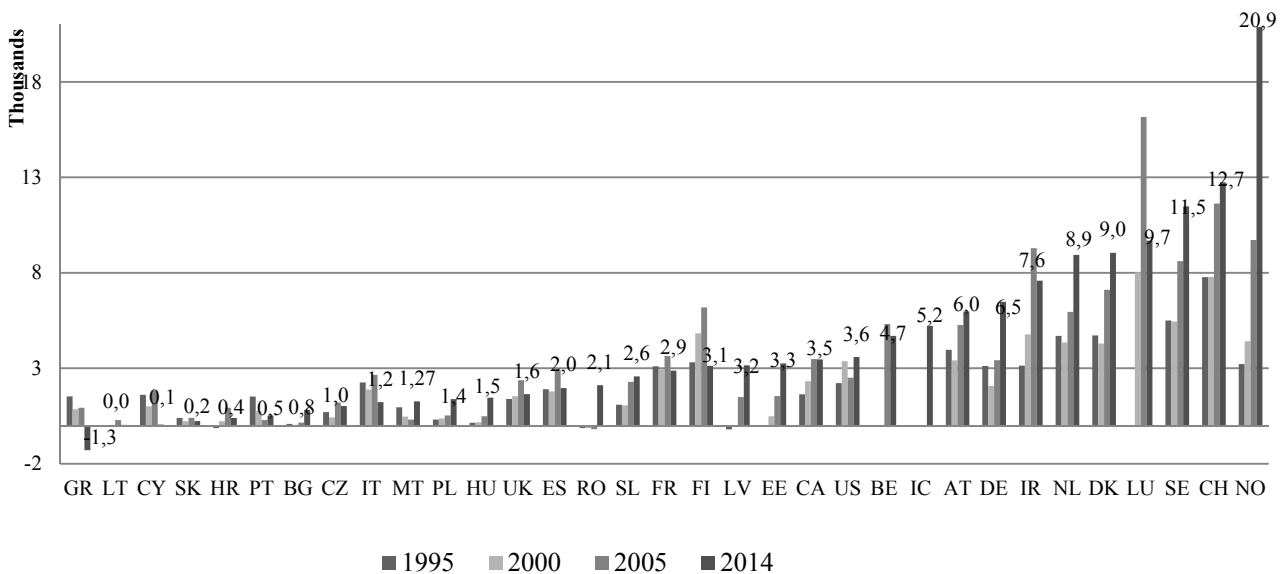
Figure 1 Adjusted Net Savings, in % of GNI, selected years



Source: World Bank (2016); Own processing

Next, the ANS per capita was calculated for the countries in the sample. To obtain the ANS per capita the ANS in current US\$ was divided by total population of the country. The results are shown in Figure 2. There are some changes in the order of countries when the ANS per capita is used instead of ANS ratio. In 1995, Switzerland was the best performing country, followed by Sweden, Denmark and Netherlands. However, Ireland and Cyprus showed relatively worse position when this indicator is used and, on the other hand, Norway improved its position markedly. In 2000, Luxembourg achieved the highest ANS per capita and it was followed by Switzerland, Sweden and Finland. Ireland, which is the country with the highest ANS ratio in this year, ended up as the fifth best performing country and the following one, Norway, improved its position in comparison to the ANS ratio. In 2005, Luxembourg achieved the highest ANS per capita together with highest ANS ratio. It was followed by Switzerland, Norway, Ireland and Sweden, which means that Norway's ANS per capita exceeded those of other Northern economies as well as that of Ireland. In 2014, Norway showed the highest ANS per capita whereas Romania showing the highest ANS ratio showed the relatively lower score in ANS per capita. Norway was followed by Switzerland, Sweden, Luxembourg, Denmark and Netherlands (see Figure 2).

Figure 2 Adjusted Net Savings, in Current US\$ per capita, selected years



Source: World Bank (2016), Own processing

The correlation coefficient between two ANS indicators in the sample in 2014 was equal to 0.689. It is obvious that while the ANS ratio is determined by the shares of the ANS components in GNI, the ANS per capita is determined by the overall ANS in monetary units including the influence of the price level and the population size. This can help understand why some less developed EU countries, such as Romania, Lithuania and Estonia are able to achieve high ANS ratio (see Figure 1) but not the ANS per capita (see Figure 2). Overall, the Northern countries (except for Finland) and BENELUX countries together with Switzerland, Ireland, Germany and Austria achieved relatively higher levels of both ANS indicators. In two Baltic economies the high ANS ratio was achieved, but not the ANS per capita while Latvia showed very low levels of the ANS indicators. Many new Member States and Southern economies showed relatively low ANS levels. As it results from the previous analysis, the development of the national savings, including the adjusted ones is significantly affected by the actual economic development. The last economic crisis led to substantial drops of the ANS indicator, including the deterioration of the positions of previously well performing countries. In 2009, the ANS ratio declined both in the EU and the overall world and in the majority of the countries in the sample except for Latvia, Switzerland, Bulgaria, Lithuania, Hungary and Portugal. On the other hand, the ANS per capita increased in four of them, i.e. except for Hungary and Lithuania. These kinds of shifts can indicate economic problems. Although the overall ANS can decrease due to the economic downturn and, probably, due to the drop of the price level, the variables reflecting the resource exhaustion and pollution would probably decline more significantly as a result of the economic recession and thus the RP is usually rising and the ANS ratio can increase as well. Generally, the ANS can decrease in economic recession due to the significantly lower resource use when production declines, which is also connected with lower level of pollution. Nevertheless, the environmental effects represent relative low ratios in the ANS. Thus, the important result could predominantly be the increase of GNS ratio (in % of GNI) by the simultaneous decrease of their absolute levels. In Lithuania this development is also connected with the increase of the EDE ratio (in % of GNI), but the declines in the environmental components also occurred. In the above mentioned countries, except for Portugal, GNS ratio increased. In Switzerland and Latvia, the CFC indicators dropped as well, while in the former only the ratio (in % of GNI) and in the latter it declined also in absolute terms. In the next subsection 3.2 the component indicators are studied more in detail and the changes related to the economic crisis are also discussed.

3.2 Analysis of the components of the Adjusted Net Savings

To compare the performance of the countries in the ANS component indicators, which are related to the economic, social and environmental dimension of the SD, their ratios in % of GNI are used instead of recalculation of all the component indicators to obtain the corresponding per capita values. In Table 2 the countries with highest and lowest ANS ratios are shown in the most recent year 2014 and in the monitored period 2002 – 2014 where the average rates are used. When in the particular country data are not available in the overall period or in the most recent year, the longest possible period with available data is used to calculate the average rate and the most recent year where data are available. The particular cases are explained in Note 2 below Table 2. Some results are in compliance with the previous analysis (Drastichová, 2014).

Table 2 The countries with the highest / lowest ANS component indicators ratios in % of GNI, 2002 – 2014, 2014

2002–2014	GNS	CFC	EDE	ED	MD	NFD	CO ₂ D	PED
LOWEST	GR, IC, PT, MT	CY, PL, BG, UK	GR, RO, BG, SK	Zero – 7 countries	Zero – 11 countries	Zero – 18 countries	CH, SE, NO, FR	IC, NO, SE, FI
HIGHEST	NO, CH, LU, SE	LT, CZ, SK, CH	LV, DK, IC, SE	NO, CA RO, DK	BG, CA, PL, SE	LT, HR, SK, EE	BG, EE, PL, RO	HU, BG, RO, PL
2014	GNS	CFC	EDE	ED	MD	NFD	CO ₂ D	PED
LOWEST	CY,GR, UK, MT	RO, PL, BG, UK	RO, GR, BG, SK	Zero – 7 countries	Zero – 11 countries	Zero – 20 countries	CH, SE, NO, DK	NO, IC, SE, FI
HIGHEST	NO, CH, EE, LU	LT, CZ, SK, CH	LV, DK, IC, MT	NO, CA, DK, RO	BG, CA, FI, PL	HR, LT, EE, SK	BG, EE, PL, CZ	HU, BG, HR, PL

Source: World Development Indicators (2016); Own processing

Note 1: The rates in the fields are ordered from the highest ones for the highest rates and from the lowest ones for the lowest rates.

Note 2: GNS – the last available data for Greece and Iceland are in 2013, for Malta in 2011; CFC, EDE, ED, MD, CO₂D, PED – the same as by GNS, but the last available data for Malta are in 2013; NFD – for Greece data are not available in 2014, for Iceland data are available only in 2011– 2013, for Malta data are not available in the overall monitored period.

Note 3: The countries with zero rates of ED in 2002 – 2014 and in 2014: BE, CY, IC, LT, MT PT, SE. The countries with zero rates of MD in 2002 – 2014 and in 2014: BE, HR, CZ, EE, IC, LT, LV, MT, NL, SL, CH. The countries with non-zero values for the NFD in 2014: HR, LT, EE, SK, SL, LV, PL, CZ, CH, AT, DK, BE; moreover: IC and DE in 2002 – 2014;

GNS is the basis for the ANS and it is the crucial component of the ANS. The EU showed its share in GNI slightly above 21% both in the monitored period and in 2014. Norway showed the highest GNS, i.e. slightly higher than 37% both in the monitored period and in 2014. Switzerland also showed GNS above 30% of GNI. Luxembourg, Sweden, Netherlands and Ireland also showed relatively high saving ratios of GNI (higher than 26%, Luxembourg: 30.837%

in period 2002 – 2014). Estonia has shown significant increases since 2011. On the other hand, the significant decrease in Ireland in 2008 and 2009 and persistence of the relatively lower ratios since then has been reversed since 2013. The economic crisis has had great impact on the countries, i.e. in the EU as a whole and the majority of the countries in the sample the GNS dropped in 2009. The exception were all three Baltic economies, Bulgaria and Romania, Switzerland, Iceland and Hungary. Nevertheless, some of them showed the significant drops in previous year (e.g. Bulgaria in 2007, Iceland and Switzerland in 2008) or following years (Latvia in 2010). Except for Spain, all three other Southern economies show low GNS ratios. This is also case of Cyprus, the UK, Malta, the USA, Poland and Lithuania while the latter showed the slight improvement in the recent period. In the EU the CFC is slightly above 16% of GNI both in the monitored period and in 2014. The low depreciation rate in Cyprus, Poland, Bulgaria, the United Kingdom (UK), Lithuania, Malta, the USA and Norway can partly help compensate the lower GNS in the majority of them, but in Norway it is the important factor even enhancing the highest GNS ratio. In Switzerland the high depreciation rate disadvantaged this country in relation to Norway having both high GNS and low CFC. The new Member States shown in Table 2 together with Slovenia showed relatively highest depreciation rate (around 20% of GNI and more).

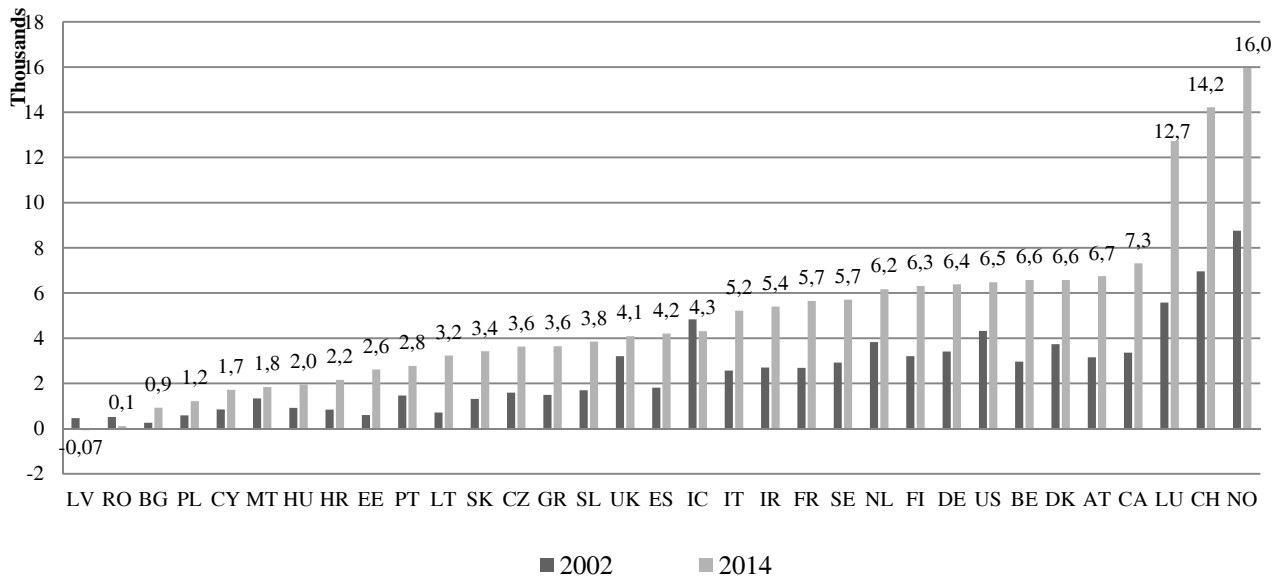
EDE as a component representing social pillar of the SD showed the highest share in GNI when comparing to the environmental components (the average in 2002 – 2014: 4.754%, 2014: 5%). The lowest ratios are between 3 – 4% in the countries shown in Table 2 and also in Luxembourg. In Italy the 2014 ratio is also below 4%, so is the average ratio of the Czech Republic and Croatia. All the Northern economies show high shares of EDE but that of Lithuania is even significantly higher than in best performing Northern country which is Denmark (15.52% and 8.07% in 2014 respectively). In all three Baltic countries this kind of expenditure has predominantly been above 4% and below 6% since the middle of 1990s (according to data availability). However, in 2004 the significant annual increase by 12.543 p. b. occurred in Lithuania and the expenditure reached 17.62% of GNI. Since then it has been at the level above 15% (below 19%) and in 2009 it even showed 18.19 of GNI. The percentage ratios of the environmental variables are relatively low, some of them show zero values in more years and even the non-zero values are very low. This is especially the case of the NFD and to lower extent of MD indicator, because these indicators also significantly depend on the available amount of these resources and obviously on the way of their exploitation. Depletion of minerals shows the highest ratio in Bulgaria (0.821% of GNI in 2014 and 0.743% in 2002 - 2014) and it is followed by Canada (0.522% of GNI in 2014 and 0.461% in 2002–2014), Poland, Sweden and Finland while all three latter still show the ratio higher than 0.1%. The highest average share of NFD in period 2002 – 2014 was shown by Latvia (0.95% of GNI) and in 2014 by Croatia (1.068% of GNI). On average and in 2014 all three Baltic countries, Croatia, Slovakia, Slovenia and Poland showed the relatively higher NFD rates, all showing higher than world's average ratio.

Norway showed the highest ED shares in GNI in the overall period as well as in 2014 (12.012% and 7.069% of GNI respectively). These ratios significantly exceeded those of Canada (2.675% and 1.54% of GNI respectively). The results confirm the great dependence of these countries on energy resources. Switzerland together with four Northern economies, i.e. Sweden, Norway, Denmark and Iceland as well as France showed the lowest CO₂D ratios. On the other hand, i.e. countries showing relatively high CO₂D ratio are especially the new Member States in the same order at the first three places in the overall period as well as in 2014. Romania and the Czech Republic interchanged the fourth and fifth position in the overall period and in 2014. Other new Member States together with Greece, the USA and Canada follow them showing relatively higher CO₂D as well. The CO₂ levels are determined by the structures of the economies and the effort of countries to adopt appropriate structural reforms. Although the new Member States have made significant efforts, the level of emission is still high in some of them. As regards PED, all five Northern economies show low levels, with the highest ratio among them showed by Denmark. The highest levels are typical of new Member States. However, the exception is Cyprus with low PED ratio and Estonia, Slovenia and Malta also showed relatively lower ratios. To sum up, in the whole EU the EDE showed the average level of 4.754% of GNI, ED of 0.371%, CO₂D of 0.216%, PED of 0.187%, MD of 0.02% and NFD indicator only 0.014%. On the other hand, the depreciation of the physical capital showed 16.275% of GNI. This reflects the importance of the economic, social and environmental ANS components in the EU's GNI.

3.3 Relations of the Adjusted Net Savings to selected Environmental and Sustainable Development Indicators

To complete the analysis, the ANS component indicators were further elaborated to create two additional indicators for 33 sample countries. Both indicators are displayed in years 2002 and 2014. Firstly, the sum of the negative ANS components, from which the EDE is deducted, in current US\$ per capita is calculated. Particularly, depreciation of the physical capital (CFC), natural capital (ED, MD) and environmental damages (CO₂, PED) are added up and the EDE is subtracted from this sum. The results are shown in Figure 3. Next, the ratio of GNS to these components (GNS ratio) is displayed in Figure 4. The former shows the absolute (net) level of the negative ANS components (costs) in current US\$ that will ultimately lead the economy to the unsustainable territory if the economy does not have enough money in the form of the GNS to compensate them.

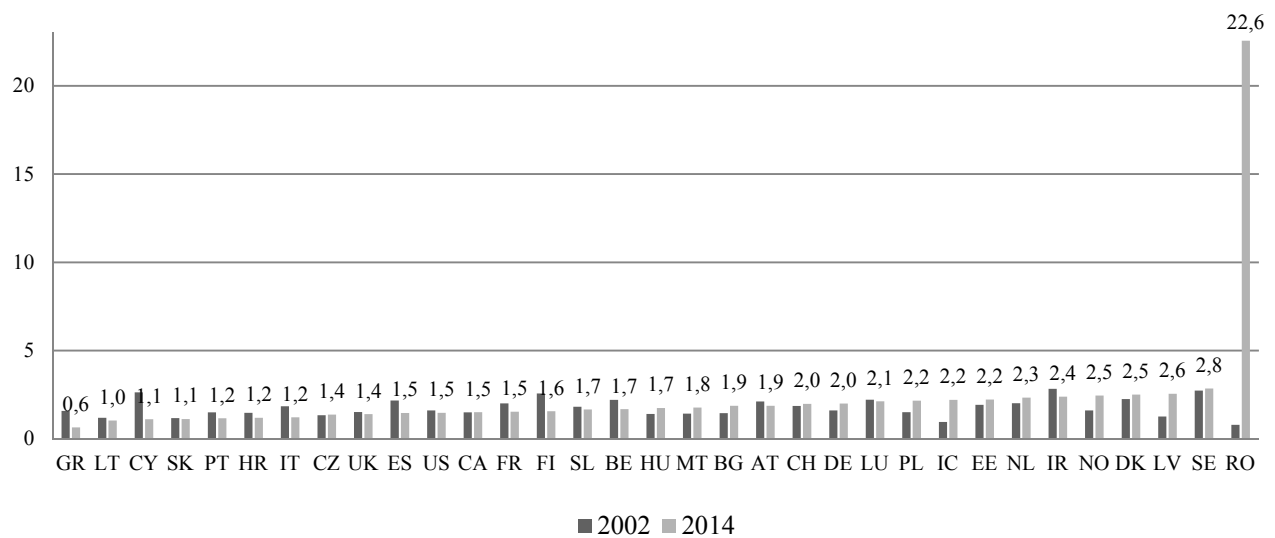
Figure 3 Sum of the negative ANS Component Indicators minus EDE, current US\$ per capita, 2012 and 2014



Source: World Development Indicators (2016); Own processing

It can be seen in Figure 3 that the best performing countries with the highest levels of the ANS also show highest absolute levels of the negative ANS components after the subtraction of the EDE indicator. In both monitored years Norway, Switzerland and Luxembourg show the highest values. On the contrary, Romania and Bulgaria together with Lithuania showed the lowest ones while the latter has shown negative values after subtraction of the EDE from the absolute value of these negative components since 2004. All the new Member States together with two Southern countries – Portugal and Greece, show relatively lower levels. The relatively higher levels in both years are also typical of Canada, the USA and Denmark. The three countries achieving highest levels also showed greatest increase between 2002 and 2014 with the highest one in Switzerland. Canada, Belgium and Austria also showed significant increases. Lithuania, Romania are the only countries showing the declines of these indicators between 2002 and 2014. The decrease occurred also in Iceland between 2011 and 2013 (data were available only in three years). Next the GNS is divided by the sum of the ANS to detect how many times (or if at all) the GNS of country can be used to pay for the negative ANS components. For Lithuania the calculation of the results had to be modified, i.e. the EDE were added up to GNS and then divided by the sum of the negative components. If the modification was not adopted the negative ratio would be obtained. In Figure 4, the ratios of GNS to the negative ANS components, after the subtraction of EDE are shown.

Figure 4 Ratio of GNS and negative Component Indicators after subtraction of EDE, 2012 and 2014



Source: World Development Indicators (2016); Own processing;

In 2014, Romania shows the highest GNS ratio, i.e. significantly higher ratio than any other country in the sample. It is followed by Sweden and Lithuania. Greece showed the worst results, it is clearly unsustainable economy because it showed the ratio lower than 1 (0.646). There are also other countries showing the ratios slightly higher than 1, such as Latvia, Cyprus, Slovakia, Portugal and Croatia. These countries should be cautious and make efforts to increase this ratio. Significant changes also occurred between 2002 and 2014. The ratio significantly increased in Romania, Lithuania, Iceland (2011 – 2013) and Norway and dropped most significantly in Cyprus, Finland and Greece. As it was already indicated in subsection 3.1. Romania showed the negative rates until 2006. The ratio was 0.798% in 2002 which indicates unsustainability and thus significant improvement in this country occurred. Iceland also improved its position, it showed the negative ANS in 2011 and turned it to positive ones and to one of the highest GNS ratios in 2013. The great improvement was also shown by Norway. For Lithuania the calculation had to be modified due to the high extent of EDE exceeding the sum of the negative components. This indicates great improvement because this country also showed negative ANS in several years in 1990s (see subsection 3.1). On the other hand, Greece showed the positive ANS in 2002, the GNS ratio was 1.585 and subsequently moved to the unsustainable territory. Cyprus and Finland even showed one of the highest GNS ratios in the sample in 2002, but Cyprus recently shows one of its lowest levels and Finland's GNS ratio also dropped significantly. Ireland showed highest GNS ratio in 2002 but it also dropped between monitored years. Sweden's ratio was the second highest in both monitored years.

4 Conclusions

The aim of the Paper was to evaluate sustainability in the EU and its countries together with additional five developed countries by means of the ANS and its component indicators. This evaluation was carried out by means of the ANS and its component indicators. The results of the 33 countries in the sample differ according to the applied ANS indicator, i.e. ANS in % of GNI or ANS per capita. Overall, the Northern countries (except for Finland), Luxembourg, Netherlands, together with Switzerland, Ireland, Germany and Austria achieved relatively higher levels of both ANS indicators. For two Baltic economies the high ANS ratio is typical, but not the ANS per capita, while the remaining one – Latvia showed very low levels of both ANS indicators. Many new Member States and Southern economies showed relatively low ANS levels. While the ANS ratio is determined by the shares of the ANS components in GNI, the ANS per capita is determined by the overall ANS in monetary units including the price level and the population size. This explains why some less developed EU countries, such as Romania, Lithuania and Estonia are able to achieve one of the highest ANS ratios, but not the ANS per capita. The ANS results also significantly depend on the ANS components. GNS is the crucial component of the ANS. In the EU it showed the share in GNI slightly higher than 21% both in 2002 – 2014 and in 2014. The average ratio of the depreciation of physical capital in 2002 – 2014 showed 16.275% of GNI. In period 2002 – 2014, the EDE indicator representing the social pillar of SD showed in the EU the average level of 4.754% of GNI. On the other hand, the shares of the environmental effects in GNI are significantly lower. ED showed the average ratio of 0.371%, CO₂D of 0.216%, PED of 0.187%, MD of 0.02% and NFD indicator only 0.014%. Although these components differ between countries according to the structures of their economies, their overall effects on the ANS are often lower than those of the previous three components.

The low depreciation rate of physical capital in Cyprus, Poland, Bulgaria, the UK, Lithuania, Malta, the USA and Norway can partly help compensate the lower GNS in the majority of them, but in Norway it is the important factor even enhancing the highest GNS ratio. Switzerland showed lower ANS than Norway due to the higher depreciation rate. Lithuania has significantly increased its EDE since 2004 which has led to the great increases of the ANS, especially the ANS ratio, since then. This indicates significant improvement because the ANS was negative in several years of 1990s or very low until 2003. Other significant improvement occurred in Romania that moved from the unsustainable territory in 2007, recently showing the highest ANS ratio in the sample. On the other hand, Greece moved to the unsustainable territory in 2008 which was also related to the economic problems resulting from the effects of the economic crisis. Recently Greece is the only unsustainable economy showing negative ANS. Analysis of the component indicators also showed that Romania achieved the lowest sum of the negative components after subtraction of EDE (net costs) and Lithuania achieved even negative value. Romania is able to cover these net cost from its GNS at highest rate as compared to other sample countries, but Lithuania is even able to cover these costs by its education expenditure. The countries showing highest ANS levels, particularly Norway, Switzerland and Luxembourg, also show highest net costs, but are able to cover them by the GNS at higher rate. The economic problems and recession caused the drop of GNS, but, on the other hand, the drop of natural resource exhaustion and pollution in the majority of countries as well. Thus, in some countries the ANS also increased as a results of the changes in the ratios of the ANS components. To conclude, every country should address the particular aspects of sustainability by the appropriate structural reforms.

References

- Anderson, D. A. (2010). *Environmental Economics and Natural Resource Management*. Abingdon, Oxon: Routledge. ISBN 978-0-415-77905-0.
- Bolt K., Matete, M. & Clemens, M. (2002). *Manual for Calculating Adjusted Net Savings* World Bank: Environment Department. [online]. [Cit. 15-10-2016]. Available from: <https://siteresources.worldbank.org/INTEEI/1105643-1115814965717/20486606/Savingsmanual2002.pdf>.
- Drastichová, M. (2014). Measuring Sustainable Development in the European Union Using the Adjusted Net Saving. In: I. Honová, M. Hon, L. Melecký, L., M. Staničková (Ed.), *Proceedings of the 2nd International Conference on European Integration 2014* (pp. 87-101): Ostrava: VŠB – Technical University of Ostrava. ISBN 978-80-248-3388-0.
- European Union (2009). *Strategy for Sustainable Development* [online]. [Cit. 10-10-2016]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3A128117>.
- Fitouss, J. P., Sen, A. K. & Stiglitz, J. E. (2011). *Mismeasuring Our Lives: Why GDP Doesn't Add Up*, New York: New Press. ReadHowYouWant.com. ISBN 1459617797.
- Gnègnè, Y. (2009). Adjusted Net Saving and Welfare Change. *Ecological Economics*, 68(4), 1127-1139. doi: 10.1016/j.ecolecon.2008.08.002.
- Hediger, W. (2006). Weak and Strong Sustainability, Environmental Conservation and Economic Growth. *Natural Resource Modeling*, 19(3), 359-394. doi: 10.1111/j.1939-7445.2006.tb00185.x
- Jeffrey, K., Wheatley, H., & Abdallah, S. (2016). *The Happy Planet Index: 2016. A global index of sustainable well-being*. London: New Economics Foundation.
- Pearce, D. W. & Atkinson G. D. (1995). *Measuring Sustainable Development*. A useful overview of weak and strong sustainability and international trade issues. In Daniel W. Bromley (Ed.), *Handbook of Environmental Economics* (pp. 166-181). Cambridge, Mass: Blackwell.
- Pearce, D. W. & Atkinson G. D. (1993). Capital Theory and the Measurement of Sustainable Development: an Indicator of Weak Sustainability. *Ecological Economics*, 8(2), 103-108. doi: 10.1016/0921-8009(93)90039-9
- Pillarisetti, J. R. (2005). The World Bank's 'Genuine Savings' Measure and Sustainability. *Ecological Economics*, 55(4), 599-609. doi: 10.1016/j.ecolecon.2005.01.018.
- Redclift, M. & Springett, D. (2015). *Routledge International Handbook of Sustainable Development*. Taylor & Francis. ISBN 9781135040710.
- World Commission on Environment and Development (WCED) (1987). *Our common future*. Oxford: Oxford University Press. ISBN 978-0-19-282080-8.
- World Bank (2016). *World Development Indicators*. [online]. [Cit. 10-10-2016]. <http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators&preview=on>.
- World Bank (2012). *Contribution to Beyond GDP, "Virtual Indicator Expo"* [online]. 2012 [cit. 28-10-2016]. Available from: http://ec.europa.eu/environment/beyond_gdp/download/factsheets/bgdp-ve-ans.pdf.

Barriers of inter-municipal cooperation in the regions of the South Bohemian Region as seen by municipalities in 2004 – 2014

Jiří Dušek

Abstract:

In the past few years several research projects focused on the barriers of inter-municipal cooperation were carried out in the Czech Republic and abroad. As the research results reflect the respective local and regional specifics, the results and conclusions are diametrically different, depending on particular conditions in the respective country.

The presented work focuses on the issues of barriers of inter-municipal cooperation as seen by the individual South-Bohemian municipalities. After the introductory theoretical part the results of a questionnaire survey focused on the analysis of selected issues of municipalities and towns in the South Bohemian Region are presented and discussed. The questionnaire survey was first done in 2004 and repeated ten years later in 2014 with the goal of comparing and mapping the changes in the attitude of South Bohemian municipalities as regards public administration, transport and other areas of interest. In the conclusion the results are interpreted as regards the development of opinions of the respective municipalities on the respective problematic areas and also in the context of changes that were implemented in area of public administration in the past few years.

Key words: South Bohemian Region · inter-municipal cooperation · municipality · region · regional development

JEL Classification: O180

1 Introduction

Today, cooperation is an essential part of well-functioning public administration and essential for the development of regions. Reasons for cooperation between various entities often lie in a “synergic effect”, i.e. together it is possible to achieve more than alone. Cooperation can generally be considered as the working together of a certain number of entities in order to achieve a certain common objective.

Contemporary inter-municipal cooperation in the Czech Republic has its roots in the period immediately following the Velvet Revolution in 1989 when the relations of Czech municipalities with each other and with municipalities abroad were restored. At the same time, agreements and contracts from before 1989 started to be revised. They were based on the so-called cooperation policy within socialist countries or international cooperation of socialist countries with developing countries. The revision of documents was implemented across all municipalities, especially as regards potential applicability, actual fulfilment and the changed political situation. In 1990 territorial government was restored and other legislative changes were implemented, which strengthened the authority of municipalities and enabled them to develop other forms of cooperation, such as micro-regions, joint participation in business corporations and common-interest associations of legal entities (alliances). Also the activities of the Union of Towns and Municipalities of the Czech Republic were restored. In the entire 1990s new regional and national structures of cooperation were originating and there was further acceleration when the Czech Republic entered the EU in 2004. Late 2010s are connected with strengthening the relations between the private and the public sector or fragmentation of the existing forms of cooperation, as the case may be. For this reason a fragmented structure of over 20 possible means of cooperation with other municipalities is available for municipalities today. The cooperation has different intensity and spatial arrangement in the respective areas, which is caused by various barriers and obstacles of inter-municipal cooperation. In view of the specific nature of the problem area, the author also mentions in the introductory part of the research a comparison with a similar research carried out in Germany in 2012.

A large number of forms of inter-municipal cooperation represent a wide choice of opportunities for cooperation on the one hand but it is a limit and an obstacle of the development of inter-municipal cooperation on the other hand as it can lead to fragmentation of power and sources. According to Ježek, 2006, p. 185-189, a missing and coherent conception of inter-municipal cooperation plays an important role. In the past 20 years quite a large number of different forms of cooperation were formed and they gradually covered most of the area of the Czech Republic. However, the dynamics of their development seems to have been exhausted due to a missing conception which would enable to

remove the blank spaces on the map of inter-municipal cooperation and cover the entire area of the Czech Republic. This step would actively help to provide effective public services within the scope of municipalities, infrastructure and to remove some disparities (for more information see e.g. Novotná, Volek, Alina, 2014, or Hálová, Alina, 2014).

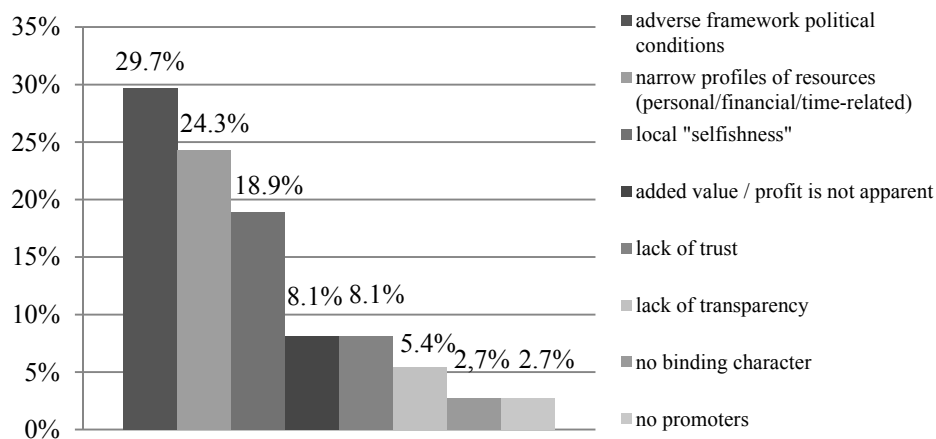
2 Methods

A questionnaire survey aimed to analyse selected problems of municipalities and towns in the South Bohemian Region was first done among the representatives of municipalities in 2004 (the data was collected by means of printed questionnaires) and repeated ten years later in 2014 (the data was collected in an electronic form). The goal was to compare and map the changes in the attitude of municipalities in South Bohemia regarding transport services, public services and public administration (overall, the research included 9 areas and 41 main questions). In 2004 the research was done in cooperation with the Regional Authority of the South Bohemian Region, ČSAD Jihotrans a.s., České dráhy a.s. (Czech Railways), Jednota – Consumer Cooperative České Budějovice), Employment Office Písek, Union of Towns and Municipalities of the South Bohemian Region, RERA a.s., The University of West Bohemia in Plzeň and Czech University of Agriculture in Prague. In 2014 the research was done only in cooperation with the Union of Towns and Municipalities of the South Bohemian Region. All municipalities in the region were addressed (623) and the data was returned by 33.71% of them (210 municipalities) in 2004 and by 31.13% of them (190 municipalities) in 2014. After reduction, a representative set of 140 (22.47%), or more precisely 141 (22.63%) municipalities was selected from the obtained data. It reflected the structure of municipalities in the South Bohemian Region so that their size categories, location and character (central location vs. periphery) within the region were taken into account and also the fact whether or not the municipalities are located in areas where the support of the state is concentrated (pursuant to the Resolution of the Government of the Czech Republic No. 560 adopted on 17 May 2006 on Regional Development Strategy of the Czech Republic, and the updated resolution No. 141/2010). The border character of the South Bohemian Region lead the author to also use the work of Hampl, 2005 for the purpose of regionalisation of municipalities. Hampl divides border regions into two types: border regions of functional (nodal) type with strong regional centres and the resulting higher density of settlement, industrialisation and urbanisation and border regions of homogenous (zonal) type which have the character of a peripheral zone with a clear connection to outside – interior – centres. Classified as border regions in the South Bohemian Region are the municipalities of Vimperk, Prachatice, Český Krumlov, Kaplice, Trhové Sviny, Třeboň, Jindřichův Hradec and Dačice. The total number of interior and border municipalities was thus defined by the author with the ratio of 390 : 233 (i.e. 62.6% and 37.4%); this ratio was also used in the investigated sample of municipalities. However, it has to be said that the definition of a border region is not unified either in the EU or the Czech Republic and it is thus necessary to always define it for specific purposes because of the specific nature of local conditions (for more see e.g. Haggett, 1975, Anderson and O'Dowd, 1999, or Wilam, 2005).

3 Research results

In the past years several research projects focused on the barriers of inter-municipal cooperation have been completed in the Czech Republic and abroad. The research results reflect the respective local and regional specifics and therefore diametrically different results and conclusions are reached, depending on the specific conditions in the respective country.

Figure 1 Barriers of inter-municipal cooperation in Germany

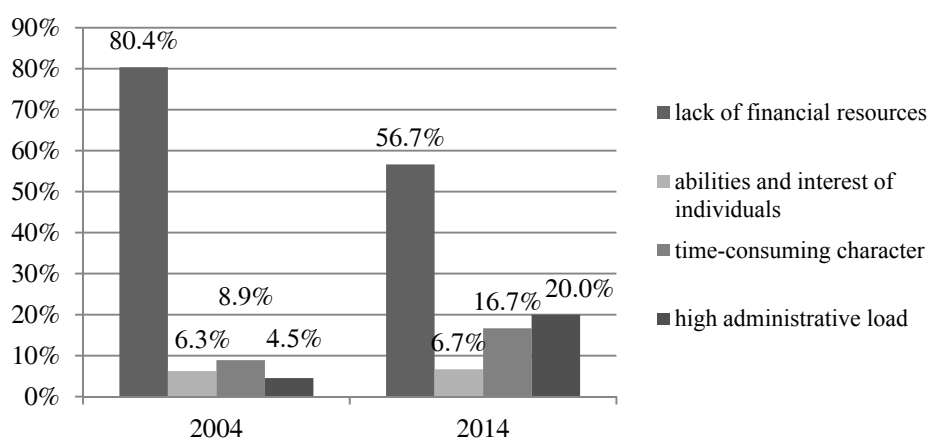


Source: Schnabel (2012)

According to Schnabel, 2012, the biggest problems in Germany are adverse framework political conditions and narrow profiles of all available resources, while local “selfishness” and different interests of the individual participants are another significant barrier. Respondents perceive other obstacles to be less significant, with values in the range of several percent. Adverse framework political conditions mainly reflect the complicated German local and regional public administration in the respective federal states as well as the experience of municipalities from the 1970s when a wave of both voluntary and involuntary merging of municipalities was recorded.

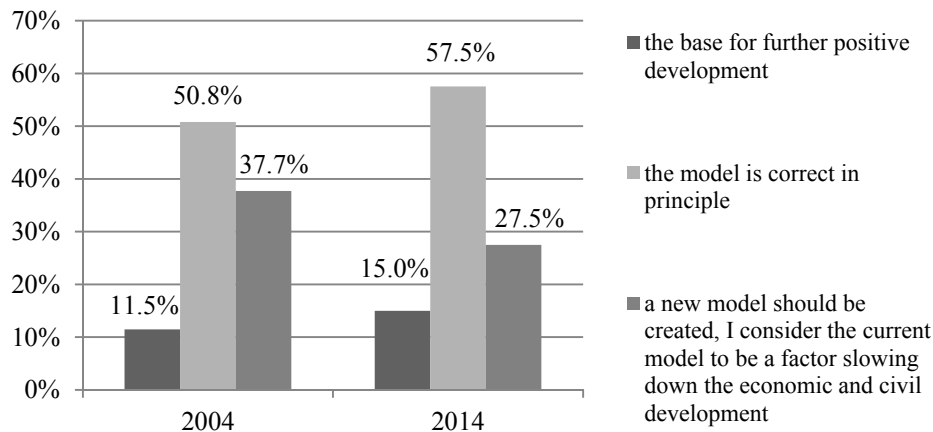
In the Czech Republic a lot of problems arise from the size structure of municipalities so the most frequently stated barrier (and a stimulus at the same time) of inter-municipal cooperation is the lack of financial resources, which was confirmed by the Questionnaire Survey Aimed to Analyse Selected Problems of Municipalities and Towns in the South Bohemian Region done by the author in 2004 and 2014. “The lack of financial resources” is stated as an obstacle of inter-municipal cooperation by up to 80.4% of municipalities. After entering the EU the situation significantly improved and the value reaches only 56.7%, which is a decrease by approximately one fourth. The level of 80% in the perception of the lack of financial resources as a serious barrier of inter-municipal cooperation corresponds with similar results of research projects done e.g. by the Centre for Regional Development Research at the University of West Bohemia in Plzeň. As regards the barriers of inter-municipal cooperation, a significant percentage growth during the programming period of 2007–2013 was recorded by the time-consuming character and high administrative load of this cooperation and the implementation of projects. The summary of responses reveals that municipalities point out complicated and quickly changing legislation, lack of preparation of the programming period, involvement of other partners etc. Therefore it is not surprising that almost 20% of municipalities do not use the opportunities of the European funds or does not get involved in inter-municipal cooperation at all. Contrary to Germany, municipalities do not state political conditions as a barrier, but quite significant discontent with the current model of public administration still appears in other questions, with only 10–15% of municipalities considering it a good base for further positive development of municipalities. More than a half of municipalities also think that the current model should be significantly changed in future, no matter if it is the change of funding of municipalities or bigger and more effective involvement of public in democratic decision-making.

Figure 2 Barriers of inter-municipal cooperation in the South Bohemian Region (Czech Republic)



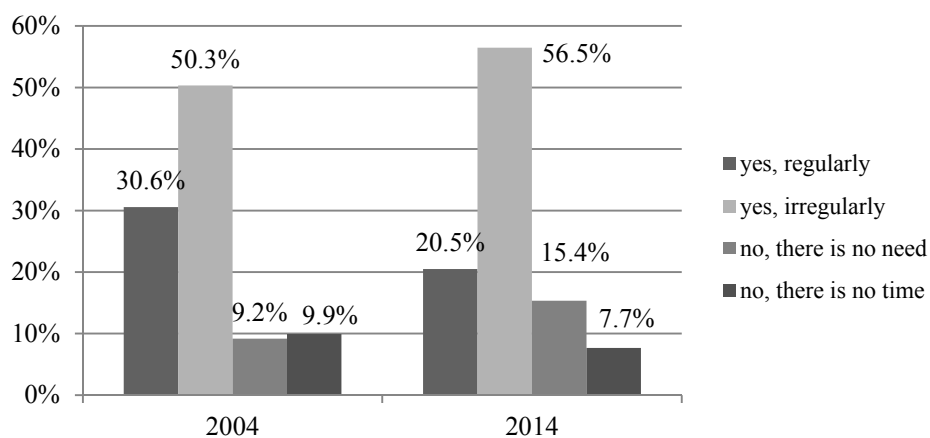
Source: The author's own research (within the Questionnaire Survey Aimed to Analyse Selected Problems of Municipalities and Towns in the South Bohemian Region), 2004, 2014.

According to some experts, the origin of discontent with the current model of public administration can be found in reforms dating back to 2000–2003. With effect from 1 January 2003, district offices were dissolved and their activities were transferred to regional offices, municipalities with extended competence and other administrative offices with the goal of decentralization and deconcentration. In connection with low support from the state, this change makes a lot of small and medium-sized municipalities feel there is a missing connecting link in the territorial government which would provide municipalities with methodological and consulting support and help them promote their interests. In 2014 the author discussed these issues repeatedly with the representatives of four local action groups (Region Pošumaví, Přemyslovské střední Čechy, LAG Sedlčansko and Vyhlídky) within the project *We are learning through film* (registration number 12/017/4210a/120/000085). Contrary to the issue of e.g. direct election of mayors, all representatives of municipalities unambiguously agreed on the issue of a missing connecting link in territorial government.

Figure 3 Satisfaction of municipalities in the South Bohemian Region with the contemporary model of public administration

Source: The author's own research (within the Questionnaire Survey Aimed to Analyse Selected Problems of Municipalities and Towns in the South Bohemian Region), 2004, 2014.

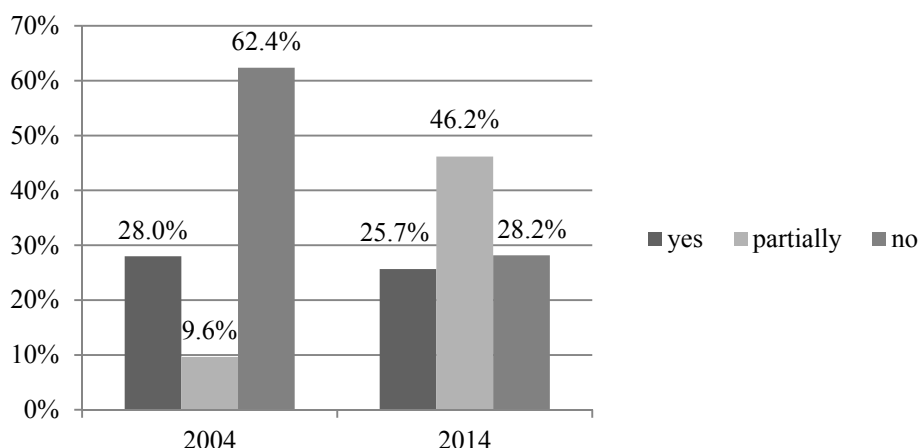
If no reform steps are made in public administration in the next few years, which is very likely in the context of current political distribution of power, the role of a certain connecting link in a region can be played by a basic form of inter-municipal cooperation – micro-region or LAG. It can play a positive role both in the development of a region and in the participation of public, the opinion of which is sometimes overlooked and disregarded, this fact being indirectly admitted by the representatives of municipalities in the area of systemic identification of needs / engagement of public. While this systemic participation was declared by 30.6% of South Bohemian municipalities in 2004, it was only 20.5% of municipalities ten years later.

Figure 4 Systemic identification of needs / engagement of public in the municipalities of the South Bohemian Region

Source: The author's own research (within the Questionnaire Survey Aimed to Analyse Selected Problems of Municipalities and Towns in the South Bohemian Region), 2004, 2014.

In terms of the discussion about the missing connecting link of public administration and the role of inter-municipal cooperation, it can be said with pleasure that as the engagement of municipalities in different forms of inter-municipal cooperation progressively grows (the % change in the number of engagements between 2007 and 2014 is +49.34%). Features of local development conducted in a community manner gradually start to be exercised more in the regions – especially thanks to the engagement of different partners on a local level while implementing the strategies. This helps the respective areas raise the quality of life and maintain sustainable future. By community-driven local development the author means a method of including partners on local level, including the civil society and local economic entities in order to create and implement local integrated strategies which help in a given area to create a more sustainable future. In the programme period of 2014-2020, community-driven local development is one of integrated tools (CLLD), which is a mechanism for targeting of EU financial means that enables a multiple-fund financing of more complex projects.

Figure 5 Exercising the principles of local development conducted in a community manner in municipalities of the South Bohemian Region



Source: The author's own research (within the Questionnaire Survey Aimed to Analyse Selected Problems of Municipalities and Towns in the South Bohemian Region), 2004, 2014.

The qualitative and quantitative growth of the forms of inter-municipal cooperation is an important pre-supposition of regional development, but it is not a guarantee of success in itself. Apart from direct obstacles of inter-municipal cooperation, such as the above-mentioned lack of financial resources or high administrative load and a time-consuming character of cooperation, a number of indirect obstacles influencing the development potential of mainly small municipalities can be identified. According to Žárská, 2009, it is mainly a demographic structure with a concentration of inhabitants in the post-productive age, low transport accessibility and insufficient technical and civil amenities, low financial capacity of municipalities limiting their development investments, limited administrative ability leading to problems with securing the whole scale of government competences by quality and qualified staff (for more information see also Szarková, Andrejčák, Matkovčiková, 2014) etc.

4 Conclusions

Of all the above-mentioned obstacles and problems of inter-municipal cooperation, the author considers the missing conception of inter-municipal cooperation to be the most significant one. Problems and imperfections connected with implementing a selected form of cooperation were often solved by creating another form of cooperation enabling to fulfil new goals and priorities of cooperation. While in the first 15 years micro-regions were a dominating form of inter-municipal cooperation, local action groups are among the fastest growing forms of inter-municipal cooperation nowadays – between 2007 and 2014, the number of participating municipalities grew by 32.12% and in some regions local action groups became the main form of inter-municipal cooperation (administrative district of the municipality with extended competence of České Budějovice, Prachatic, Vimperk). As this means of cooperation is favoured by the European Commission and local action groups have a new role in the programming period of 2014–2020 (local action groups become the lowest segment of the implementation structure of local development policies), local action groups are expected to become the main form and the driving force of inter-municipal cooperation in the Czech Republic at the turn of the programming period of 2014–2020 and 2021–2027. Strengthening local action groups at the expense of micro-regions is easier because micro-regions and local action groups often operate on the same area and they are interlinked with a common functional and organizational structure (the formation of some local action groups was initiated by micro-regions – e.g. the local action group of Strakonicko, while it was the opposite case somewhere else – e.g. the micro-region of Jindřichohradecko-West). Recently, the position of local action groups is strengthening so much that there are first opinions speaking about the fact that local action groups are threatening municipal government. This opinion can be considered as an extreme one, but only to a certain extent. If there is intensive engagement in inter-municipal cooperation, there can be a situation when a municipality limits its activities and tasks at the expense of the activities of inter-municipal cooperation. Schnabel, 2012, warns against a state when a municipality is involved in a large number of inter-municipal cooperations which are not subject to any direct control of its municipal council and the municipality only influences their activity in an indirect way through its representatives (often a mayor) in their authorities. Inter-municipal organization always has its own budget to which the respective involved municipalities are obliged to contribute. These municipalities have in fact lost their dispositional sovereignty over a large part of their own budget.

The influx of financial resources from the national sources and the sources of EU oriented on the cooperation of municipalities with subjects in the area can have a negative impact not just on inter-municipal cooperation on a regional level, but also on the cooperation of municipalities with subjects from other countries. The latter cooperation, with the decline of 40.7% and the existence of other barriers (e.g. language and cultural barrier, currency risk), is currently among not very prospective forms of cooperation. Experience with the operation of cross-border impulse centres and Euro-regions in the previous period clearly showed that the formation and development of new forms of inter-municipal (cross-border) cooperation can be initiated with financial stimulation. However, such cooperation does not have a long-lasting character and is not sustainable in the long run.

As regards the perspectives of inter-municipal cooperation, the analyses done by the author prove that inter-municipal cooperation has positive benefits as far as the development of the respective districts of the South Bohemian Region is concerned. Despite this fact, the view of inter-municipal cooperation is not equivocal in professional and political circles as it often reflects local specifics, different historical development and experiences etc. (e.g. Poland, Scandinavia vs. Czech Republic, Slovak Republic, Hungary, France). British sociologist and political scientist Michael Keating who was concerned with the link between the performance and effectiveness of public administration in the context of the size of municipalities, gathered a comprehensive set of arguments in favour and to the disadvantage of small municipalities and when the positives and negatives of integration are to be evaluated, he recommends to consider the following four factors (Keating, 1995, p. 117-134):

- the effectiveness factor – the relation between the size of a municipality and the relative price of services provided to citizens,
- the local democracy factor – the relation between the size of a municipality and the democratic character of local politics,
- the distributive justice factor – the relation between the size of a municipality, the tax burden on citizens and the level of services provided for citizens (a question of budget determination of taxes in the Czech Republic),
- the development factor – the relation between the size of a municipality and the perspectives of its further development.

Other authors concerned with these issues include e.g. Swianiewicz, 2002, Vajdová, Čermák, Illner, 2006, Galvasová, et al, 2007, Halachmi, Boorsma, 2013, Teles, 2015, etc. In their works, they reach the same conclusions as Keating, 1995, i.e. that the results of expert research projects are not always equivocal in this area, like for example in the view of an optimum municipality size.

Acknowledgement

The work was realized within the Internal Grant Agency of the College of European and Regional Studies as the result of the projects “Survey aimed to analyse selected problems of municipalities and towns in the South Bohemian Region 2004 and 2014”.

References

- Anderson, J., O'Dowd, L. (1999). Borders, Border Regions and Territoriality: Contradictory Meanings, Changing Significance. *Regional Studies*, 33(7), 593-604. ISSN 0034-3404.
- Galvasová, I., et al. (2007). *Identifikace kompetencí zatěžujících výkon veřejné správy se zvláštním přihlédnutím k malým obcím*. Brno: GaREP, Centrum pro regionální rozvoj Masarykovy univerzity v Brně.
- Haggett, P. (1975). *Geography and Modern Synthesis*. London: HarperCollins Publishers. ISBN 978-00-6042-576-0.
- Halachmi, A., Boorsma, P. B. (2013). *Inter and Intra Government Arrangements for Productivity: An Agency Approach*. Berlin: Springer Science & Business Media. ISBN 978-14-7572-864-4.
- Hálová, P., Alina, J. (2014). Analysis of investment in infrastructure and other selected determinants influence to unemployment in CR regions. In Loster, T., Pavelka, T. (eds.). *8th International Days of Statistics and Economics Location* (pp. 445-455). Prague: University of Economics. ISBN 978-80-87990-02-5. WOS:000350226700044.
- Háml, M. (2005). Border Regions in the Czech Republic: Contemporary Tendencies of Development Differentiation. In *Geografie – Sborník ČGS* (pp. 241-254), 105, 3. ISSN 1213-1075.
- Ježek, J. (2006). Dobrovolná sdružení obcí a měst v České republice a jejich budoucnost. In *Conference Proceeding Veřejná správa* (pp.185-189). Pardubice: Univerzita Pardubice. ISBN 80-7194-882-9.
- Keating, M. (1995). Size, Efficiency and Democracy: Consolidation, Fragmentation and Public Choice. In Judge, D., Stoker, G., Wollman, H. *Theories of Urban Politics* (pp. 117-134). London: Sage Publications. ISBN 0-8039-8865-6.
- Novotná, M, Volek, T., Alina, J. (2014). Regional Disparities in Productivity of Small and Medium-Sized Enterprises in the Food Industry. In Klimová, V., Žitek, V. (eds.). *17th International Colloquium on Regional Sciences. Conference Proceedings* (pp. 757-763). Brno: Ekonomicko-správní fakulta Masarykovy univerzity. ISBN 978-80-210-6840-7. WOS:000358536900098.
- Schnabel, F. (2012). *Formy meziobecní a regionální spolupráce v Německu* [online]. Praha : *Economia*, 2012, 5.3.2012 [cit. 2016-10-30]. Available from: <http://moderniobec.cz/formy-meziobecni-a-regionalni-spoluprace-v-nemecku>.

- Swianiewicz, P. (ed.). (2002). *Consolidation or Fragmentation? The Size of Local Governments in Central and Eastern Europe, Local Government and Public Service Reform Initiative*. Budapest: Open Society Institute Budapest. ISBN 963-9419-45-1.
- Szarková, M., Andrejčák, M., Matkovčíková, N. (2014). *Personnel audit as a function of personnel marketing and personnel management*. Brno: Tribun EU. ISBN 978-80-263-0809-6.
- Teles, F. (2015). *Local Governance and Inter-municipal Cooperation*. London: Palgrave Macmillan. ISBN 978-11-3744-575-9.
- Vajdová, Z., Čermák, D., Illner, M. (2006). *Autonomie a spolupráce: důsledky ustavení obecního zřízení v roce 1990*. Praha: Sociologický ústav AV ČR. ISBN 80-7330-086-9.
- Wilam, P. (2005). *Přeshraniční spolupráce v rámci Evropské unie* [online]. Ostrava: Ostravská univerzita, 2005 [cit. 2016-10-30]. Available from: http://www1.osu.cz/home/Rumpel/JEAN%20MONET/Texty/Preshranicni_spoluprace_text_Wilam.pdf.
- Žárska, E. (2009). Finančná kapacita obce ako determinant rozvoja. In *Teoretické a praktické aspekty verejných financií* (pp. 92). Praha: Oeconomica. ISBN 978-80-245-1513-7.

Sustainability and Sustainable Development of Non-profit Organizations

Dita Hommerová

Abstract: *This paper deals with current worldwide concepts of the pillars of sustainable development with respect to activities of non-profit organizations. There is a large number of theories, approaches and concepts of sustainable development. The overall success of non-profit organizations, characterized by their development and sustainability, is also contributed to by a targeted effort to achieve sustainable development, utilizing the social, economic as well as environmental essence of the inner workings of society. An organization which in the long term is sustainable from the economic, environmental and social points of view generates an added value for society in terms of sustainable development by conducting its activities and at the same time ensures its strong position in the market and success in a competitive market environment. Due to their fundamental nature, non-profit organizations are engaged in just about all the mutations of the concept of sustainable development and through their activities cover a wide range of sustainable development needs. Sustainable development is a response to the need of human society to develop qualitatively rather than quantitatively and in line with limitations arising from our environment.*

Key words: Sustainability · Sustainable development · Success of non-profit organizations · Growth of a non-profit organization

JEL Classification: M29

1 Introduction

Development of the term sustainable development

Sustainable development is a response to the need of human society to develop qualitatively rather than quantitatively and in line with limitations arising from our environment. It does not take into account merely economic growth, but also societal values and natural resources. The pivotal question of sustainable development is how to describe the quality of life, how to measure it and how to sustain it given the natural limitations of our community on planet Earth.

There is a large number of theories, approaches and concepts of sustainable development.

Sustainability is defined by section 6 of Act No. 17/1992 Coll. on the Environment. "Permanently sustainable development of society is that development which preserves for present and future generations the possibility of meeting their basic needs, and at the same time, does not reduce the diversity of nature and preserves the natural functions of ecosystems." (Act No. 17/1992 Coll. on the Environment, 2016)

Evidence of the idea of sustainable development dates back to approx. 300 years ago in forest management, when part of the crops was kept aside for the purpose of planting. As a result of doubts about sustainable development in nature, the so-called Club of Rome was established in 1968 – a global think tank consisting of approximately a hundred scientists, economists, but also heads of state and government officials from more than fifty countries around the world. (Thöndtová, 2010, p. 44). In 1972, the Club of Rome published a report, which warned about limits to growth over the course of the next hundred years being reached, as, according to the computer simulations on which the report was based, economic growth was in contradiction with effective environmental protection. In 1984, a study led by the Norwegian politician Gro Harlem Brundtland was presented that defined sustainable development, including conditions for economic growth. It was necessary to elaborate the study for individual regions and countries, which led to the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992. The most significant outcome of the conference was the definition of the minimum requirements for sustainable development in a strategic plan called Agenda 21, which among other things was the first to deal with how to implement its principles in practice. "Think globally, act locally" is a motto reflecting the vision of Agenda 21. The local Agenda 21 strives to apply sustainable development principles in practice with local issues being taken into account. "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." (Korčák, 1991, p. 20)

The Role of Non-profit organizations

Non-profit organizations have become an integral part not only of the advanced society of the 21th century, but also a well-functioning market. They act as an active intermediary between the public and for-profit sectors.

Non-governmental non-profit organizations play an essential role in today's society and their numbers in the Czech Republic have been increasing over the years. According to official statistical figures, there were over 123 thousand NPOs registered in the Czech Republic at the end of 2013. As of December 2015, there were 89,584 associations and 26,423 subsidiary associations; 2,894 public benefit corporations; 388 institutes; 505 foundations; 1,518 endowment funds; and 4,166 church organizations registered in the Czech Republic. The new Civil Code came into force in January 2014.

They are formed mainly when commercial entities or the government are not able or willing to provide a particular service that is essential for society. The goal of non-governmental non-profit organizations is thus to fill the gap between the for-profit sector, the government and the family. (Novotný, 2008)

2 Methods

This paper deals with current worldwide concepts of the pillars of sustainable development with respect to activities of non-profit organizations. Sustainable development in general as well as according to the worldwide understanding of this term rests on three basic pillars. These are the social, environmental and economic pillars of sustainable development.

Here is a brief introduction to the globally respected 3-pillar system of sustainable development. (Korčák, 1991)

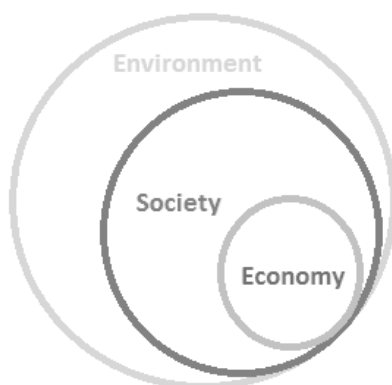
- *The social pillar* - The social pillar deals with the cohesion between individual generations or social groups, equal rights, access to education or reducing poverty.
- *The economic pillar* - The economic pillar deals with economic growth, unemployment, international trade, globalization, development of regions and organization of companies in relation to the other two pillars.
- *The environmental pillar* - The environmental pillar focuses on reducing pollution, sustainable exploitation and consumption of non-renewable resources, protection of precious ecosystems and combating climate change.

The 3-pillar concept of sustainable development intensively deals with, among other things, appropriate sustainable development indicators, and strives to look for new ways of measuring the quality of life. These should reflect not only the quantitative increase in consumption and production, but should also take into account mainly those factors that contribute to the quality of life, such as health, work and life balance, safety, the ability to develop oneself through education, and mutual support within the community.

"The goal is to ensure that the development in one pillar is not at the expense of the others. The advantage of this concept is its use in the monitoring, analytical and prognostic activity. The concept is further developed both in terms of its indicator bases and in terms of the structure of its goals and tool for achieving them." (Czesaný, Johnson, 2012, p. 206)

The widely respected 3-pillar model is based on the partial overlap of the three pillars. However, there is a concept (Figure 1) which claims that no economy can exist without society, and no society can exist without the environment, therefore, the superordinate term is the environment within which society and economy exist.

Figure 1 An alternative 3-pillar concept of sustainable development



Source: Wikipedia (2016)

A more general definition of sustainable development was put forth by the World Commission on *the* Environment and Development, according to which sustainable development is such kind of development which meets the needs of the present without compromising the ability of future generations to meet their own needs, and without this happening at the expense of other nations. (Korčák, 1991)

The third definition of sustainable development is based on the potential of capital assets. The capital in question is understood to include social capital, natural resources, human capital, production and financial capital. This concept can be analytically evaluated, because if the aggregate capital grows in the long term, then development is considered to be sustainable.

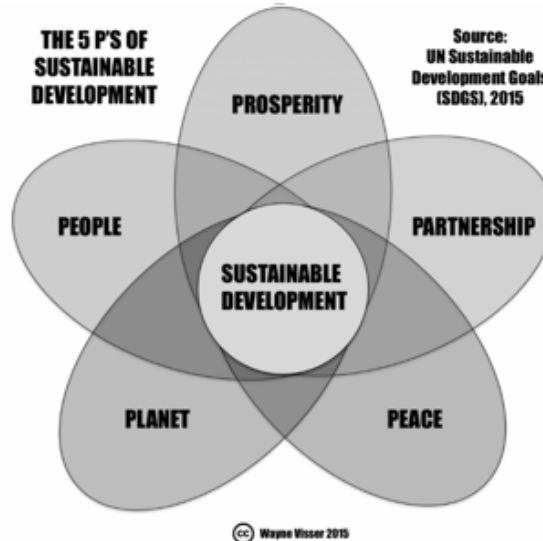
Significantly above-average results in the areas of social, economic and environmental goals are those of, e.g., Switzerland, Great Britain, and the Scandinavian countries. It is recommendable for the Czech Republic to utilize examples of best practices in planning sustainable development goals at the national level, and not only in the non-profit sector.

The social pillar has not yet been clearly defined in specialized literature. It is often presented as a sociocultural or sociopolitical dimension. The necessary indicators needed for us to grasp the social pillar are often missing.

Czesaný (2012) presents the main principles of sustainable development in the way in which they were formulated by international institutions, mainly the OECD, Eurostat, the UN and the World Bank. Most important for the non-profit sector and with a direct impact thereon is the so-called partnership principle. "Incorporating the partnership principle into the fundamental principles is substantiated. The objectives of sustainable development cannot be realized without cooperation and coordination between the commercial sphere, the public sector, non-governmental institutions, the general population and international entities. A successful response to challenges includes greater transparency and responsibility of all stakeholders." (Czesaný, Johnson, 2012, p. 209)⁵

In his study *Transforming Our World: The 2030 Agenda For Sustainable Development*, Wayne Visser (2015) presents five pillars of sustainability (5 P's) (Figure 2).

Figure 2 Five pillars of sustainability (5 P's)



Source: Visser (2015)

People

We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfill their potential in dignity and equality and in a healthy environment.

Planet

We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.

⁵ For more detail on the forms of partnership in the non-profit sector, see Helmig (2012)

Prosperity

We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.

Peace

We are determined to foster peaceful, just and inclusive societies which are free from fear and violence. There can be no sustainable development without peace and no peace without sustainable development.

Partnership

We are determined to mobilize the means required to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity, focused in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people.

Non-profit organizations are engaged in all parts of this concept and through their activity cover a wide range of sustainable development needs.

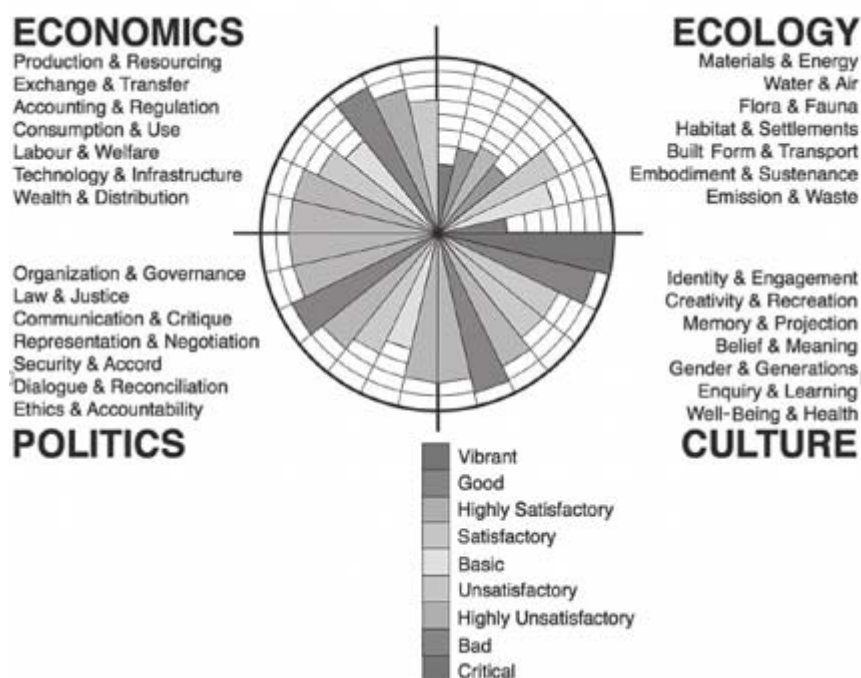
The year 1994 saw the culmination of the increasing significance of the cultural dimension in creating an image of sustainable development. A 4-pillar model was approved by representatives of Rat von Sachverständigen für Umweltfragen (the German Advisory Council on the Environment). This model is defined as a discursive process in a square whose corners represent ecology, economy, social environment and culture. According to Brocchi (2013, p. 2), culture can represent:

- Cultures of sustainability
- Cultural strategies of sustainability
- Factors hindering or promoting cultural evolution

Brocchi (2013) points out that if culture controls the relationship between the social system and the environment, then today's crisis of the environment is in fact a crisis of the cultural environment, and therefore requires a cultural solution and cultural strategies. To overcome the current global crisis, we don't need development, but rather cultural evolution.

Paul James (2015) also deals with the cultural dimension, dividing the social pillar into two parts – politics and culture, and using this concept tries to compare selected cities around the world (Figure 3).

Figure 3 Urban Profile Process – Circles of Sustainability



Source: James, P. (2015, p. 5)

Among other things, the non-profit sector represents alternative or complementary options of resolving social (e.g., social exclusion), economic (e.g., unemployment) and environmental problems (e.g., corporate social responsibility, education in the area of environmental protection, etc.) and contributes to the economic, social and cultural uplift of the region and sustainable development of society.

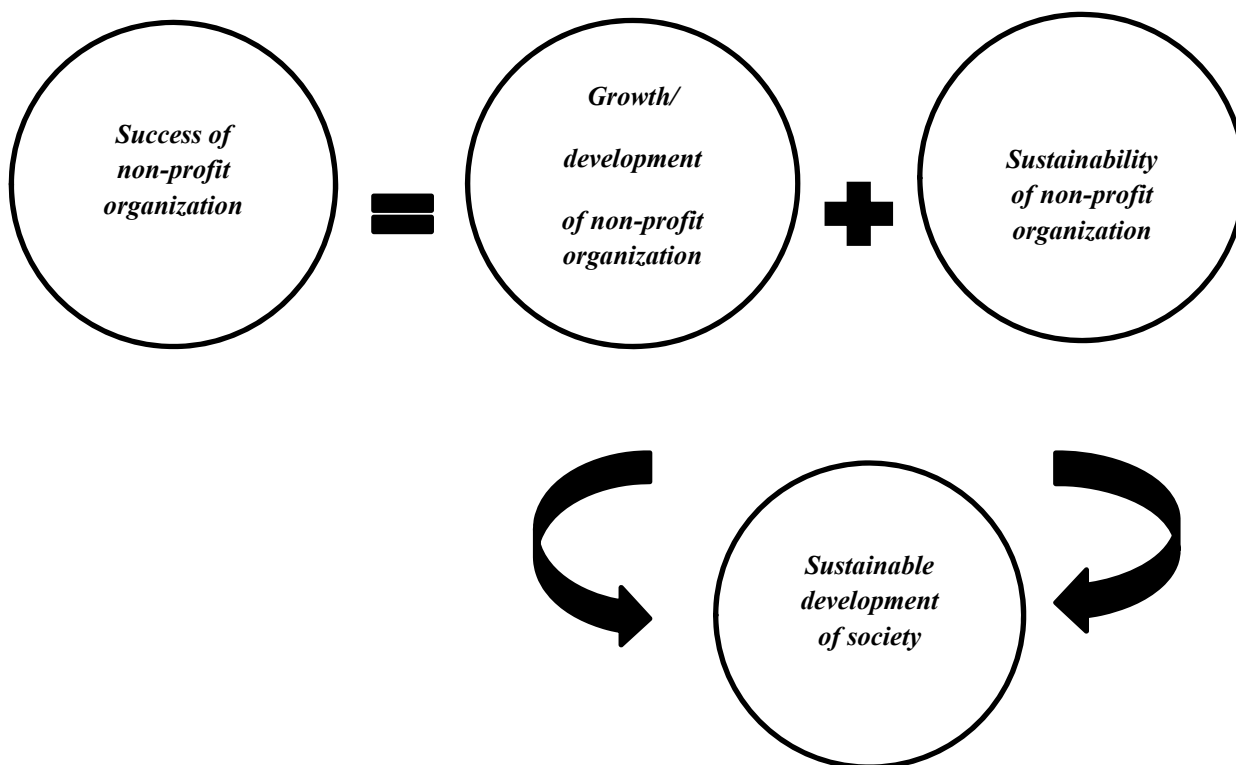
Critics of economic growth consider it to be something that makes problems worse. They see the solution and social progress in improving living conditions. One way to address this problem in the non-profit sector is, for example, so-called social entrepreneurship, which is based on voluntary work. Such activities give rise to positive externalities (e.g., working with minorities, hobby groups, etc.)

It is crucial especially for non-profit organizations to build trust and a good reputation. For a non-profit organization to gain donors, "customers", quality staff and other target groups of interest (stakeholders⁶), it needs to have trust in its own performance and capability. In their paper "*Defining the Content of Sustainability Reports in Nonprofit Organizations: Do Stakeholders Really Matter?*", based on 54 studies of sustainability of non-profit organizations worldwide, Manetti and Toccafondi (2014) define the role of stakeholders and their role in ensuring sustainability of non-profit organizations.

3 Results

The following formula determines the success of a non-profit organization (Figure 4).

Figure 4 The contribution of successful non-profit organizations to sustainable development



Source: author's own

The success of non-profit organizations is a prerequisite for the further development of these organizations and for their sustainability (Figure 4).

4 Conclusion

Due to their nature, non-profit organizations contribute in varying degrees to the sustainable development of society as a whole. They deal with issues of environmental protection, ending poverty, social inclusion, and education in various areas.

⁶ People and institutions that have something to do with a particular, in this case non-profit organization.

References

- Brocchi, D. (2013). *Die kulturelle Dimension der Nachhaltigkeit* [online]. Available from: http://davidebrocchi.eu/wp-content/uploads/2013/08/2007_dimension_nachhaltigkeit.pdf.
- Czesaný, S., & Johnson, Z. (2012). *Ekonomický cyklus, hospodářská politika a bohatství zemí*. Praha: Oeconomica.
- Helmig, B., & Boenigk, S. (2012). *Nonprofitmanagement*. München: Verlag Franz Vahlen GmbH.
- James, P. (2015). *Urban sustainability in theory and practice: Circles of sustainability*. Routledge, ISBN: 978-1-138-02572-1.
- Korčák, P. (1991). *Naše společná budoucnost: světová komise pro životní prostředí a rozvoj*. 1. ed. Praha: Academia.
- Manetti, G., & Toccafondi, S. (2014). Defining the Content of Sustainability Reports in Nonprofit Organizations: Do Stakeholders Really Matter? *Journal of Nonprofit & Public Sector Marketing*, 26, 35-61.
- Novotný, J., & et al. (2008). *Faktory úspěchu nestátních neziskových organizací*. Praha: Oeconomica.
- Thöndtová, G. (2010). Možnosti a meze trvale udržitelného rozvoje. In Šubrt, J. & kol. (2010). *Soudobá sociologie IV*. Praha: Karolinum.
- Wikipedia (2016). *Tři pilíře udržitelnosti: ekonomika i společnost jsou omezené prostředím* [online]. [cit. 2016-09-30]. Available from: <https://cs.wikipedia.org/wiki/Udr%C5%BEitelnost>.
- Visser, W. (2015). *Transforming Our World: The 2030 Agenda For Sustainable Development* [online]. [cit. 2015-12-18]. Available from: <http://www.waynevisser.com/report/sdgs-finalised-text>.
- Zákon o životním prostředí 17/1992 Sb.* [online]. [cit. 2016-10-10]. Available from: <http://www.zakonyprolidi.cz/cs/1992-17>.

Measuring quality of life in EU capitals

Tetiana Korovchenko

Abstract: *This paper focuses on research of theoretical foundations of the concept of quality of life and comparison of quality of life in some of the capitals of Europe using selected indicators which characterize as closely as possible the quality of life of society. The emphasis is placed on the fact that the final outcome of the quality of life research should cover the situation in all aspects of life of individuals and society as a whole.*

The purpose is to compare the conclusions of the objective and subjective approaches in order to assess the quality of life at the level of European capitals. By using selected indicators obtained with respect to Eurobarometer data analysis, the aim of this analysis is to assess and compare the characteristics of the quality of life of European capitals. Methods used for this include system approach, statistics method (data collection), methods of correlation and cluster analysis.

This article explored the status and perception of factors affecting the quality of life of citizens as a result of statistical studies of European capitals, developed on the basis of the Eurobarometer survey data. Possibilities of the quality of life measurement often offer a huge number of indicators. We outline the existing approaches for its measurement and at the same time we establish that only general enquiries are not sufficient. Therefore, two approaches have been used during the research - objective and subjective. This made it possible to assess the quality of life of the population at all levels.

Key words: Quality of life · Flash eurobarometer · Objectivist and subjectivist approaches · Groups of countries · Capitals

JEL Classification: I31 · R58 · O21

1 Introduction

In the last decades, there have been real problems with improvement of the quality of life in many countries of the world (Ayvazyan, 2016). The introduction of new methodical approaches to assess the effectiveness of activities of the regional state authorities is an important prerequisite for achieving a high level and quality of life of the population. Practical application of modern methodical approaches to assess the effectiveness of the regional public administrations provides planning for a long period and at the same time provides those governments services that meet the demands of the citizens.

Human satisfaction is one of the basic requirements which determine quality of one's life. But this is a highly subjective value which varies with time and the actual term satisfaction is very broad and doubtful. Information on citizens' satisfaction serves as an important basis for decision-making and self-evaluation for regional management (Philips, 2006). That is why it is necessary to measure and evaluate the satisfaction of citizens. It is important to identify not only areas in which people fulfil their personal aspirations but also other areas with negative influence on people. Regional inhabitants judge their own interests by evaluating the possibilities and obstacles that affect the fulfilment of their personal needs and interests. Their positive or negative relationships are directly linked to the place where they live (Isakin, 2007).

Quality of life is determined by life potential of society, including social groups, individuals and processing characteristics, resources, conditions and results of their life socially positive needs, values and goals (Ayvazyan, 2016). Quality of life within the subjective satisfaction is manifested by people themselves and their lives, as well as the objective characteristics specific to human life such as a biological, psychological (spiritual) and social phenomenon. In the process of managing the social and economic development of the country, an important role is played by indicators of quality of life. S.A. Ayvazyan (2016) emphasizes that having formalized methodology for measuring quality of life built on the basis of corresponding statistical data and other private properties of this category, we are able to define strategic goals in the development of human society; compare different cells of the society with the indicator in time and space. Finally, the design criteria for targeted social welfare, conditional optimization which (with different kinds of climatic, political and resource constraints) allows to determine the optimal trajectory of socio-economic, environmental and demographic development (Vasiliev, 2003).

Determining the level of quality of life plays an important role in the governance process of socio-economic development of the country. The relevance of this issue is also the fact that with proper measurement, based on both

objective and subjective statistical indicators, we get the opportunity to determine the strategy of development of the society, the level of economic well-being of the population, as well as potential of human possibilities.

The primary problem with using quality of life indicators (regardless of what the fulfilment of this phenomenon includes) is the ability of public authorities to define the general parameters of the data system that will be used for decision making (what specific data the responsible authorities need). Quality of life is quite challenging. This is mainly due to the fact that there is a significant number of indicators which may be important in assessing the quality of life. It should be noted that there are many theoretical concepts of quality of life, which represent different approaches to the assessment of quality of life (Table 1).

Table 1 The basic theoretical concepts of quality of life

The concept of economic welfare	Based on the judgment that the basis for a high level of social life is its material well-being
The utilitarian concept of quality	Characterized by the exceptional importance of the subjective assessment of quality of life.
The concept of the expansion of human possibilities	Based on the understanding that improving the quality of human life is a process of development of his freedoms.

Source: own processing based on Ayvazyan, (2016).

Aside from theoretical concepts two methodological approaches are also distinguished to measure and evaluate the quality of life: the objective (based on the fact that the leading role in community life is given to social structures) and the subjective (based on the fact that the leading role is occupied by an individual). As a rule, assessment of the quality of life in this approach comes down to the individual assessment of his/her condition (Ayvazyan, 2016). For a larger view of the diversity in quality assessment methodologies, the basic methodologies are considered within the framework of objective and subjective approaches.

Table 2 Methods of measurement of quality of life

Objectivist approach	Subjectivist approach
1. Indicators based on income	1. Assessment of quality of life by Ferenc and Powers
2. Indicators based on anthropometric indicators of children	2. Eurobarometer – it is a series of public opinion surveys conducted regularly on behalf of the European Commission.
3. Green Net National Product, GNNP	3. Swedish ULF-system (Undersokningar av Levnads Fordhallanden)
4. Genuine Progress Index, GPI	4. Analysis of the quality of life of the state's population
5. Index of Economic Well-Being, IEWB	5. Consumer Confidence Indexes - CCI
6. Physical Quality of Life Index, PQLI	6. Index WHOQOL
7. Index of Social Health, ISH	7. Philippine Social Climate Analysis
8. Johnston's Quality of Life Index	Combination of objectivist and subjectivist approaches
9. International Index of Living Conditions	1. Indicator of journal Money Magazine
10. Integrated Social Index of Michalos	2. Myers Trend Indicator (Community trend method)
11. Index of Social Progress, ISP	3. The basic and improved Quality of Life indexes by Diener
12. The technique of inter-regional analysis of the quality of life by V.V.Kossov	4. Comprehensive Quality of Life indicator by Cummins
13. Methods of integrated evaluation of the quality of life by S.A.Ayvazyan	5. Indicator happily lived life by Ruth Veenhoven
14. Human Development Index	6. The German system of social indicators
	7. Dutch index of living conditions (Living Conditions Index - LCI)

Source: own processing based on Ayvazyan, (2016)

2 Methods

In order to adopt the appropriate tools for the government, not only at national or regional level as well as individual towns and villages, it is necessary to assess the quality of life. The question is whether the more appropriate source of information is the subjective or objective assessment approach. The goal is to compare the results of objective and subjective quality of life assessment approach, in this case at the capital level. Hypothesis 1: There is a statistically significant correlation between the level of quality of life assessment using subjective and objective approach.

Hypothesis 2: Results of subjective assessment of quality of life in major cities depends on their geographical and cultural location.

22 European capitals were selected for the analysis, where the data is available from the survey Flash Eurobarometer 419 for the year 2015 (European Union Open Data Portal, 2016), concerning the characteristics of the quality of life of their inhabitants. Six indicators were selected that concisely describe the quality of life, namely: people's satisfaction with their personal job situation; people's satisfaction with financial situation of their household; people's satisfaction with the life they lead; people's satisfaction with the place where they live; people's satisfaction with health care services, doctors and hospitals; people's satisfaction with schools and other educational facilities. In order to assess the quality of life in objective terms, we use the most recent data of the gross domestic product per capita (hereinafter - GDP PC) of the capitals for 2013. Time shift in the data within two years is acceptable, considering the fact that the level of wealth (GDP PC) prospectively affect the parameters used by the subjective approach of the quality of life and at the same time ensures the use of the latest available data.

Flash Eurobarometer survey consists of interviews, conducted by telephone and undertaken on an ad hoc basis. The main advantage of the Flash survey, as opposed to a normal Eurobarometer survey, is that it is much faster, providing results almost instantaneously. In addition, it is more suitable for targeting specific groups within the EU population (European Union Open Data Portal, 2016).

To verify the first hypothesis Spearman correlation coefficient (1) was chosen, which determined the degree of correlation of the sum of the standardized values of the 6 indicators from the Eurobarometer, secondly GDP PC of the capitals, at a significance level $\alpha = 0.05$, where $n = 22$ reaches a critical value level 0.4241.

$$r_s = 1 - \frac{6 \sum_i (p_i - q_i)^2}{n(n^2 - 1)} \quad (1)$$

where:

n – number of subjects

p_i – order of values of the sum of the standardized values of the 6 indicators

q_i – order of GDP PC values

For the verification of the second hypothesis the statistical data of the standardized values of the selected 6 indicators from Eurobarometer were processed using cluster analysis (using the Ward method using Euclid distance). The hypothesis will be accepted if the defined clusters will belong each at least from 80% to one geo-cultural group. The cardinal points were used as these geo-cultural groups within the European capital cities (north-west; north-east; south-west; south-east), which include in themselves also cultural positions both in geographical as well as in figurative sense.

3 Research results

3.1 Comparison of the results of assessment of the quality of life from the subjective and objective approach

For the verification of the first hypothesis which assumes statistically important correlation between indicators for assessment with the subjective approach and the selected complex indicator for assessment with the objective approach, the data presented in the table 3 were used.

Table 3 Value indicators used to assess the quality of life

	People's satisfaction with their personal job situation	People's satisfaction with the financial situation of their household	People's satisfaction with the life they lead	People's satisfaction with the place where they live	People's satisfaction with health care services, doctors and hospitals	People's satisfaction with schools and other educational facilities	Sum of the variables	GDP PC in Euro
Brussel	4.22	3.72	4.1	4.26	4.2	3.49	23.99	48 991
Sofia	4	3.61	3.88	4.25	3.29	3.05	22.08	10 851
Praha	4.18	3.9	4.18	4.43	4.09	3.75	24.53	22 039
Berlin	4.24	3.92	4.31	4.45	4.07	3.2	24.19	30 215
Tallinn	4.14	3.83	4.15	4.45	3.35	3.18	23.1	21 037
Dublin	4.26	3.95	4.4	4.55	3.55	4.07	24.78	50 617
Madrid	3.86	3.6	4.03	4.23	3.59	3.23	22.54	30 320
Helsinki	4.5	4.12	4.42	4.56	3.83	3.72	25.15	49 317

Paris	4.12	3.83	4.06	4.25	4.06	3.6	23.92	53 578
Zagreb	3.97	3.54	4.11	4.33	3.73	3.72	23.4	14 227
Budapest	3.78	3.5	3.78	4.22	3.08	3.07	21.43	16 485
Roma	3.76	3.58	3.98	4.05	3.34	3.2	21.91	34 903
Vilnius	4.28	3.83	4.26	4.42	3.48	3.14	23.41	17 097
Riga	4.11	3.68	4.09	4.25	3.28	3.32	22.73	18 857
Amsterdam	4.25	3.98	4.43	4.39	4.32	3.7	25.07	47 038
Wien	4.33	4.11	4.5	4.62	4.32	3.72	25.6	42 084
Oslo	4.34	4.34	4.58	4.68	4.18	3.85	25.97	81 359
Warszawa	4.06	3.75	4.19	4.43	3.0	3.3	22.73	20 968
Lisboa	3.89	3.37	3.82	4.15	3.5	3.4	22.13	22 322
Stockholm	4.34	4.36	4.46	4.68	4.01	3.45	25.3	63 256
Bratislava	4.12	3.69	4.13	4.32	3.28	3.18	22.72	33 706
London	4.34	4.04	4.37	4.43	3.85	3.4	24.43	46 942

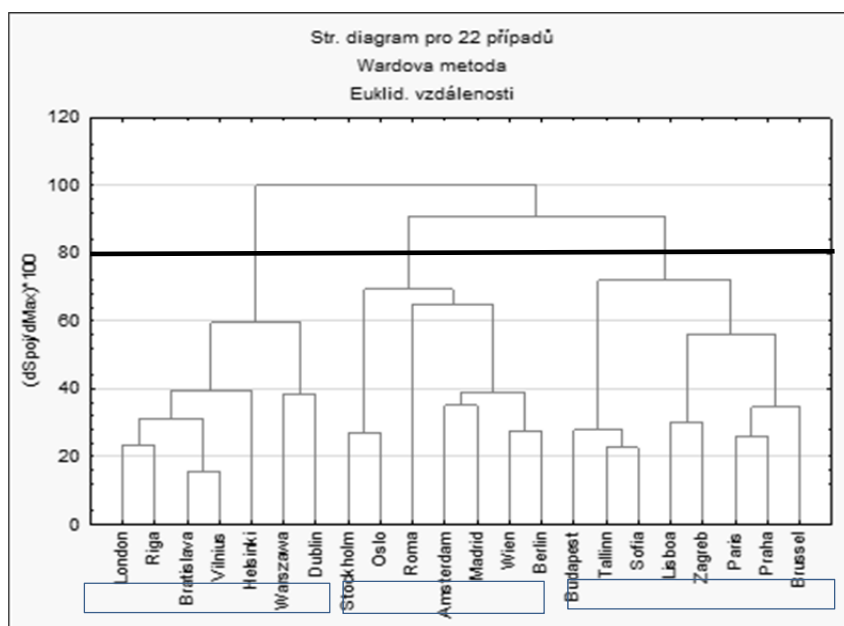
Source: Own processing using the data from the European Union Open Data Portal (2016) a Eurostat (2013).

The calculated Spearman's rank correlation coefficient reached the value of $r_s = 0.6770$, this means in comparison to critical value a statistically important result. It can be concluded that the hypothesis of a significant correlation of the quality of life of both approaches – objective and subjective – is valid.

3.2. The influence of geographical and cultural position on assessment of quality of life

The cluster analysis used to verify the second hypothesis, which assumes geographical and cultural proximity of similar parameters of quality of life, divided the analysed 22 European capitals into three groups, as shown in Figure 1.

Figure 1 Defined clusters of the capital cities using the parameters of subjective approach to assessment of quality of life



Source: own processing using SW Statistica and data from the European Union Open Data Portal (2016)

The three created clusters of European capitals at 80% (see Figure 1) were confronted with the classification of these capital cities in geo-cultural groups (see Table 4).

Given that none of the three clusters falls at least 80% within a single geo-cultural group, the hypothesis about significant influence of geographical location and cultural environment on the results of subjective quality of life has not been confirmed.

Table 4 Distribution of countries per geo-cultural groups

I. North + „West“		II. North + „East“	
Group	Capital	Group	Capital
1	London	1	Riga
1	Warsawa	1	Bratislava
1	Dublin	1	Vilnius
2	Stockholm	1	Helsinki
2	Oslo	3	Budapest
2	Amsterdam	3	Tallin
2	Wien	3	Praha
2	Berlin		
3	Paris		
3	Brussel		
III. South + „West“		IV. South + „East“	
Group	Capital	Group	Capital
2	Madrid	3	Sofia
2	Roma	3	Zagreb
3	Lisboa		

Source: own processing

4 Conclusions

The most appropriate method of evaluating the quality of life within the framework of objective approach, is the method of Eurobarometer survey, due to the fact that the survey exclusively focuses on quality of life, showing how satisfied people are with various aspects of urban life. But we chose 2 methods - objective, and subjective to fully estimate the quality of life of the population.

A statistically significant degree of correlation between the sum of the variables of the questionnaire survey Flash Eurobarometer and GDP PC showed the proximity of the assessment of quality of life with subjective and objective approach. This means that if the responsible politicians tried more to improve some of the indicators, better quality of life would be achieved. On the other hand, it is possible that efforts to increase GDP PC (society would become richer), would lead to an improvement in the parameters that are important in terms of subjective assessment of quality of life.

Regarding the geographical and cultural position of the capital cities, the result has led to the rejection of the second hypothesis, i.e. the subjective assessment of quality of life is not significantly affected by geographic location and cultural environment.

Possibilities of quality of life measurement often offer a huge number of indicators. We outlined the existing approaches for its measurement and at the same time established that only general enquires are not sufficient. Their relevance does not bring major changes within further research. On the other hand, public administration should know that thanks to research on quality of life it gains advantage of public involvement, interest groups, professionals etc. in local decision making. Involving other entities increases their responsibility for quality of life within their area, increases sense of belonging of people to the region and saves capacity of their officers. At the same time, we must respect the public choice and be understanding towards the fact that the public by itself does not have to have the need to discuss social issues.

Acknowledgement

This paper was made with the support of IGA University Pardubice in relation to project solutions no. SGS_2016_023.

References

- Andrews, F. M., & Withey, S. V. (1986). *Social indicators of well being: Americans perceptions of Life quality*. New York.
- Aronsson, T. (1997). *Welfare Measurement, Sustainability and Green National Accounting, A Growth Theoretical Approach*, Edward Elgar Publishing, ISBN: 978-1-85898-485-8.
- Ayvazyan, S. A. (2016). *Quality of Life and Living Standards Analysis. An Econometric Approach*. Berlin: de Gruyter. ISBN: 978-3-11-031625-4.
- Becker, G., Philipson, T., & Soares, R. (2015). The Quantity and Quality of Life and the Evolution of World Inequality, *American Economic Review*, 95(1), 291.
- Diener, E., & Suh, E. (1997). Measuring Quality Of Life: Economic, Social, And Subjective Indicators, *Social Indicators Research*, 40(1-2), 189.
- EU Data (2016). *European Union Open Data Portal data* [online], ISSN 2315-3091. Available from: http://open-data.europa.eu/en/data/dataset/S2070_419_ENG
- Eurostat (2016). *Gross domestic product (GDP) data* [online]. Available from: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=met_10r_3gdp&lang=en
- European Commission (2016). *Public Opinion data* [online]. Available from: http://ec.europa.eu/public_opinion/index_en.htm
- Isakin, M. A. (2007). *Identification of priorities of socio-economic development of the region: mathematics and methodological support and its experimental testing*. [Dissertation thesis]. Moscow: Higher School of Economics.
- Kraftová, I. (2011). Dispersion on the issues of human development. In *Hradec Economic Days 2011: economic development and management of regions: the international conference*. Hradec Králové: Gaudeamus, 2015, 48-54. ISBN 978-80-7435-547-9.
- Lagas, P., Frank, D., Frank, R., & Visser, H. (2015). Regional quality of living in Europe, 2(2), 1–26. doi: 10.18335/region.v2i2.43.
- Michalos, A. C. (2005). Estes Index of Social Progress (ISP). In *Encyclopedia of Quality of Life and Well-Being Research*, ISBN 978-94-007-0753-5.
- Micklewright, J., & Suraiya, I. (2001). What Can Child Anthropometry Reveal About Living Standards and Public Policy? *An Illustration from Central Asia Review of Income and Wealth*, 47(1), 65-80.
- Myers, D. (1987). Community-Relevant Measurement of Quality of Life. *A Focus on Local Trends Journal*, University of Wisconsin-Madison.
- Phillips, D. (2006). *Quality of Life: Concept, Policy and Practice*. London: Routledge. ISBN 978-0-415-32355-0.
- Estes, R. J. (2014). Physical Quality of Life Index. *Encyclopedia of Quality of Life and Well-Being Research* (pp 4804-4805).
- Rojas, M. (2010). *The Measurement of Quality of Life: Conceptualization Comes First*, 72.
- Talberth, J., Cobb, C., & Slattery, N. (2006). *The genuine progress indicator 2006: A tool for sustainable development*, 33.
- The Conference Board. (2016). *Consumer Confidence Survey data*. Available from: <https://www.conference-board.org/data/consumerconfidence.cfm>
- Vahedi, S. (2010). *Analyses of Their Item Response Theory Properties Based on the Graded Responses Model*. World Health Organization Quality-of-Life Scale (WHOQOL-BREF).
- Vasiliev, A. L. (2003). Russia in the XXI century. In *Quality of life and standardization*. AM: Standards and Quality.
- Veenhoven, R. (1996). Happy life-expectancy. A comprehensive measure of quality-of-life in nations. *Social Indicators Research*, 39, 1-58.
- Weijers, D. (2014). An interview with Alex C. Michalos. *International Journal of Wellbeing*, 4(1), 106-110. doi:10.5502/ijw.v4i1.7.

Procurement and its Rules in the Programming Period 2007–2013 under the Operational Program Education for Competitiveness in the Czech Republic

Petr Vrkoslav, Dagmar Škodová Parmová, Tereza Procházková

Abstract: *The paper is focused on procurement within the Operational Programme Education for Competitiveness (OPVK) during the programming period 2007 - 2013. The introductory part contains a brief description of the OP and its integration between regional policy objectives. The study deals with the procurement process in general and, afterwards, in the specific OP environment. It also describes the process of performing control of public contracts (ex-ante and ex-post) and their results, as well as an overview of the most common errors identified during the inspections with a brief analysis of their causes and proposing measures to eliminate them. Another part focuses on the issue of ineligible expenses caused by mistakes in public procurement. The final section provides a closer look at public procurement for the current programs in the period 2014 – 2020.*

Key words: Procurement · European Social Fund · Public contracts · Ineligible expenses

JEL Classification: H27 · R58

1 Introduction

The issue of public procurement plays a significant role during the implementation of projects financed both from the EU and from the national sources, and is one of the possible risks threatening the smooth progress of their implementation. The main objective of this paper is to describe the process of procurement and control on the example of the Operational Programme Education for Competitiveness financed by the European Social Fund. The paper briefly analyses the legislative framework for procurement at national and EU level. Simultaneously, it describes in detail the process of checking procurement by the grant provider, and in relation to recipients of the subsidy or the Office for the Protection of Competition, as well as to the management of financial institutions. Based on the results of carried out checks, the authors describe the most common errors and their possible causes. At the same time, brief suggestions for their elimination are outlined. Another aim of this research is a comparison between a methodological framework for public procurement during the previous and current programming period, for example, operational program Education for Competitiveness and Operational Programme Research, Development and Education.

2 Objectives and Methodology

From the methodological point of view this research is based on three fundamental principles: description of the environment within the process of procurement in chosen EU member states, and at the same time on a detailed description of its follow-up process in the Czech Republic, especially on the part of the grantor – here the Ministry of Education of the Czech Republic. Furthermore, this research is based on the results obtained from the analysis of data collected on behalf of the grantor during the implementation of the Operational Programme Education for Competitiveness. The data about the compliance with legislation rules in all reliable projects of the chosen Operational Programme were collected on the basis of 626 ex-ante or 4,696 ex-post controls on procurement under the implemented projects. The reports about these controls were provided by the competent department of the Ministry of Education in spring 2016. On the basis of collected data and their evaluation in relation to the ineligibility of expenditure on the basis of the errors found in the control of public procurement the mostly done errors are described. Simultaneously, research is also focused on a comparison of procurement rules under the previous and current programming period.

3 Research results

The procurement process

The legislative framework is based on two levels of legislation, both at the European Union level (EU Procurement Directive) and at the national levels (Public Procurement Act and the Mandatory procurement procedures). Public contracts are awarded in accordance with both above mentioned documents. As part of the research, the Czech public

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procurement was compared with the situation in the legislation on public procurement in the Slovak Republic, in Germany and in Sweden. Based on this comparison we can say that Czech law is logically closest to the Slovak one. Our law regulates the rules for awarding contracts below the thresholds. On the other hand, an entirely different approach can be seen in the case of Sweden, where it is actually very easy to simply implement the EU directives on public procurement without additional legislation for contracts covered by this Directive. Another different approach to the implementation of EU directives on public procurement can be found in Germany, which does not create special rules for awarding contracts, but only for its integration into the existing Act against Restraints of Competition.

Furthermore, concerning the relationship between the risk of corruption in procurement and procurement funding source it was found that for contracts financed by the EU, the risk of corruption increases. Conclusions that are based mainly on the study "Are EU funds and corruption risk? The impact of EU funds on grand corruption in Central and Eastern Europe" by authors Fazekas, Chvalková, Skuhrovec, Tóth and King (2014). The study examined the impact of the European funds on the environment according to a higher risk of corruption in public procurement during the period 2009–2012 in the Czech Republic, Hungary and the Slovak Republic. The study results suggest that the provision of financial resources from the EU funds significantly increases the risk of corruption in selected countries. The same conclusion, i.e. that EU funds are a higher risk of corruption in public procurement, was confirmed by other studies, for example by Mariniello and Coviello (2013) or Fazekas and Tóth (2015).

Implementation of procurement procedures within the OP

One aim of this research was to describe the development of procurement environment; particularly the way of implementing mandatory procedures to control documents in the Operational Programme was checked. It was introduced on the basis of the development of the rules for public procurement within the particular versions of the Manual for Beneficiaries. Throughout the programming period has been granted a total of 8 versions of the Manual for Beneficiaries (7 versions in the period 2008-2012), while procurement rules went through major or minor changes. Clearly, for the particular recipient while implementing the multiple projects financed by the OP, these changes could cause some complications. It was necessary to take account of that version of the Handbook for the recipient which was valid for this or that project.

During this part of the research the legislative history of the Act on Public Contracts affecting significantly the process of contracts awarded under OP was described. There was also given a space to the question of applying the principles of 3E in public procurement, and concluded that they are often neglected. The Public Procurement Act explicitly formally mentions the 3E principle, because this law is aimed de facto only on process (formal) site procurement, see particularly § 6 of the Public Procurement Act. The contracting authority is obliged in proceeding under this Act to respect the principles transparency, equal treatment and non-discrimination, while it is the responsibility of the contracting authority to monitor the economic (content) side of the resources used by the contracting authority as establishes the Financial Control Act.

The process of checking public contracts within OP projects

During the implementation of the OP by the grant provider, a total of 626 ex-ante inspections of the terms were done, and a number of 4969 ex-post inspections of procurement, too. About 25% of all orders made within the OP was entered in one of the schemes provided for in the Public Procurement Act, esp. the open procedure, simplified sub-limit driving or entering a dynamic purchasing system or of the concluded framework agreements with several candidates. The remaining 75% of contracts were minor public contracts. The checks showed that almost half of the public procurement within the OP was wrong.

Based on data on conducted ex-post inspections the outputs of the checks were analysed, especially in relation to the importance of errors for different types of contracting authorities, such as high schools, middle schools and elementary schools. Based on the data obtained there can be traced obvious difference in the results of ex-post inspections among different types of schools. In the case of universities, the ineligibility of expenditure was observed in almost every tenth order, and in case of primary schools, it was in almost every fifth case.

The most common errors in public procurement within the OP

The most frequent errors were revealed in the context of the checks carried out on public contracts. Observed misconducts were categorized according to each stage of the procedure when they occurred.

The most common errors incurred prior to the commencement of tendering procedure were to categorize public contracts under the law or the Handbook according to the recipient limits. The other one was erroneous definition of the subject matter, e.g. using business names or using technical parameters favoring a particular company or manufacturer. Furthermore there was vaguely specified method of evaluation of tenders, the contracting authority evaluation criteria

and method of evaluation of tenders was not described sufficiently clearly and comprehensively to make the assessment process transparent. It was also not clear how the points will be allocated based on each individual criterium.

The most frequent errors arising during the procurement procedure were mainly errors in the process of assessing the bids from the perspective of non-compliance with the principles of equal treatment, and further errors in the process of evaluating the bids from the viewpoint of non-compliance with the principle of transparency, which is insufficient way of evaluating the tenders within the individual evaluation criteria.

Finally, the most frequent mistakes arose after the procurement procedure. In particular, the failure was in the publishing obligations of the contracting authority after the finishing of the tender procedure. After concluding the contract, this allowed substantial changes to the terms of the contract, and permitted failure to archiving of all relevant documents related to the procurement procedure.

We also described the circumstances of co-occurrence of these errors on the part of the recipient and the provider of the subsidy, which was followed by a brief proposal of appropriate measures for the possible reduction of errors in procurement, again, both by the provider and the subsidies payee. Grant recipient should place great emphasis on compliance with all the rules relating to public procurement, at the same time should not neglect the increasing competencies of its employees responsible for public procurement, also continuously monitor the decision-making practice of the authorities concerned with the public procurement. Finally, it is recommended to use specialized companies and specialists in the area of public procurement, especially for beneficiaries with limited experience with administration of procurement procedures.

On the provider side the priority should be to simplify mandatory procedures for the procurement of small scale. Within the OP the terms for contracts between the estimated value 200 000 - 2 000 000 CZK excl. VAT are not much different from the below-threshold simplified procedure (regime under the Public Procurement Act). Another important activity related to the subsidy should be the mandatory introduction of ex-ante control of the terms and conditions for all public contracts and the associated truly consistent check of the specifications before commencing a procurement procedure to detect possible errors. There must also be an ongoing publishing activity of methodological materials focusing on public procurement or mediation through methodological meetings with representatives of the beneficiaries in order to become familiar with rules for public procurement, to exchange practical experience, and to learn the most common errors detected during the checks. Another part of this research was devoted to the issue of ineligible expenditure and process irregularities of the OP. It included information on the rate of ineligible expenditure because of irregularities in public procurement which showed that ineligible expenses in public procurement formed the largest part of the total amount of ineligible expenditures (about 40%).

4 Conclusions - Procurement in the programming period 2014 – 2020

The final part of the analysis was devoted to the "new" law on public procurement and also to the rules for public procurement in the current programming period 2014–2020, in particular rules within the OP Science, Research and Innovations and their comparison with the previous programming period. It was found that in the current programming period, there were several positive steps, notably concerning the simplification of the procurement process. The unification of rules for the procurement of small scale across all operational programs was based on the concept of a uniform methodical environment.

Finally, we can say that even though the data only from OP projects where the grant provider was directly Ministry of Education through the Department of CERA were processed, we can outline conclusions that apply to the issue of procurement under the Structural Funds as such.

Acknowledgement

This paper was supported by the Project No. GA JU 053/2016/S.

References

- Coviello, D., & Mariniello, M. (2014). Publicity requirements in public procurement: Evidence from a regression discontinuity design. *Journal of Public Economics*, 109, 76-100.
- Dimulescu, V., Pop R., Doroftei, I. M. (2013). Risks of corruption and the management of EU funds in Romania. *Romanian Journal of Political Science*, 13(1).
- Fazekas, M., Chvalkovská, J., Skuhrovec, J., Tóth, I. J., King, L. P. (2014). Are EU funds a corruption risk? The impact of EU funds on grand corruption in Central and Eastern Europe. *Corruption Research Center Budapest Working Papers*.
- Fazekas, M., Tóth, I. J. (2015). Corruption in EU Funds? Europe-wide evidence on the corruption effect of EU funded public contracting. *Working Paper series: GTI-WP*, 01 June 2015.

- Jurčík, R. (2014). *Veřejné zakázky a koncese*. 2. ed. C. H. Beck.
- MMR (2007). *Národní strategický referenční rámec* [online]. Available from: <http://www.strukturalni-fondy.cz/cs/Fondy-EU/Programove-obdobi-2007-2013/Narodni-strategicky-referencni-ramec>
- Mungiu-Pippidi A. (2013). The Good, the Bad and the Ugly: Controlling Corruption in the European Union, European Research Centre for Anti-corruption and Stat-building, *Working Paper*, 35, April 2013.
- Ochrana, F. (2008). *Povinnost zadavatele postupovat při zadávání veřejných zakázek podle principů 3E s ohledem na ustanovení zákona o finanční kontrole* [online]. Available from: http://www.portal-vz.cz/getmedia/5ca730e6-510f-4993-98ca-d2bc770c16dc/3E_vs_principy_ZVZ_A1.
- Popescu A. (2014). Corruption in Europe: Recent Developments. *CES Working Papers*, 6(2A), 150-160.
- Transparency International (2012). *Money, Politics, Power: Corruptiion Risks in Europe*. Transparency International, June 2012.

Session 2

Economic impacts of Changes and Policies in the fields
of Finance, Accounting and Taxation

Internal Audit and its Role in evaluating the Risk of Financial Statement Manipulation in the Area of Costs, based on a Case Study of a Chosen Accounting Unit

Zita Drábková, Zdenka Volkánová

Abstract: *The basic purpose of accounting statements is to accurately and truthfully show reality. For most interested parties, accounting data is one of the essential sources of information about a company. Financial statements are also the fundamental source of information for managers and Corporate Governance for company management. The risk of deceptive account reporting or “improving” financial results has been confirmed by many instances of international research done by large auditing companies, and also relates to subjects based in the Czech Republic. The reasons for using dishonest techniques, creative accounting, and deceptive reporting could be many, for example the necessity of reaching specific figures and criteria for parent companies, creditors, and banks. Internal audits and internal control systems should detect creative accounting methods that are far from accurate and truthful, together with accounting fraud, and at the same time prevent companies from acting accordingly. This contribution analyses accounting unit cost which has been causing accounting loss and poor financial health of chosen trade corporations for a long time. At the same time it evaluates specific findings in the area of spending efficiency in connection with revenues. Furthermore, the contribution summarizes aspects of using creative accounting techniques in the area of costs, and the impact of changes in their management including impacts on the efficiency of internal audits and set accounting units control systems.*

Key words: Risk of accounting statements manipulation · Internal control system · Internal audit

JEL Classification: G32 · M41 · M42

1 Introduction

An effective strategy against fraudulent actions must be based on company culture, an active approach to risk evaluation, and adequate response in case any specific suspicious activity occurs. Company culture must stress ethical and transparent approaches and these must be applied daily – otherwise all precautions and rules against fraud remain only empty suggestions that are not followed. Rules for preventing fraudulent activity should be part of internal regulations.

In particular it is essential to mention the acceptance and implementation of a company ethical codex that must also be appropriately communicated within the company, especially in the form of training and workshops. Besides stating general aims, these rules must also stipulate the company’s active approach and expectations from their employees in specific positions towards risk evaluation, prevention, and detection of suspicious activities. Specific actions and precautions should be implemented in all decisive business processes. These specific precautions can for example be the screening of new employees and new business partners, monitoring for possible conflicts of interests among employees in charge or the leadership and business partners, internal audits of risky areas, basic analysis of accounting data and documentation, and the search for any irregularities and suspicious circumstances.

According to the Association of Certified Fraud Examiners data, internal audit contributed to uncovering 43.3% of accounting fraud in 2012, 42.2% in 2014, and 39.1% in 2014. The share of Financial Statement Fraud was 9.6% from all types, including property misappropriation (ACFE, 2016).

According to other available statistics most fraud is uncovered as a result of a notification or report from someone. It is essential to facilitate these reports as much as possible, especially by establishing a permanently accessible telephone line (it is recommended to be provided externally) to make it as easy as possible for the person reporting the activity.

Parties and companies commit fraud with the aim of getting finance, possession or service, to avoid paying for specific services or their loss, and for personal or business benefits. An organization’s activities are influenced by basic

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regulations such as laws, government regulations, public notices, etc. as well as internal regulations such as establishment documents, orders, methodical instructions, handbooks, and other standards that are implemented in order to perform the main organization activity as smoothly as possible.

This easy-to-use handbook clearly explains how to develop an effective system of accounting and operational controls and offers the best practices with pragmatic insights and proactive strategies to protect organizations from suffering further substantial losses of assets and reputation that occur from financial dishonesty within an organization (Bragg, 2009).

The guide describes the various types of controls in all core business functions and outlines several frameworks for designing and implementing those controls. Case studies are used to illustrate and offer further guidance on applying these controls (Kyriazoglou, 2012).

2 Methods

This contribution focuses on risks of accounting statements in the area of significant disruption of true and fair appearance. On the basis of detecting a high risk of the disruption of accurate and honest representation of accounting statements by mistake or deliberate fraud, the contribution aims to analyse the relationships among accounting information in 11 accounting periods in a case study of a specific accounting unit where continued future activity was threatened as a result. The chosen accounting unit was tested during 11 accounting periods by a chosen model for detecting manipulation of CFEBT accounting statements.

The selected entity was operated in a construction sector and had a fluctuating operating results and the poor financial health of the reporting period in years 1 to 4. At the same time the selected unit was significantly threatened it's further operation at the end of year 7. The entity didn't carry out an internal or an external audit in the period of years 1 to 7. Based on previous research into the possibility of detection of manipulated financial statements, the CFEBT model was designed and based on the hypothesis of a relation between a loss and an increase in cash flow in the period of five years i.e. whether the sum of their value in five years with minor variations lead to a similar result.

The CFEBT model is defined as follows:

$$CFEBT = \frac{\sum_{t=1}^5 CF_t - \sum_{t=1}^5 EBT_t}{\sum_{t=1}^5 EBT_t} \times 100 \quad (1)$$

Where:

- ΔCF Increase of cash flow in period t
- EBT Earnings before taxes in period t

Considered materiality is between 5-10%.

If CFEBT materiality, there is probably a high risk of breaching a true and fair view of the accounts. In this situation we recommend testing significant relationships among accounting statements with a detailed test in the modified versions of the CFEBT model (Drábková, 2013).

The following is a relationship analysis of significant accounting items among statements of the chosen accounting unit which was part of the solution to the assigned task related to its stated profits and aimed at detecting the causes of an undesirable state of accounting unit financial health and repeatedly stated accounting losses. Analysis of the chosen accounting unit's statements was done for 11 accounting periods based on cost analysis, calculations were done using the proportion calculation method. Another step was evaluating the impact in the accounting unit internal control system including evaluating risks of accounting fraud and creative accountancy beyond true and fair view of accountancy after implementing specific approaches leading to the improvement of the internal control system efficiency during years eight and nine. The effect of the implemented processes and regulations as a result of detected risks in the area of costs integrated into the accounting unit's control mechanisms is subsequently followed by aspects of impacts in the change to the company's financial health.

3 Research results

The chosen accounting unit is based in the building industry and in the accounting periods for years one to eight achieved fluctuating management results before taxation with prevailing accounting losses, for more detail see Figure 7 for years one to eight. The accounting unit was solving significant financial problems in the end of year eight including negative consequences in managerial calculations control, profitability with subsequent negative consequences on business corporation competitiveness.

The accounting unit was evaluated as high risk as it did not perform any internal audit processes and in accounting periods one to nine accounting statements were not subject to evaluation by an external auditor. In all observed accounting periods the accounting unit was observed as being in compliance with Czech accounting regulations (CAS).

3.1 CFEBT model for detecting risks of accounting faults and fraud

Accounting statements were tested by the CFEBT score and achieved a result of 98% in accounting periods one to seven. This value is significantly above the considered materiality level.

The following step was a detailed analysis of significant relationships between cash flows change and EBT. Using the modified model, there were significant irregularities detected in accruals and inefficient cost management with the recommendation for detailed cost and profit analysis including implementing cost management approaches.

Based on the analysis of significant accounting relationships among balance sheet, statement of profit and loss, and cash flow development in accounting periods one to seven, the main risk in disruption of the matching principle between costs and profits was detected. Within the CAS conditions the costs without direct matching to factually and timely distinguished profits in compliance with time cost differentiation were shown.

Based on detailed cost analysis the accounting unit showed a breach of CAS in the area of reporting costs when company costs included those unrelated to the company economic activity.

Subsequently, the efficiency analysis of the usage of construction machines which the company included in fixed assets was made.

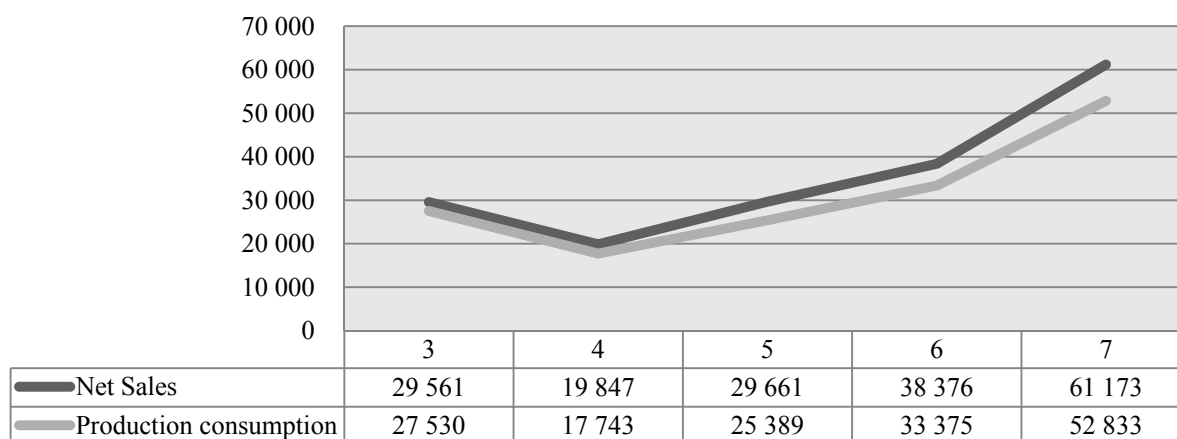
3.2 Detailed analysis of risky areas

The analysis done detected a risk of accounting statement manipulation beyond true and fair CAS view with aspects of accounting fraud within the observed period of years one to seven.

As a consequence another analysis was performed for individual years of the accounting period and the following areas in five years, or rather periods one to seven, were evaluated:

- Matching principle in accountancy: output consumption and realized actions were compared, see Figure 1:

Figure 1 Outputs and output consumption in years 3 to 7 (in thous. CZK)



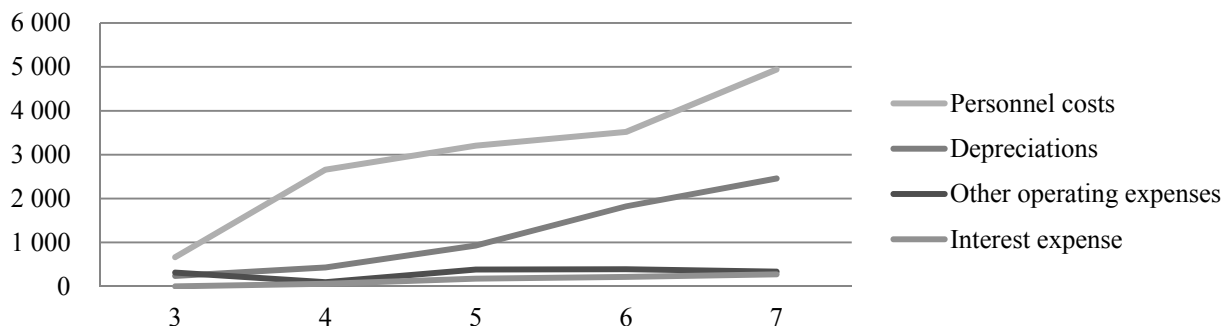
Source: Own processing

As we can see in Figure 1 for years three to seven, year's three to four show a decline in output and output consumption. The curves for output and output consumption in this period are almost identical. In this period the company was not sufficiently controlled either from the point of view of financial management, nor the point of view of control mechanisms.

Periods five to seven showed specific improvement of the situation, which was caused above all by securing long-term contracts in the building industry.

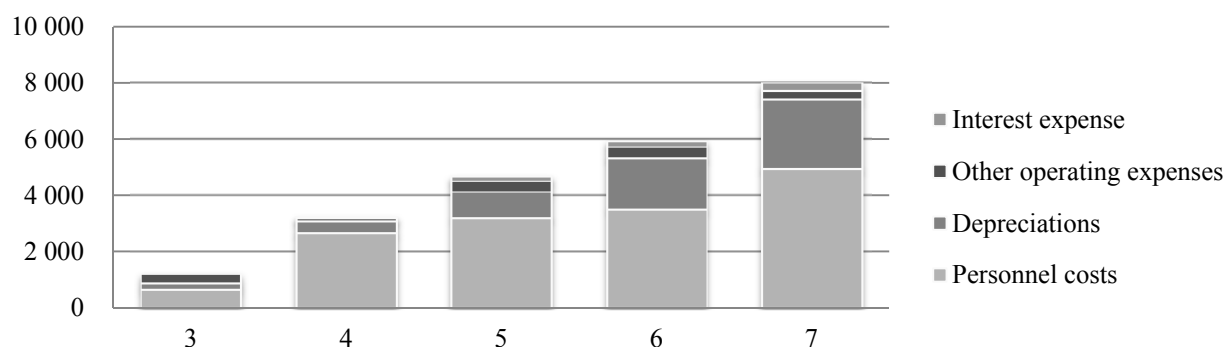
- Subsequently the development and costs structure were observed. See Figure 2 and Figure 3.

Figure 2 Development of chosen cost items, years 3 - 7 (in thous. CZK)



Source: Own processing

Figure 3 Structure of costs in years 3 - 7 (in thous. CZK)



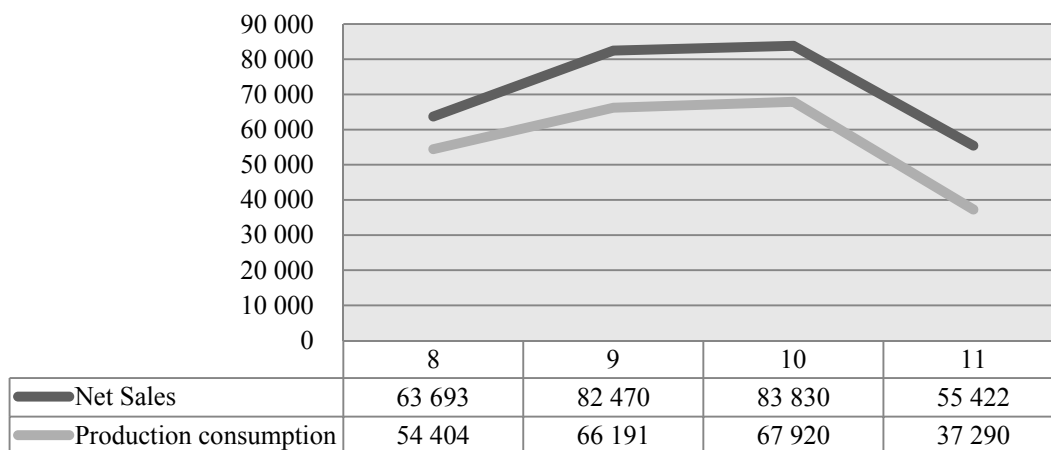
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3.3 Evaluations and impacts on the internal control system

In years 10 and 11 outputs and output consumption declined in comparison with the difference in the development of stated realized outputs and output consumption in years 8 to 11 when long-term building contracts were terminated, see Figure 4 and Figure 5.

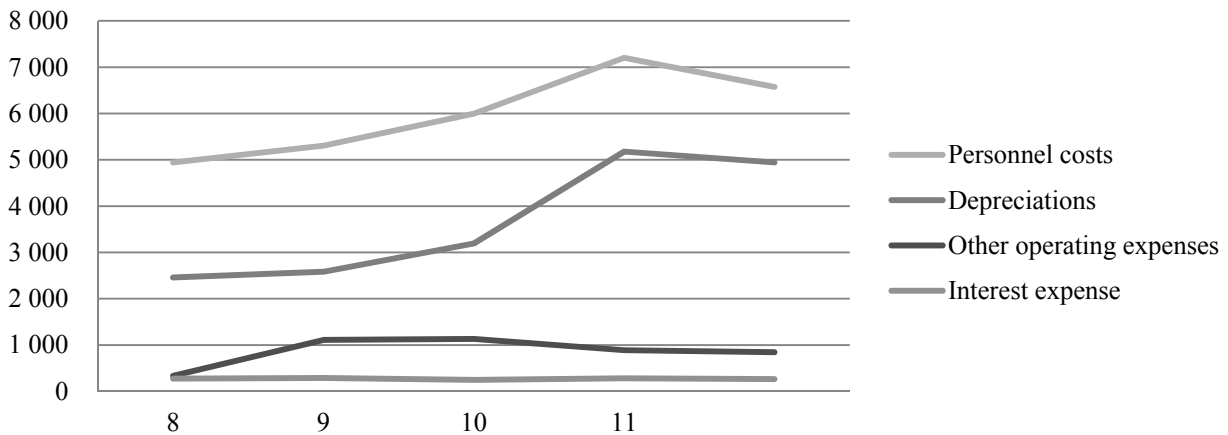
In year nine the company implemented management for regular observation and planning costs, including controls of individual centres exploitation in terms of responsibility, into the internal control system. The company was using effective tools for financial cost management on cost centres, monthly reports, evaluations of plans, and real exploitation of including evaluating effectiveness of costs spent.

Figure 4 Outputs and output consumption in years 8 to 11 (in thous. CZK)



Source: Own processing

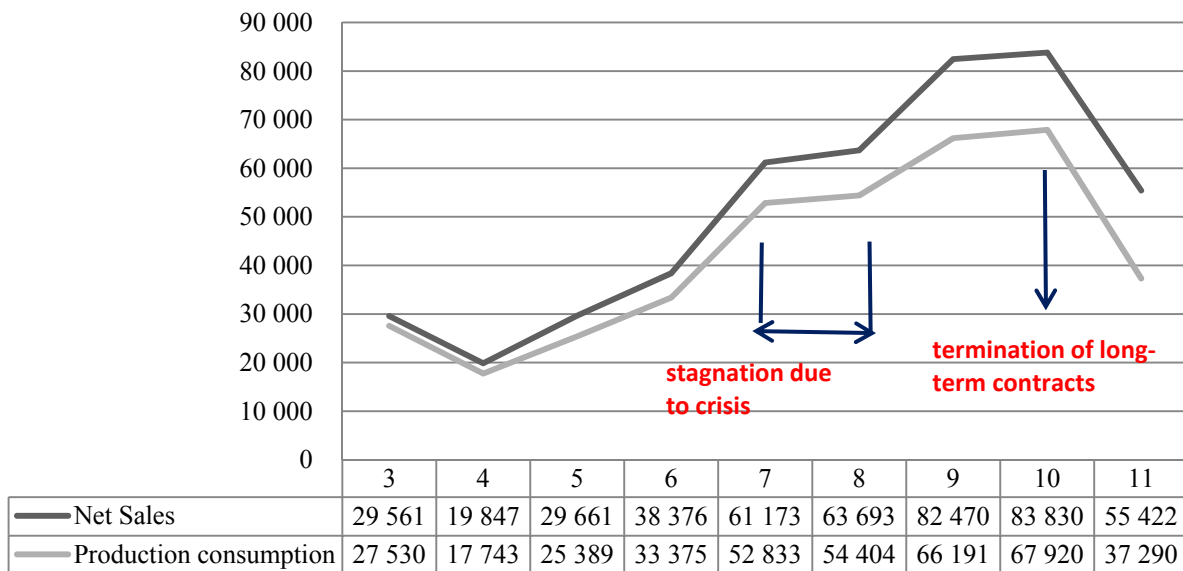
Figure 5 Development of chosen cost items in years 8 to 11 (in thous. CZK)



Source: Own processing

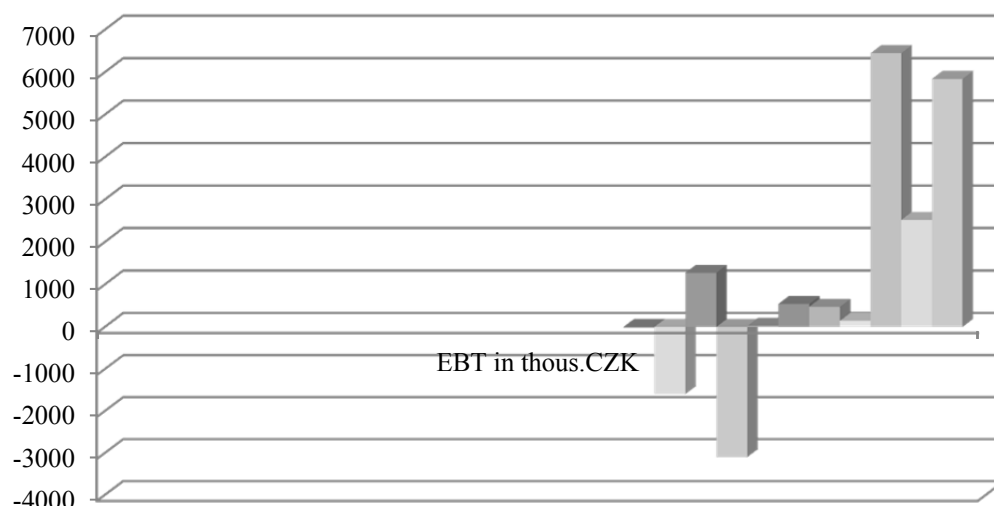
Years six and seven were influenced by the first wave of economic crisis in the building industry and Figure 6 shows an obvious stagnation of both outputs and output consumption. Cost items management was positively evaluated in this period as was represented by the decline in outputs and equally in output consumption. Information and data are based on, among other things, company statutory statements valid until December 31, 2015 where line 11 represents added value. It is possible to say that output consumption prevails added value by variable and indirect costs. Items services also include fixed costs, which are mainly rent paid and repairs paid for building machinery, but while elaborating on costs there was no evidence these were significant items in terms of size. In year 10 long-term contracts were terminated and no compensation in the form of new contracts was made.

Figure 6 Outputs and output consumption in years 3 to 11 (in thous. CZK)



Source: Own processing

Figure 7 shows a fluctuating EBT in the reporting periods between 9-11 years in which there has been a significant increase in profits due to implementation of control mechanisms.

Figure 7 Overview of management results before taxation for years 1 to 11 (in thous. CZK)

Source: Own processing

3.4 Proportional indicators of financial analysis in years 1 to 11

Table 1 below proved that, within periods 1 to 11, in the beginning the company showed very poor profitability results. The improvement is visible in year 9 or 10, where this improvement corresponds with the initial settings of control mechanisms and financial management.

Table 1 Profitability in years 1 to 11

Profitability in percent (%)	Year	Year										
		1	2	3	4	5	6	7	8	9	10	11
ROE (15%) (16.97% in year 7)	EAT/VK	-10	113	-918	239	5	-48	-35	-10	112	22	42
ROE (with the usage of EBIT)	EBIT/VK	x	x	-918	234	-15	-81	-72	-81	147	33	43
ROA (9%) (7.92% in year 7)	EBIT/Assets	-1	-45	12	-74	2	6	1	1	14	6	10
ROS	EBIT/Turnover	x	-28.27	0.043	-0.15	0.007	0.020	0.012	0.007	0.081	0.032	0.108

Source: Own processing

where:

EBIT – profit before interests and taxation

EAT – profit after taxation

VK – own capital

Table 2 presents selected fluctuating ratios of costs and revenue in the reporting period. Development of revenues and expenses was negatively affected by the stagnation in the construction market in the period of 6-7 and due to the termination of long-term supply contracts in the years 10-11. However, evidently there is stabilized costs and revenues since the introduction of control mechanisms in years 9 and 10.

Table 2 Expenses in years 1 to 11

Expensiveness	Year	1	2	3	4	5	6	7	8	9	10	11
Ratio of costs and profits	Expenses/Revenue in percent (%)	xxx	127	95	103	96	96	94	94	88	90	79
Operating costs / Outputs	(%)	xxx	xxx	93	89	86	xxx	89	108	86	87	87
Material& energy/ Outputs	(%)	xxx	124	93	39	29	15	16	15	16	29	41
Personal costs / Outputs	(%)	xxx	2	2	13	11	9	8	8	7	9	12
Depreciation / Turnover	(%)	xxx	1	1	2	4	5	4	4	4	7	9
Interest/ Turnover	(%)	xxx	0	0	0	1	1	0	0	0	0	0
Added value margin	(%)	xxx	-24	7	11	18	13	14	15	20	20	34

Source: Own processing

4 Conclusions

In conclusion it can be said that breaching CAS leads companies to many incorrect decisions in terms of decisive tasks which company management must deal with. Based on the usage of financial analysis mechanisms, irregularities in stating real accounting company data can be clearly detected. Negatives are that if we are looking for irregularities that are indicated by values of financial analysis indicators, it is also necessary to gain more detailed information both from accountancy such as analysis of some cost accounts to the level of receipts, and the company management. If the evaluator works with publicly accessible statutory statements only, the analysis cannot be done properly. Furthermore, publicly accessible statements with annexes do not always show relevant information.

The CFEBT model is considered to be a basic comprehensive view of the financial statements and the links between them. The model traces the development of the statements and links them to more accounting periods (optimally in five years) and analyses the links between cash flow and profit. Modified CFEBT score presents a detailed test which may become an effective part of the anti-fraud programme of internal controlling systems. The awareness of the risks of financial statements improves the efficiency of corporate internal controlling systems and lowers the information asymmetry between the owners and Corporate Governance.

- In our opinion, user accounts can reduce uncertainty about submitted financial statements on if complete analysis of financial statements was processed for several years.
- The CFEBT model is considered to be a basic comprehensive view of the financial statements and the links between them. The modified version of the CFEBT model respects the individuality of the accounts of a sample entity and substantially eliminates the diversity of national accounting systems such as the Czech accounting standards, IFRS and US GAAP.
- We believe that the suggested CFEBT model may be used by auditors to identify risks of accounting fraud of in accordance with ISA 240 and as part of anti-fraud program into the internal control systems or by any user accounts for testing financial statements. So, we can recommend to manage risk of financial statements for any accounting units (especially managers Corporate Governance and owners) and not to rely only on the results of the ratios, bankruptcy and credibility models which often provide users with conflicting results.

Acknowledgement

This paper was supported by GAJU nr. 149/20014/S.

References

- ACFE (2008). Možnosti odhalení podvodu [online]. *Report to the Nation on Occupational Fraud & Abuse*. Available from: <http://www.acfe.com/rtn2016/detection.aspx>.
- ACFE (2016). *Fraud Risk Management Guide*. USA: COSO.
- Bragg, S., M. (2009). *Accounting Control Best Practices*, Second Edition. USA: John Wiley & Sons Publishing.
- CIMA (2009). *Fraud Risk Management: A Guide to Good Practice* [online]. Chartered institute of Management Accountants. Available from: http://www.cimaglobal.com/documents/importedddocuments/cid_techguide_fraud_risk_management_feb09.pdf.
- Diesenbacher, O. (2011). Click Fraud - Analyse und Methode zur Identifizierung, München, GRIN Verlag.
- Drábková, Z. (2013). The potential to reduce the risk of manipulation of financial statements using the identification models of creative accounting. *Acta Universitatis Agriculturae et Silviculturae Mendelianae*, 226(7), 2055-2063.
- Drábková, Z. (2013). Possibilities to reduce audit risk using the CFEBT model to identify creative accounting and fraud in term of Czech accounting standards. *Proceedings from International Scientific Conference IPROFORUM 2013, 7.-8.11. 2013* (pp. 59-63). Jihočeská univerzita Ekonomická fakulta.
- Drábková, Z. (2015). Analysis of possibilities of detecting the manipulation of financial statements in terms of the IFRS and Czech accounting standards. *Acta universitatis agriculturae et silviculturae Mendelianae Brunensis*, 63(6), 1859-1866. doi:10.11118/actaun201563061859.
- Kyriazoglou, J. (2012). *Business Management Controls: A Guide*. USA: It Governance Publishing.
- Mathone, S. P. (2013). *Using Analytics to Detect Possible Fraud: Tools and Techniques*. UK: John Wiley and Sons Ltd.
- Puan Sri Datin Dr. Mary, et al (2012). *Principles and Contemporary Issues in Internal Auditing*, Second Edition. USA: McGraw Hill Book Company.

The Bookkeeping of Enterprising Natural Persons

Irena Honková, Michal Kuběnka, Zdeněk Brodský, Simona Činčalová

Abstract: *This paper deals with the form of bookkeeping that enterprising natural persons (individuals) use, and with searching of dependency between the form of bookkeeping and the field in which the enterprising natural person operates. From February to June 2015 there was a questionnaire survey conducted, which was attended by 749 respondents. The preference of particular forms of bookkeeping was revealed through the Friedman test. It has been found that the most common method of bookkeeping of enterprising natural persons are tax records, while a substantial proportion also has a double-entry bookkeeping. Surprisingly, the least used method is the simple evidence of income and subsequent determination of the income tax base of natural persons using lump-sum expenses. After the survey and statistical evaluation there was an argument within discussion on results that the lump-sum expenses have been currently used for tax optimization rather than for reduction of the administrative burden and thus, for the primary evidence purposes. As for the researched dependence between the form of bookkeeping and the selected business field, this dependence has been statistically validated by the test of independence. In the discussion of the results there are fields listed according to the most common form of bookkeeping.*

Key words: Bookkeeping · Enterprising natural persons · Tax records · Lump-sum expense · Field of activity · CZ-NACE

JEL Classification: M41

1 Introduction

In developed economies, small and medium enterprises (SME) represent nearly 90% of the total number of enterprises. The share of the group of this size in the gross national income is between 30 – 70%. (Synek, 2002) In the Czech Republic, the share of SME in the national economy is 99.81%. The share of natural persons in the SME is 86%. (Synek, 2002) Therefore, there is a very important component of so-called small businesses (Synek, 2002) consisting of an entrepreneur – a natural person. Sole proprietorship is the simplest legal form of business. These are low capital-intensive enterprises (Hrdý & Krechovská, 2013).

Entrepreneurs – natural persons in the Czech Republic have three options to deal with their bookkeeping.

- The first option is not to keep books at all, of course, under certain conditions (see below), and when calculating the tax liability, they can only use the total income minus so-called lump-sum expenses.
- The second option is to keep tax records.
- The third option is to keep a double-entry bookkeeping.

This benevolence of the state is to support the business activity by reducing administrative burdens.

The objective of this paper is to determine which form of bookkeeping enterprising natural person use and whether they generally prefer any form of bookkeeping.

Furthermore, the regression analysis of the form of bookkeeping for the areas of business activity, expressed by CZ-NACE activity codes, will be conducted.

Following the above objectives the following hypotheses have been formulated:

- H1: Enterprising natural persons do not prefer any form of bookkeeping.
- H2: There is no relationship between the form of bookkeeping and the CZ-NACE section of activities.

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1.1 Accounting systems

Historically, there have been three basic accounting systems: single-entry bookkeeping, cameral bookkeeping and double-entry bookkeeping. (Strouhal, 2012)

The single-entry bookkeeping is based on the monitoring of incomes and expenses of funds, which are recorded in the cash book. An economic result is recognized in this accounting system as the difference between incomes and expenses, and so the economic result is basically identical to the cash flow of the enterprise. Similar to the single-entry bookkeeping in the Czech Republic are so-called tax records, which focuses mainly on tax revenues and tax expenditures. (Strouhal, 2012)

Tax records are primarily records of the taxpayer's incomes and expenses within his business activity. In addition to the monitoring of incomes and expenses in chronological order, tax records include the evidence of tangible (and intangible) assets, receivables and payables, as well as creation of necessary reserves for repairs of tangible assets. (Vančurová & Láchová, 2009)

The cameral bookkeeping is a specific historical form of bookkeeping used in organizations and public authorities. It monitors incomes and expenses of these entities. (Strouhal, 2012)

The double-entry bookkeeping is based on the capture of accounting information by double-entry method. The property is viewed both in terms of the form, and in terms of sources of its coverage. (Strouhal, 2012)

The amendment to Act no. 563/2001 Coll. effective since January 1st, 2004 canceled the single-entry bookkeeping and implemented the term „bookkeeping“, which refers only to the double-entry bookkeeping. (Kovanicová, 2008)

In order to distinguish the double-entry bookkeeping from the general concept of bookkeeping (such as management of business operations), we will continue to use the term double-entry bookkeeping in this paper.

The obligation to keep the double-entry bookkeeping applies to legal persons based in the Czech Republic, foreign legal persons doing business in the Czech Republic and to natural persons (domestic and foreign), who are accounting units. They are: (Ryneš, 2013)

- a) natural persons registered in the commercial register,
- b) natural persons whose turnover according to the VAT Act exceeded the amount of 25 mil CZK in the immediately preceding calendar year,
- c) natural persons who keep double-entry bookkeeping at their sole discretion,
- d) natural persons who are members of associations without legal personality,
- e) other natural persons who have an obligation to keep books imposed by special legislation.

1.2 Evidence and taxation of incomes from natural persons

Incomes from business and other self-employment are one of the partial income tax bases of natural persons. (Vančurová & Láchová, 2009)

Incomes of individuals are taxed by personal income tax (PIT) as part of the partial tax base no. 2 from business and other self-employment pursuant to the Act no. 586/1992 Coll., on income taxes, § 7. (Hrdý & Krechovská, 2013)

Business incomes are incomes from such activities carried out by the entrepreneur in his own name and for his own account. (Vančurová & Láchová, 2009) These are: incomes from agricultural production, incomes from trade and incomes from other business under a special law, e.g. doctors, lawyers, auditors, tax advisers, etc. As business income we consider also the profit share of a partner of a general partnership and of a general partner of a limited partnership.

A taxpayer reduces business incomes by expenses spent for achieving, securing and maintaining the incomes. He may decide to account the expenses. Then, to be able to determine the partial tax base, he keeps books or tax records. (Vančurová, Láchová, 2009)

An enterprising natural person for determining the tax base from business must: (Křemen, 2014)

- a) take records of achieved incomes and incurred expenses or
- b) keep books and tax achieved economic result or
- c) determine the expenses using so-called lump-sum expenses.

The lump-sum expenses are very popular and common way of determining costs or expenses of the enterprising natural person. They are the expenses determined by a percentage from achieved taxable incomes. (Hnátek & Zámeck, 2010)

Based on the law on income tax, an amount of lump-sum expenses differs for particular types of activities. An entrepreneur in agricultural production, forestry and water management can apply the lump-sum expenses at 80% of incomes, the same percentage can apply a tradesman if he has income from a craft business. In case of a non-craft business, the lump-sum expense is 60% of incomes. Other enterprising natural persons can apply the lump-sum expenses at 40% of their taxable incomes. (Hnátek & Zámeck, 2010)

The lump-sum expenses can be applied by a taxpayer even in the case he keeps books as an entrepreneur. Then, he taxes incomes according to his bookkeeping and as expenses he applies the lump-sum expenses as a percentage of incomes, not revenues. Thus, he is based upon the application of the lump-sum expenses taken from income records received from 1.1. to 31.12. of the tax year, including received advance payments. (Hnátek & Zámeck, 2010)

This method of determining the tax base has already been strictly targeted at tax optimization and the partial aim of this paper is to determine whether this kind of misuse has been really applied in practice.

2 Methods

In order to collect data, there was a questionnaire survey conducted from February 2015 to June 2015, financial period 2014. The respondents were enterprising natural persons not registered in the commercial register, whose turnover has not exceeded 25 mil. CZK. i.e. those who can make decisions on which form of bookkeeping they use. A total of 759 respondents participated, 10 of whom were excluded due to inconsistent information. The respondents should provide their names, address, company number, their core business field and the form of bookkeeping.

The data were then entered and processed in Excel and Statistica. Fields of activity were given two-digit CZ-NACE code, and during the subsequent statistical processing activities were summarized by designations of sections A-S.

Hypothesis H1: The enterprising natural persons do not prefer any form of bookkeeping was tested through a statistical non-parametric Friedman test.

Friedman test verifies that the random variables $Y_{i1}, Y_{i2}, \dots, Y_{ik}$ (in this case, various forms of bookkeeping Y_{i1}, Y_{i2} and Y_{i3} are identical). The test criterion is a random variable (Kubanová, 2004):

$$Q = \frac{12}{IJ(J+1)} \sum_{j=1}^J (\sum_{i=1}^I R_{ij})^2 - 3I(J+1) \quad (1)$$

wherein:

I is the number of respondents (749),

J is the number of characters – classes (3),

R_{ij} is the order. (The selected form of bookkeeping has order 1, the other two have order 2.5).

The critical area is expressed as:

$$W = \{Q: Q > \chi^2_{2, J-1, \alpha}\} \quad (2)$$

For $I = \infty$ and $J = 3$ the value of the critical area is 5.99. (Linda, 2006)

Hypothesis H2: There is no relationship between the form of bookkeeping and the CZ-NACE section of activities was verified by a statistical test of independence.

The test of independence verifies that the random variables X and Y are independent. The random variable X is the form of bookkeeping, the random variable Y is the section of activities by CZ-NACE. The test of independence has been carried out in three steps. The first step is to calculate the marginal frequencies, i.e. to create totals of rows and totals of columns.

The second step is to calculate the theoretical frequencies: (Linda, 2006)

$$\frac{n_{i \cdot} \cdot n_{\cdot j}}{n} \quad (3)$$

wherein

$n_{i \cdot}$ is the sum of the i -th row,

$n_{\cdot j}$ is the sum of the j -th column,

n is the total number (749).

The third step is to calculate the values for each pair of indices i, j (Kubanová, 2004):

$$\frac{(n_{ij} - \frac{n_i \cdot n_j}{n})^2}{\frac{n_i \cdot n_j}{n}} \quad (4)$$

wherein:

n_{ij} is the value of the i -th row and j -th column,

n_i is the sum of the i -th row,

n_j is the sum of the j -th column,

n is the total number (749).

The test criterion has the form (Kubanová, 2004):

$$\chi^2 = \sum_{i=1}^r \sum_{j=1}^s \frac{(n_{ij} - \frac{n_i \cdot n_j}{n})^2}{\frac{n_i \cdot n_j}{n}} \quad (5)$$

wherein:

r is the number of rows (749),

s is the number of columns (3),

n_{ij} is the value of the i -th row and j -th column,

n_i is the sum of the i -th row,

n_j is the sum of the j -th column,

n is the total number (749).

Critical thresholds $\chi^2_{\alpha, (r-1)(s-1)}$ are presented in statistical tables, e.g. Linda, (2006).

3 Research results

As already mentioned, the main objective of this paper was to determine which form of bookkeeping is most frequently used by enterprising natural persons.

This analysis was compiled in Table 1. It contains particular sections of CZ-NACE (CZSO, 2014) activities and answers about the forms of bookkeeping used by the relevant enterprising natural person. There are three missing sections O – Public administration and defense; compulsory social security, Section T - Activities of households as employers; activities of households producing undifferentiated goods and services for their own use and Section U – Activities of extraterritorial organizations and bodies, since there was no respondent from any of these sections.

The table includes the totals of respondents by given sections in order to make it clear how many respondents from given sections participated in the questionnaire survey.

The most important result of this analysis shows the last row of the Table 1. It clearly shows the representation of the various forms of bookkeeping. The most common form of bookkeeping for natural persons is the tax records. It is kept by 321 persons of the total number of 749, which is 43%. The second most common form is the double-entry bookkeeping, which is kept by 34% of respondents (that means 258 of 759). The least used option for natural persons is the option to not keep books at all and record only their incomes (22% of respondents, that means 170 of 759).

Table 1 The analysis of the form of bookkeeping that enterprising natural persons use

Section CZ-NACE	Records of income	Tax records	Double-entry bookkeeping	Together
A – Agriculture, forestry and fisheries	18	31	16	65
B – Mining and quarrying	0	0	1	1
C – Manufacturing	16	46	32	94
D – Electricity, gas, steam and air conditioning	2	3	5	10
E – Water supply, activities sewerage, waste management	0	2	0	2
F – Construction	25	61	38	124

G – Wholesale and retail trade, repair of vehicles	23	49	51	123
H – Transportation and storage	2	10	20	32
I – Accommodation and food service	8	21	23	52
J – Information and communication	3	5	1	9
K – Financial and insurance	17	11	12	40
L – Real estate activities	2	4	1	7
M – Professional, scientific and technical activities	17	24	27	68
N – Administrative and support activities	10	10	4	24
P – Education	1	5	3	9
Q – Human health and social care	1	2	6	9
R – Arts, entertainment and recreation	4	7	3	14
S – Other activities	21	30	15	66
Together	170	321	258	749

Source: Own processing

Given that none of these forms of bookkeeping is negligible (the proportions represented 22% - 34% - 43%), it is necessary to perform a statistical test where these preferences would be tested in terms of their significance.

The hypothesis H1 has been tested using Friedman test (1) (2): Enterprising natural persons do not prefer any form of bookkeeping. (see Figure 1)

Figure 1 Calculation of the Friedman test in Statistica

Variable	Friedman's test ANOVA chi-kv. (N = 749, sv = 2) = 46,08011 p = ,00000 C = ,03076 r = ,02947			
	Average order	Sum of order Rij	Average	Standard deviation
not to conduct accounting	2,159546	1617,500	2,159546	0,628729
tax records	1,857143	1391,000	1,857143	0,742804
double - entry bookkeeping	1,983311	1485,500	1,983311	0,713264

Source: Own processing

$$Q = \frac{12}{3 * 749 (3 + 1)} (1617,5^2 + 1391^2 + 1485,5^2) - 3 * 749(3 + 1) = 135372$$

The value of the test criterion fell into the critical area. H1 hypothesis was rejected. It means that statistically there is a preference in the selection of the form of bookkeeping.

Subsequently, it has been examined whether the selected form of bookkeeping relates to the section of activities, for example if there are any fields of activity where enterprising natural persons choose the double-entry bookkeeping and any fields of activity where they prefer the lump-sum expenses, record only their incomes and thus eliminate administrative burden.

Therefore, the hypothesis H2 has been tested: There is no relationship between the form of bookkeeping and the CZ-NACE section of activities.

Testing was carried out using the test of independence (5). Its calculation was based on Table 1, based on which, the theoretical frequencies were calculated (3) see Table 2.

Table 2 Calculation of the theoretical frequencies

Section CZ-NACE	Records of income	Tax records	Double-entry bookkeeping
A – Agriculture, forestry and fisheries	14.75300401	27.85714	22.38985
B – Mining and quarrying	0.226969292	0.428571	0.344459
C – Manufacturing	21.33511348	40.28571	32.37917
D – Electricity, gas, steam and air conditioning	2.269692924	4.285714	3.444593
E – Water supply, activities sewerage, waste management	0.453938585	0.857143	0.688919
F – Construction	28.14419226	53.14286	42.71295
G – Wholesale and retail trade, repair of vehicles	27.91722296	52.71429	42.36849
H – Transportation and storage	7.263017356	13.71429	11.0227
I – Accommodation and food service	11.8024032	22.28571	17.91188
J – Information and communication	2.042723632	3.857143	3.100134
K – Financial and insurance	9.078771696	17.14286	13.77837
L – Real estate activities	1.588785047	3	2.411215
M – Professional, scientific and technical activities	15.43391188	29.14286	23.42323
N – Administrative and support activities	5.447263017	10.28571	8.267023
P – Education	2.042723632	3.857143	3.100134
Q – Human health and social care	2.042723632	3.857143	3.100134
R – Arts, entertainment and recreation	3.177570093	6	4.82243
S – Other activities	14.9799733	28.28571	22.73431

Source: Own processing

In the third step, the values according to the relationship (4) have been calculated, see Table 3.

Table 3 Calculation of the values for the test criterion

Section CZ-NACE	Records of income	Tax records	Double-entry bookkeeping
A – Agriculture, forestry and fisheries	0.714632965	0.354579	1.823604
B – Mining and quarrying	0.226969292	0.428571	1.24756
C – Manufacturing	1.334112233	0.810537	0.00444
D – Electricity, gas, steam and air conditioning	0.032045865	0.385714	0.702345
E – Water supply, activities sewerage, waste management	0.453938585	1.52381	0.688919
F – Construction	0.351260568	1.161674	0.520027
G – Wholesale and retail trade, repair of vehicles	0.8660991	0.261711	1.758452
H – Transportation and storage	3.813752651	1.005952	7.311457
I – Accommodation and food service	1.225027639	0.074176	1.44535
J – Information and communication	0.448605984	0.338624	1.4227
K – Financial and insurance	6.911271696	2.20119	0.229534
L – Real estate activities	0.106432106	0.333333	0.825944
M – Professional, scientific and technical activities	0.158911883	0.907563	0.546179
N – Administrative and support activities	3.805106155	0.007937	2.202423
P – Education	0.532266115	0.338624	0.003234
Q – Human health and social care	0.532266115	0.89418	2.712537
R – Arts, entertainment and recreation	0.212864211	0.166667	0.688709
S – Other activities	2.419278111	0.103896	2.631247

Source: own processing

Individual values in Table 3 have been summed (5) and the value of the test criterion has been determined as follows $\chi = 62.2082$. The critical threshold is $\chi_{20.05, 35} = 49.8018$ (Linda, 2006).

Since the value of the test criterion 62.20 is greater than the critical threshold 49.80, the H2 hypothesis has been rejected.

The relationship between the section of CZ-NACE activities and the form of bookkeeping has been proved.

4 Conclusions

The hypothesis H1: Enterprising natural persons do not prefer any form of bookkeeping, was rejected.

The hypothesis H2: There is no relationship between the form of bookkeeping and the CZ-NACE section of activities was rejected.

The survey conducted and subsequent evaluation using statistical tests has shown that enterprising natural persons most often choose the form of tax records, which replaced the original single-entry bookkeeping. This form was chosen by 43% of respondents. The popularity of this form of bookkeeping lies probably in the fact, that enterprising natural persons are able to keep the cash book by themselves, without the need of professional education. On the other hand, 34% of respondents keep the double-entry bookkeeping voluntarily, which already requires professional education and therefore they have to employ an accountant or to use the services of external accountants.

The option of primary evidence of only incomes and the use of the lump-sum expenses to determine the income tax base is used only by 22% of enterprising natural persons. Given that the applicable tax legislation allows to keep tax records while (under certain conditions) to apply the lump-sum expenses when calculating the tax base, it is evident that this tool is not used to reduce administrative burden, as originally intended, but for the tax optimization of enterprising natural persons. Few years ago, it has been proven by the fact that the lump-sum expenses are used by nearly half of all enterprising natural persons (MFCR, 2010), but the survey showed that only 22% of them use them primarily, it means for the purposes of reducing the administrative burden. A quarter of enterprising natural persons keeps books, but due to their tax optimization they choose the lump-sum expenses for determining the tax base.

Furthermore, it has been tested whether the method of bookkeeping differs for the individual fields of activities. It has been found that the form of bookkeeping really depends on the field of activities.

The most common form of double-entry bookkeeping was observed in the following fields:

- B – Mining and quarrying,
- D – Electricity, gas, steam and air conditioning,
- G – Wholesale and retail trade, repair of vehicles,
- H – Transportation and storage,
- I – Accommodation and food service,
- M – Professional, scientific and technical activities,
- Q – Human health and social care.

The most common method of bookkeeping just through the incomes evidence is popular for K Section – Financial and insurance and N – Administrative and support activities, while N - Section had the same number of respondents also in the form of tax records.

The fields where the most common form of bookkeeping are tax records:

- A – Agriculture, forestry and fisheries,
- C – Manufacturing,
- E – Water supply, activities sewerage, waste management,
- F – Construction,
- J – Information and communication,
- L – Real estate activities,
- P – Education,
- R – Arts, entertainment and recreation,
- S – Other activities.

The objective of this paper was to determine which form of bookkeeping is used by enterprising natural persons and whether this form relates to the field of activities in which these persons conduct their business.

Surprisingly, it has been found that enterprising natural persons do not choose the least administratively burdensome method through simple evidence of incomes, but they most often choose the tax records method, and double-entry bookkeeping also has a significant representation. It has been proven by the fact that bookkeeping of natural persons has also an important information function, and that it is not just a base for calculating tax obligations. In addition, a whole quarter of enterprising natural persons that keep books does not use bookkeeping for determining the income tax base from business and chooses the lump-sum expenses, which are more favorable to them.

Regarding the dependence of the form and the associated difficulty of bookkeeping on the section of national economy, this dependency has been statistically confirmed and discussed in chapter 5.

Acknowledgement

This article was created with the assistance of the Fund SGS 2016/023.

References

- Hnátek, M., & Zámek, D. (2010). *Daňové a nedaňové náklady*. Praha: ESAP.
- Hrdý, M., & Krechovská, M. (2013). *Podnikové finance v teorii a praxi* (1. ed.). Praha: Wolters Kluwer Česká republika.
- CZSO. (2014). *Klasifikace ekonomických činností: (CZ-NACE)* [online]. [08-03-2014], Available from: https://www.czso.cz/csu/czso/klasifikace_ekonomickyh_cinnosti_-cz_nace-.
- Kovaníková, D. (2008). *Abeceda účetních znalostí pro každého*. Praha: Polygon.
- Křemen, B. (2014). *100 legálních daňových triků:2014*. Praha: ESAP.
- Kubanová, J. (2004). *Statistické metody pro ekonomickou a technickou praxi*. Bratislava: Statist.
- Linda, B. (2006). *Kritické hodnoty a kvantily vybraných rozdělení pravděpodobností* (1. ed.). Pardubice: Univerzita Pardubice.
- Ryneš, P. (2013). *Podvojně účetnictví a účetní uzávěrka*. Olomouc: Anag.
- Strouhal, J. (2012). *Účetnictví 2012: Velká kniha příkladů* (1. ed.). Brno: BizBooks.
- Synek, M. (2002). *Podniková ekonomika* (3. ed.). Praha: C.H. Beck.
- MFCR. (2010). *Tiskové oddělení 2101* [online]. [08-03-2014]. Available from: <http://www.mfcr.cz/aktualne/v-mediich/2010/2010-11-23-vmediich-4598-4598>.
- Vančurová, A., & Láchová, L. (2009). *Daňový systém ČR: Cvičebnice*. Praha: VOX.

Control Methods for Detection and Identification of Fraud in Accounting

Marcela Hradecká

Abstract: *Detection of creativity, misstatements and fraud in business corporations can be performed in many ways. These always have the common feature and that is the human factor "creativity". Behavioral effects have implications for human decision-making, as well for defects in behavior. In the context of corporate organizational structure it is appropriate to establish an internal audit department, respective, controlling department, whose focus is the application of control methods for the prevention of irregularities and fraud in accounting, but also the creation and setting higher goals of strategic business corporations.*

Inspection activity is performed by financial and non-financial methods. In recent years, great emphasis is placed on environmental management of business corporations, which are reflected into the accounts, "environmental accounting". This paper focuses on the possibility of linking environmental strategic objectives of the firm implemented through methods Balance Scorecard and balance model DMFCA as a way to use environmental cost for inspection accounts of business corporations.

Key words: Fraud · Control Method · Balanced Scorecard · Environment Management · Environment Accounting

JEL Classification: M2 · M41 · M42

1 Introduction

Controlling activities in corporate processes referring to strategic objectives and accounting are ever more demanded. The required standards that include properly set profit and loss account and also the environmental protection tend to be more globalized in character. The management of business corporations has to react flexibly on the new demands and include them into the strategic priorities.

The Balance Scorecard Method is one of the possible implementations of the strategic objective into the organizational structure of the enterprise. It allows the involvement of all employees of the corporation into the fulfillment of the strategic objective without difference of the individual employee's profession or position. The unifying element during the application of the Balance Scorecard Method is „communication. Concurrent application of the Balance Scorecard Method with other control methods can provide an elaborated system which prevents the discrepancies but also fraud. Very important factor is the management approach to accounting and the degree of creativity of the employees. This paper analyzes the conjunction of the Balance Scorecard Method with the Detection Material Flow (Fraud) Cost Accounting Method DMFCA.

2 Methods

Commonly used expressions accountings are financial, managerial, cost, tax accounting etc. The new concept which slowly gets into the awareness of the entrepreneurial sphere is the “environmental accounting, “ aimed at the protection of the environment and proper disposal of waste stemming for production, including waster (faulty products.

Control activities for the detection of irregularities, mistakes and fraud are the task of the internal audit of the business corporations.

The internal audit commonly applied control activities include:

- Basic documents of the corporation - deed of foundation and amendments, changes and updates of these documents, records of the shareholders general meetings

- System of responsibilities for the management of the corporation and the conclusion of contracts (business and employment contracts)
- Following the rules of the corporate Codex if it was created
- Internal rules, procedures and directives
- Organizational structure and the circulation of accounting documents, system of approval of documents
- Transaction systems, namely purchases, sales, cashier transactions, salaries
- Organization of subsystems, software information system, archiving and back up of data
- Stock taking of assets and liabilities, both physical and in documents
- Control of the quality and production processes
- Confirmation letters for confirming receivables and liabilities and their heights
- Subsidies, donations and other contributions, documentation
- Compliance with valid legislation

In case of a specific audit the demands can be extended in view of the expected risks.

Both financial and non-financial methods are used for the control activities.

Financial Methods:

- Calculation methods
- Cost and activities assignment methods
- Managerial accounting analyses
- Financial analysis
- Analysis of profitability and return on investment
- Comparisons
- DMFCA model
- Non-financial Methods:
- Balance Scorecard Method „BSC“
- Competency models
- Non-financial performance measure models

The selected control method DMFCA - *Detection Material Flow Cost Accounting* (Kouřilová, 2013), detects material, energy, financial and legal balances with the aim to set the environmental costs in accounting books and accounting statements. This method can be used in production plants where apart from the product a side-product in the form of waste is also created. Material for the production taken from the warehouse is not completely (100%) consumed and the waste produced is not recorded in the accounting. This means that the material delivered from the warehouse is fully (100%) accounted into the production costs and distorts the calculation of products and setting of the product price.

The waste produced has, however, its value for further processing or use and can be resold as raw material for other subjects. The failure to record it and not to put the value of the waste into the accounts distorts the economic results and the bottom line of the company in the area of production costs and also lowers the margin and the added value from the sale of products. If the corporation does not record (file) the waste of production it establishes room for possible fraud and theft. At the same time the corporation fails to generate possible added profit from the sale of this. This means another distortion of the revenues of the corporation. It is therefore necessary to revise the flow of stocks especially in the area of materials and follow the flow simultaneously both in CZK (crown) units and natural units. Changes in accounting¹² which took place in 2016 led to changes of recording and accounting of the flow of stocks and corporation's own activities. The revenue approach accounting was cancelled and replaced by cost accounting. This means that revenue accounts in the accounting groups 61 a 62 „changes of the stocks from own activities,“ and they were replaced by cost accounts of the group 58 „changes in the stocks of own activity and activation.“ The rectifications in the cost area is more precise and do not distort the corporation's turnover. In addition the extraordinary profit/loss was completely eliminated which means the cancellation of extraordinary cost and revenue accounts.

The four basic balances of the DMFCA can be developed into strategic objectives of the business corporation not only to provide for the increase of the value of the corporation but for environmental aspects. The Balance Scorecard¹³ is suitable for the aiming, and management of corporate strategy. The main pillars of this method are finance,

¹² Zákon č. 563/91 Sb. o účetnictví

¹³ Kaplan, Robert. S. – David P. Norton: *The Balanced Scorecard. Translating Strategy Into Action*. Published 1996 by Harvard Business School Press, Boston, Massachusetts 02163, USA. ISBN 80-7261-037-4.

customers, inner relationships (employees) and education and training. All these pillars lead towards setting the strategic objectives of the corporation. DMFCA method helps to effectively apply the Balance Scorecard management method because it is based on precise recording of materials and waste and the Balance Scorecard method needs for its most effective implementation the most detailed evidence from the production and operation area.

3 Research results

The research conducted in production corporations showed that in 78% of the researched business corporations regular or occasional losses occur, that can be financially measured and that are caused by improper handling with the production process waste. Those corporations, where the Balance Scorecard or the DMFCA management methods were introduced, or where they are both used in a combination the financial losses as a result of poor material flow management do not occur.

On the basis of the research the authors recommended the use of the Balance Scorecard method to all production corporations as the most suitable method for the management of the corporation. This method also seems the most appropriate when applied to environmental strategic objectives.

The final question of the research: *Why should the business corporation select this strategic objective?*

The answer is simple. The motivation to increase future sales, profits of the corporation and the increase the value of the corporation. Provided the management of the business corporation decides to adopt the new strategy „*Absolut green factory*“ in a time and well planned manner it can fully influence the planned sales, costs and investment connected with the strategic plan in individual years and manage through it the cash flow of the corporation. If the management of the business corporation waits for the issued environmental directives and regulations of the European Union or alternatively for the more restrictive domestic legislation in the area of environment it may happen that the company will not be able to react in a short time to the tightened ecological limits or to the prohibition of some non-ecological packaging or the prohibition of dumping of this non-ecological packaging.

The results of the research can be presented on the following example: Application of the Balance Scorecard method on a production corporation which produces gloves.

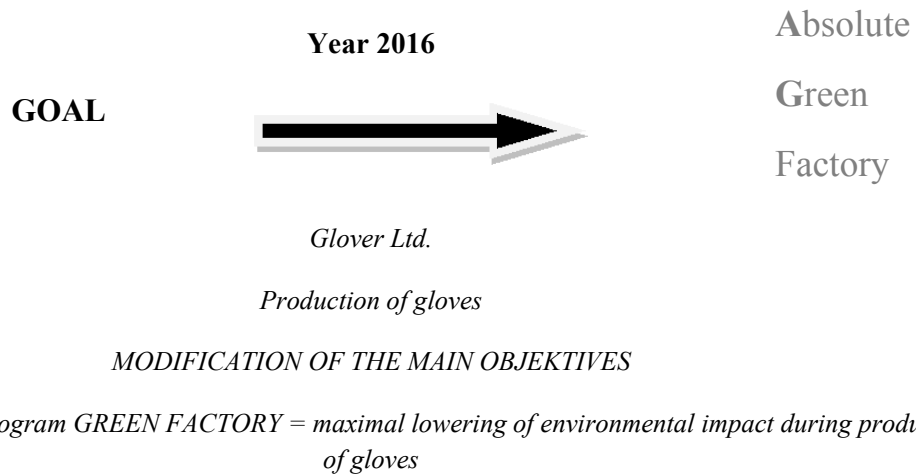
On the basis of data from financial profit and loss accounts, conducted analyses and audits the management of the business corporation received a negative report on the economic performance of the corporation. On the basis of the results it was decided to adopt the Balance Scorecard method. In the framework of the strategy a new major objective was selected and it was decided that the production corporation which produces leather gloves will become *absolute green factory*. It is therefore not a collection of tiny measures in the form of cost or investment cuts restrictions, on the contrary, it is an overall change of the approach to material, energy waste and natural resources management. Business corporations plan investment into heat pumps, weight control systems, new conveyor technologies and further training of the staff.

New directives, budgets, procedures and other instruments for reaching the target will be created to reflect on the individual tasks arising from the strategic objective.

Basic documents which were used by the corporation when setting the strategic objective for the Balance Scorecard method:

- Profit and Loss Final Accounts of the last five years
- Energy audit
- Marketing plan
- Sales and return on investment plan
- Financial and accounting audit
- Social audit
- Ecological audit

Figure 1 Strategic objective - Balance Scorecard method



Source: Author’s own research

Figure 2 Strategic Objectives of the production corporation according the major areas – Balance Scorecard method

FINANCE	CUSTOMER	EMPLOYEEES	TRAINIG
<ul style="list-style-type: none"> • Lowering of costs of transportation of the material by the instalation of new conveyors • Instalation of weight control system in the raw leather dispatch and fro the packiging line • Stock taking (accounting) of products in both monetary and natural units • Stock taking (accounting) of waste and faulty products in both monetary and natural units • Decommissioning of the gas boiler roomand the instalation of the heat pump of the air-air system for the heating of water and the production hall • Instalation of new water management recuperation of waret 	<ul style="list-style-type: none"> • Get attention of a new sector of the market for whichour leather waste is a raw material • Use more aggressive business conditions with customers who place larger orders (large order volumes) 	<ul style="list-style-type: none"> • Motivational part of the wage to discourage production of waste and faulty pieces • Preparation for the start of production of belts made of recycled leather • Prohibition of smoking on the whole premises • New obligatory directive on separation of waste and litter • All suppliers will receive new standard description of packiging for goods ordered by our companyRepairs of machines only in company’service station. • Daily recording of the electrical energx consumption of the machines • Purchaes of only ecological raw materials 	<ul style="list-style-type: none"> • Teaching of English in all administrative departments • Training on stock taking and accounting of waste • Training on ecological packiging for the purchasing department

Source: Author’s own data

Finance

The area of finance can be divided into 3 subareas: investment, financial per se and nonfinancial

- The installation of new conveyors of raw materials lowered the transportation costs it leads to a decrease of electricity consumption and the lowering of production costs.
- Decommission and dismantling of the gas boiler room and the installation of the heat pump, leads to a large decrease of energy consumption and to lowering of production costs.
- Installation of the weight control system of the raw materials dispatch and of semi-finished products for the sewing operators, leads to better control of the production material flow and handling and at the same time prevents loss of material.
- Stock taking (accounting) of waste in both weight units on the basis of control weighing, allows better stocktaking and accounting of stocks, semi-finished products and production environmental waste. The control is taken both in monetary and weight units.
- Installation of a new water management, leads to large savings of water. Water is recuperated for possible secondary use.

Customer

- New segment of market. Customers for whom our leather waste is a raw material. Registered (accounted) environmental waste becomes goods that can be sold to newly addressed customers and sales can be generated.
- Concentration on customers with higher volume of orders. It allows better planning of logistics, delivery of production inputs but also better use of the raw material during production. Production costs savings are reached.

Employees – internal relations

- Motivational part of the wage for keeping the quality of products, the amount of faulty products (spoilage) decreases.
- Preparation of production of a new product, the accounted environmental waste will be processed on the company premises.
- Separation of waste and litter, the corporate environmental codex is established.
- New standard for accepting raw material only in ecologically recyclable or disposable packaging, leads to protection of the environment.
- Repair and servicing of machines within the company, leads to saving of costs for the transport and reduction of down time in production.

Training

- Teaching of English for the staff, will allow reach more effectively not only the domestic market but also market abroad. The sales shall increase.
- Training on stock taking and accounting of waste shall make staff familiar with the corporate codex and the environment protection requirements and the proper registering and accounting of environmental waste of production.

The strategy of the business corporation Absolute green factory brings in the first stage big investment into new technologies. The management of the business corporation has to decide in close cooperation with the controlling department whether they will use foreign capital, for example a bank loan or their own capital for the investment. Another important economic consideration will be the calculation of the cost effectiveness of the investment and the rate of return of the investment. These planned calculations will be reflected in the production calculations because the savings in production costs (electricity, water and sewage, heating) will result in lower costs in the costs calculation.

Cost effectiveness of the investment :

$$R = \frac{\text{profit from the investment}}{\text{investment}_j} \quad (1)$$

Savings from production costs influence the value of the profit from the investment

Rate of return of the investment

$$N = t_x + (CF_1 : \dots : CF_x) \quad (2)$$

t – Number of years of repayment, CF – power of cash flow

Into the value of the power of cash flow are reflected the savings of production costs and also the lowering of overall costs reached by improved stock taking and accounting of waste on the stocks accounts.

Calculation formula for production:

Variable costs

Operating costs

Fixed costs

Margins

Price

Indirect and other costs in the calculation formula are influenced by lowering of operational environmental costs, energy and this way they influence the price of products. Further, there occurs the lowering of the value of the direct cost of the material for production by the reduction of environmental waste.

4 Conclusions

Control methods implemented into the internal organization of the business corporation allow improvement in the detection of discrepancies and in some cases even frauds. The investment into technology does not mean only a financial burden for the enterprise and the increase of debts of the corporation but can, when the strategic objectives are properly set lead to savings of long term operational costs and protect the environment which is currently a global trend.

„Failure to follow the global trends and passing the corporate strategic objectives can lead to bankruptcy of the business corporation as the enterprise cash flow shall be negative in the long run.“

References

- Kaplan, R. S., & David P. Norton, D. P. (1996). *The Balanced Scorecard. Translating Strategy Into Action*. USA: Harvard Business School Press, Boston. ISBN 80-7261-037-4.
- Kouřilová, J. (2013). Model DMFCA jako způsob užití environmentálních nákladů ke kontrole účetnictví v podniku. In *The International Scientific Conference INPROFORUM 2013*. ISBN 978-80-7394-440-7.
- Král, B. & et al. (2008). *Manažerské účetnictví*. 2. ed. Management Press, Praha. ISBN 978-80-7261-141-6.
- Valach, J. & et al. (1999). *Finanční řízení podniku*. 2. ed. Ekopress, Praha. ISBN 80-86119-21-1.
- Zákon č. 563/91 Sb. o účetnictví

Impacts of Corporate Social Responsibility Elements on Policy of Net Working Capital Management with respect to Business Performance in the Czech Republic

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Abstract: *The issue of asset and capital structure management in the corporations is, similarly to the issue of implementation of corporate social responsibility elements in the form of environmental management and occupational safety, a significant topic in the corporate environment of non-financial character in pursuance of gaining competitive advantage in the global marketplace. The question remains to what extent these two factors are involved in the determination of the economic performance of the company. Common base of both research topics is their high attractiveness for entrepreneurs, combined with inadequate number of empirical experience in corporate practice. The basis of the research is modelling the impact of the implementation of environmental management and occupational safety on the performance of businesses and the management of net working capital. Subsequently, the secondary effects on the riskiness of financial structure of companies surveyed, are examined, which is an important factor in investors' assessments. The paper presents empirical research that aims to quantify the links between environmental management, occupational safety and management of net working capital and subsequently quantify their impact on corporate economic performance, represented by the economic value added (EVA), all with regards to feedback connections. A prerequisite for modelling was a multivariate regression model whose explanatory variables were the assets structure, the capital structure and the ownership of certification standards OHSAS 18001 and ISO 14001. The model has been applied to a group of large companies based in the Czech Republic, operating in the automotive sector. As part of the results a positive influence of the ownership of certification standards on EVA performance has been expected.*

Key words: Corporate social responsibility · Net working capital · Economic performance

JEL Classification: M21

1 Introduction

Business environment that is strictly focused on efficiency and effectiveness generates a large amount of secondary effects on the environment in which it operates. It is now possible to register a significant growth of mainly negative consequences for society. Climate change, environmental pollution, ignorance of the law, ignorance of the social responsibility of the organization to employees and corporate environment. This list represents only a small part of the ethical problems that occur in the global environment. Aim of this paper is to quantify the links between environmental management, occupational safety and management of net working capital and the subsequent quantification of their impact on economic value added EVA.

Corporate social responsibility (CSR) as such is still the subject of extensive discussions of many studies (Greenfield, 2004; Maignan and Ralston, 2002; Mc Williams et al., 2006; Pearce and Doh, 2005), leading not only to do the right things, but also leading to better results (Bhattacharya and Sen, 2004). CSR concept is still interpreted in different ways. The most famous interpretation is presented in the Green Paper (European Union): "CSR is the voluntary integration of social and ecological aspects into everyday corporate operations and interactions with corporate stakeholders, which can be divided into primary, including owners, employees, customers, business partners, local communities and NGOs, and secondary, including competitors, the public, the media, civic and business associations and government institutions."

Generally, there are derived the common grounds that can be considered as the basic principles of CSR. Among them belongs:

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- voluntary initiative beyond the required legislation,
- improving the quality of life,
- sustainable development,
- communication with participants,
- integration of social and environmental values into everyday business practices.

As consequence, CSR has shifted from the ideological framework to the reality and many experts deem necessary for the corporations to define their role in society in terms of social and ethical standards in business (Pinkston and Carroll, 1994). Although corporations are still trying to maintain and demonstrate its commitment to fulfilling CSR, many of them are struggling with the implementation of this effort (Lindgreen et al., 2009). Although there is no single, universally accepted definition of CSR activities, Kunz (2012) generally divides activities into three areas: economic, social, and environmental. These are the environmental and social CSR fields that are the subject of the present paper, about working capital and thus with the performance of corporations.

The automotive industry is currently a powerful global industry, which is mainly affected by the climate change, decrease in natural resources, energy security, demographic changes and employment, innovations, and new green technologies. In the Czech Republic, there is the backbone of the automotive industry Skoda Auto, TPCA, Hyundai, Tatra, Avia, Iveco and SOR. The largest share in the performance of the automotive industry is mainly formed by suppliers of components and spare parts. The significance of this sector can be confirmed by the production of more than 16 million cars on EU territory for the year 2015, in the Czech Republic these are 1.3 million cars (European Automobile Association Manufacturers', 2015). The challenges and opportunities given are associated with the concept of CSR, which is in the case of the automotive industry closely linked to sustainable development (Dunphy et al., 2014).

A lot of norms and standards have been created by the government and non-governmental organizations (as per the International Organization for Standardization, IOS) to help implement the CSR strategy. In the automotive industry, the management systems are usually certified by ISO 9001, ISO 14001, and ISO/TS 16949. Implementation of ISO 9001 is focused on the quality of the system, or more precisely, it aims to achieve a competitive advantage through the quality control. Certification of ISO 9001 demonstrates the company's commitment to deliver quality. The norm is not intended only for the automotive industry, but it can be used in all areas of production and services. In the automotive industry, the industry standards usually accompany the norm, such as QS 9000 or VDA (the standard that focuses on the system of the quality management of the suppliers). ISO/TS 16949: 2009 is the new departmental standard, designed exclusively for the system of quality management in the automotive industry, which unifies the requirements for a quality management system in the industry. This standard contains the full text of ISO 9001: 2008 and is supplemented by more specific requirements of the automotive industry.

The most commonly voluntarily used standard in the automotive industry is per Czech technical standards ISO 14001. Its principle is to promote environmental protection and prevention from its pollution. The standard was approved by the European Committee for Standardization (ECS in English, CEN in French), which is a non-profit organization dealing mainly with the support of the European economy, global trade, prosperity of the European population and the environment.

ISO 14001 is per IOS based on the methodology of Plan-Do-Check-Act (PDCA):

- *Plan*: establish the objectives and processes necessary to deliver results in line with the organization's environmental policy.
- *Do*: apply processes.
- *Check*: monitor and measure processes in relation to environmental policy, objectives, the targets, legal requirements, and other requirements and show results.
- *Act*: take actions to continually improve performance of the environmental management system.

A very important standard implemented in the automotive industry, which is not very well known, is ISO 18001, OHSAS: 2007 - Occupational Health and Safety Management Systems. The standard represents a certification of management systems of health and safety at work. OHSAS 18001 specifies requirements for occupational safety and health (OSH), and thereby it creates conditions for corporations to responsibly manage risks and improve the safety and health of their employees. The benefit from the implementation of this standard is to help minimize the risks to employees, improve the current system of OSH, gain confidence, demonstrate care, and others (OHSAS 18001 B., 2007).

About the introduction of ISO standards 14001 and OHSAS 18001 as non-financial factors of CSR, there are hidden impacts on net working capital about final business performance. These impacts on net working capital management result mainly from the need for innovation and investment to obtain the above certifications. In relation with decisions

on such investments is also linked its financing strategy, which consequently affects the policy of net working capital management. It is therefore necessary to manage working capital with respect to the implementation of ISO standards and their subsequent compliance.

In relation to working capital management the companies generally consider two basic management policies, namely aggressive and moderate (Nazir and Afza, 2009 A).

The first management approach is the aggressive policy when a business tends to have the smallest ratio of liquid assets, which are financed by short-term resources. This way leads to a shortening of turnover cycle and the release of tied funds. Furthermore, due to the aggressive policy of working capital management, a growth of short-term debt ratio appears, which supports the use of this approach since short-term debt is considered as the cheapest source of financing. Another effect can be seen in increase of debt financing and subsequently in increase of financial leverage, which improves the return on equity. On the other hand, according Birghama and Ehrhardt (2014), the aggressive policy of working capital management is not a sustainable strategy in the long term, which is also confirmed by Besley and Birgham (2012), since the aggressive policy significantly reduces the liquidity position of the company. From another point of view, Brooks (2013) points out that business improvement, the shortening of the turnover cycle must necessarily harm either suppliers or customers.

The aggressive policy of working capital management is ultimately targeted to maximize profitability from the perspective of the owner of the company at a price higher than a risk of financial structure. In contrast, the moderate policy of net working capital management aims to multiple interest groups, since it tries to lower a risk of financial structure and it is a cost of other sources. This in turn leads to a greater commitment by the financial resources of the company's assets. On the other hand, this situation is favourable from the viewpoint of the customer, since it may result in increased sales. On the liabilities side of the balance sheet, the moderate policy of working capital management strives for a greater proportion of long-term resources, allowing businesses to benefit from the discount.

Režňáková (2010) examines net working capital from the perspective of solvency of the company. By optimizing the components of net working capital, per the authors, it is affected the liquidity of the company and thus the risk of the investor, which influences the weighted average cost of capital. This confirms the view Pavelková and Knápková (2009), who state that the working capital management items on the liabilities side, affects debts of the company and thus the risk. This in turn leads to a reduction in the average cost of capital and thus it leads to increase in the economic value added. On the other hand, this results in a lower proportion of debt financing and to a higher proportion of 'more expensive' equity, which in turn will lead to an increase in the weighted average cost of capital. Generally, in this area, the influence on the direction cannot be clearly determined.

Režňáková (2010) further states that the aggressive policy of WCM increases the performance of the company from the perspective of the owner, because the effect of increasing the return on invested capital will exceed the effect of lower profit due to a decline in sales. This is also confirmed by Vahid et al (2012). Bellouma (2011) affirms that a reduction in turnover cycle be the method of financing small and medium enterprises in developing markets. This statement is in accordance with Váchal and Vochozka (2013), who in this context emphasize that money tied up in current assets must be assessed in terms of opportunity cost. This issue is further elaborated by Lind et al (2012), who reported that the growth of working capital would lead to a greater commitment of capital as such, and would reduce the return on investment. These authors also argue that changes in average collection period are largely offset by changes in creditors payment period and a major influence on the development of cash conversion cycle can be seen in inventory turnover. This leads to the idea that the working capital management is essential to focus on, especially in case of just inventory management. Bei and Wijewardana (2012) believe that it is highly important to be focused on proper working capital management. But as stated by Režňáková (2010), it is necessary to consider differences between sectors. Per Filbecka and Kruger (2005) these differences between the sectors tend to be constant in time.

Banos-Caballero, Garcia-Teruela Martínez-Solano (2014) suggest that reducing levels of working capital may have a positive effect on the performance of businesses to a certain point. Due to their findings, the size of the item is affected by the limitations of the company in attracting external funding. Per the authors, the most important part of restricting access to external sources is their price, which becomes part of the cost of capital. With this idea agrees Nazira and Afza (2009 A).

Hill, Kelly and Higfield (2010) empirically verify the impact of the cost of capital on investment in working capital. Per their research, increase in the cost of capital reduces these investments and leads businesses to a more aggressive approach in managing payables, receivables, and inventory. Vochozka with Mulač (2012) also resemble a conflict of interest between owners, who prefer a more aggressive approach, and managers who prefer a more moderate policy, which is also confirmed by Růčková with Roubickova (2012) and Fotr (2012).

Režňáková (2010) further highlights the impact operationally necessary net working capital to the company. Per the author if the need is negative, or vice versa is too large, it leads to a decrease in the value of the company. Pirvutoiu (2009) concludes that a company having a negative net working capital cannot meet its obligations and a positive value of net working capital is therefore a condition of its continual existence.

However, other authors are not so strict and claim that it is a risky way of financing, which in turn will probably lead to higher costs of capital. But the question remains whether this theory was confirmed by empirical research examining the behaviour of enterprises and the development of their profits. Generally, the short-term bank loans generate higher financial costs. This is probably due to the asymmetry in securing commitments to creditors. Furthermore, zero cost of trade payables are also questionable. It can be expected that with the use of trade credit is connected the rejection of discounts (discounts for prompt payment or earlier). Per Brooks (2013), the unused discount in the light of opportunity costs can be understood as an interest on commercial credit, and it must be weighed against other financing costs.

Working capital management influences the business performance through several channels. It affects the amount of revenues, costs, and the size of financial leverage. Selected performance targets then affect policy of working capital management, and the method of its optimization.

Banos-Caballero, Garcia-Teruela Martínez-Solano (2014) were concerned in finding an optimal level of working capital. Their model is largely influenced by the fact whether enterprises have limited access to external sources of funding or not. These authors argue that the relationship between business performance and the level of working capital has a concave shape. Based on this finding, looking for a local extreme determines the optimal level of current assets. Their assumption is based on two contradictory phenomena. On the one hand, a growth of levels of working capital will lead to higher sales and better opportunities for the use of early payment discounts from liability and thus will lead to an increase in corporate performance. On the other hand, a larger volume of assets creates a greater need for financing resources. With this issue are naturally associated costs of these resources, which will grow with increasing debt of the company. This effect in turn leads companies to lower levels of working capital and the stronger, the more access to external resources limited.

Similarly, Nazir and Afza (2009 B) examined the impact of WCM policy on the company's profitability. The results of their model indicate that with the growth of aggressive asset management, declines the corporate profitability measured by return on assets. On the passive said we can see the same effect. With increasing aggressiveness, profitability decreases. On the other hand, the aggressive management policy of liabilities associated value growth Tobin's Q. It could be said that investors prefer companies that use more short-term debt.

The same conclusions came from Tufail (2013) who noted the same direction of the management of assets and liabilities on return on assets. The author also mentioned the impact of debt equity firm on its profitability, which recorded a negative correlation here.

2 Methods

The research used secondary data of comparably sized businesses within one sector. The choice of this method seems to be necessary because diversity in terms of companies' size generates different levels of working capital held between sectors and leads to different performance measurement in relation to the selection of non-financial factors about CSR. The secondary data was analysed and the results were subjected to further research exploitation.

The research of secondary data is related to a specific sample of large manufacturing businesses based in the Czech Republic. Based on the statistical classification of economic activities CZ NACE, the businesses engaged in the manufacture of motor vehicles and trailers were selected (the code designation CZ NACE 29). The Amadeus database was used for the collection of secondary data.

The criteria for the selection of business entities from the Czech Republic were as follows:

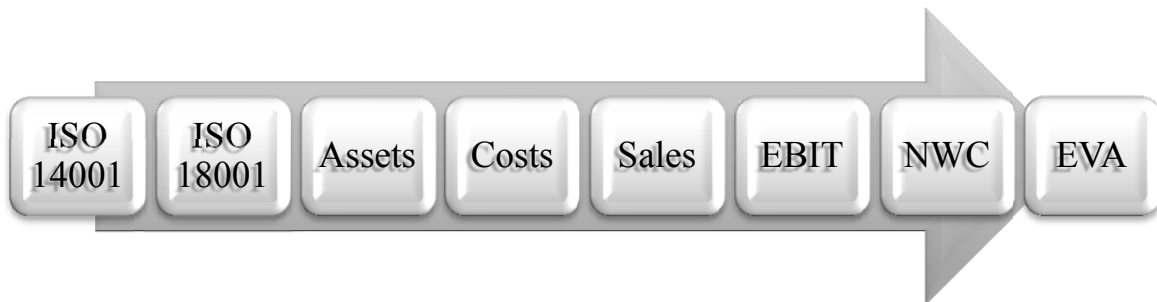
- active business entity,
- large business,
- a limited liability company, joint stock company,
- CZ NACE 29,
- based in the Czech Republic.

About the identification of a suitable sample of businesses, the selection of companies with incomplete data entries or extreme data values was made. The business entities publishing the data about the size of current assets, total assets, short-term debts, and total debts remain in the sample. These factors were determined to capture the structure of assets

and liabilities as explanatory variables. The research was conducted on data for the year 2013 and the total sample consists of 168 businesses based in the Czech Republic.

For the analysis of input data, a multivariate regression analysis was used, which aims to quantify the impact of selected explanatory variables on the economic performance of enterprises, represented by the economic value added (EVA). The explanatory variables of regression model were the structure of assets and the structure of liabilities in the form of elements of net working capital, the return on sales (ROS) calculated from EBIT, the size of weighted average cost of capital WACC, and the ownership of certification standards ISO 14001 and ISO 18001 OHSAS, which represents a dummy variable as a proxy for the implementation of non-financial factors of CSR in the form of environmental management and occupational safety system. As an explained dependent variable, the economic value added EVA was chosen. The following figure explains the logical links between different variables in absolute terms.

Figure 5 Logical links between variables



Source: Own processing

Economic value added was calculated by the following equation:

$$EVA = EBIT \cdot (1 - T) - C \cdot WACC \quad (1)$$

Where:

EVA is Economic value added [CZK]

EBIT is Earning before interest and taxes [CZK]

T is percentage of taxes [%]

C is amount of capital [CZK]

WACC is Weighted average cost of capital, where cost of equity was obtained by CAPM model.

Based on the specified dependent and explanatory variables, the following functional relationship was analysed, in which the applications of economic verification set the expected signs. The authors assume that the implementation of the certification standards ISO with respect to CSR may lead to an increase of economic value added EVA, which would be confirmed by the positive correlation between the two variables. A positive impact on EVA is expected in the case of following variables: Assets (+), Sales (+), EBIT (+). In the case of NWC variable both positive and negative influences are supposed (+, -). On the contrary, a negative correlation would be found in the case of the variable Costs representing the WACC (-). The explanatory variables ROS (+) and Capital (+) are used to capture the structure of assets and liabilities, in which the authors suggest a positive correlation to the EVA. The functional relationship is determined as follows:

$$EVA = f(\text{Capital, ROS, WACC, } d_ISO_14001, d_ISO_18001), \quad (2)$$

$$\text{where } f(+\text{Capital, } +\text{ROS, } -\text{WACC, } +d_ISO_14001, \pm d_ISO_18001). \quad (3)$$

Based on the results, the model was verified in the context of economic verification, or alternatively, statistically insignificant variables reduced it. Thus, the model verified belongs among the desirable BUE or BLUE economic estimates.

Within the data analysis the following multidimensional model was determined:

$$EVA = \beta_0 \text{const.} + \beta_1 \text{Capital} + \beta_2 \text{ROS} - \beta_3 \text{WACC} + \beta_4 d_ISO_14001 \pm \beta_5 d_ISO_18001 + \varepsilon, \quad (4)$$

where:

<i>EVA</i>	represents the economic performance of businesses, relatively expressed in sales [%],
<i>const.</i>	is a constant term of the regression model,
<i>Capital</i>	represents the structure of liabilities, relatively expressed in sales,

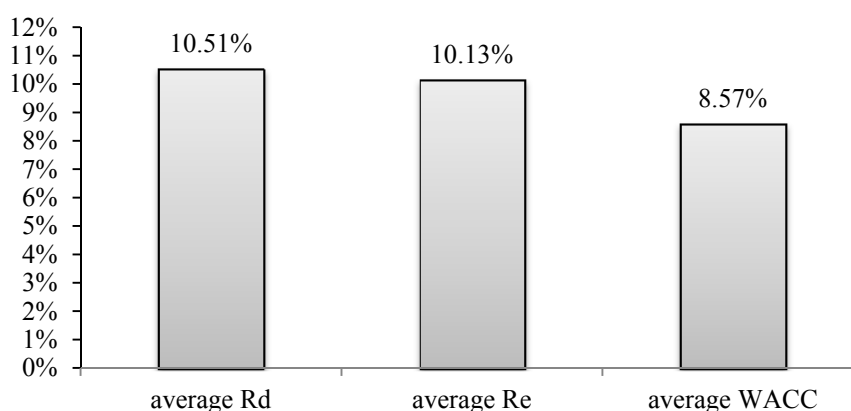
<i>WACC</i>	is the weighted average cost of capital,
<i>ISO 14001</i>	as a dummy variable representing a non-financial factor for CSR in the form of environmental management,
<i>ISO 18001</i>	as a dummy variable representing a non-financial factor for CSR in the form of work safety,
ε	is the error term additively connected.

The multivariate regression model and its verification was conducted using statistical software Gretl. The final form of the model verified is presented in the section of research results.

3 Research results

When analysing the input sample data using the arithmetic mean, it was found that for the automotive sector the mean value of cost of debt is 10.5% and the mean value of cost of equity is 10.13%. The average value of the weighted average cost of capital is then 8.5%. The economic value added achieved rather negative figures in average absolute value of -55.94 mil. CZK. Based on the analysis, it is evident that large enterprises in the automotive industry do not create value, but rather decrease it. The following figure shows the average cost of financial resources of the business.

Figure 6 Average cost value of the financial resources



Source: Own processing

Based on obtained data and illustrated diagrams XY, a linear progression between regression model variables was expected. Furthermore, it was assumed that a policy of asset and capital structure management in the form of components of working capital, which were relatively expressed in sales, would show some dependence on EVA (whether positive or negative) and concurrently, elements of non-financial factors in the form of ISO 14001, representing environmental management as an element of social responsibility, would have a positive dependence. The resulting model is presented in the following table.

Table 3 Model A

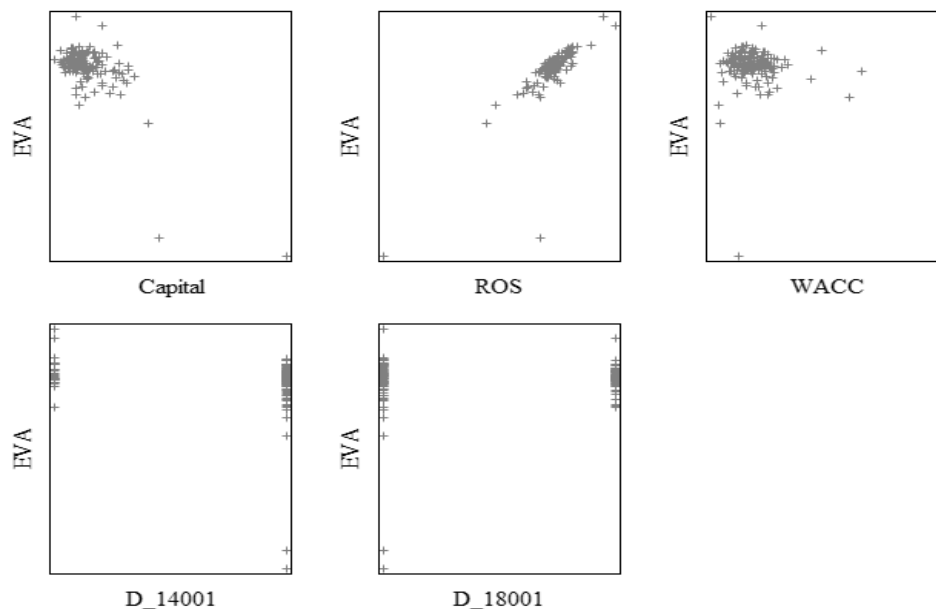
	<i>Coefficient β</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
Const.	0.0741311	0.00601615	12.32	5.36e-025	***
Capital	-0.0935856	0.00216805	-43.17	2.04e-090	***
ROS	0.892298	0.00467498	190.9	1.25e-191	***
WACC	-0.884501	0.00264983	-18.89	1.10e-042	***
D_14001	0.00747528	0.00236856	2.821	0.0054	***
D_18001 OHSAS	-0.00155813	0.00194162	-0,8025	0.4235	
Sum squared residual		445.1963	Standard. error of regression		1.662887
R-squared		0.999998	Adjusted R-squared		0.999998
F(4, 162)		17194492	P-value(F)		0.000000
Log-likelihood		-318.8363	Akaike criterion		649.6725
Schwarz criterion		668.3805	Hannan-Quinn		657.2657
<i>Statistics based on the original data</i>					
Mean dependent var		0.343239	S.D. dependent var		4.821363

Source: Own processing

Table 1 shows the results of the model with corrected heteroskedasticity about the proposed methodology. Because of the violation of this classical assumption of the linear regression model, others classical assumptions were also violated. This problem of inhomogeneity of the error term was removed using a model with correct heteroskedasticity and the achieved results are given in Table 1 Model A.

The final model is statistically significant at the 1% level of significance and all its variables, except for the variable D_18001 OHSAS. In consequence of the use of the model with corrected heteroskedasticity, only the collinearity of explanatory variables and the normality of residuals could be tested. The tests show that there is no collinearity between variables and the residuals are not normally distributed. Model A explains 99.99% variability of the sample. It also indicates that the increase in ratio of capital and sales by one unit leads to the decrease of the economic value added by 9.35856%. On the contrary, the increase in return on sales by one unit leads to the increase in EVA by 89.2298%. The increase in the weighted average cost of capital by one unit leads to the decrease in EVA by 88.4501%. Dummy variable ISO 14001, as the example of implementation of environmental management, increases the economic value added by 0.747528%, which implies the desired state for value creation of analysed corporations. The introduction of variable D brings the opposite effect_18001 OHSAS, representing the implementation of work safety, which decreases the EVA indicator by -0.155813%. It is therefore possible to believe that ownership of the certification standard ISO 18001 brings a negative effect on the economic value added of observed corporations, which is being destroyed. However, this result is not statistically significant. The following figure depicts the XY diagrams of individual input variables for multivariate regression analysis.

Figure 7 XY diagrams



Source: Own processing

4 Conclusions

The modelling results confirmed the assumptions of the authors on the impact of the working capital management policies and the implementation of the ISO 14001 certification standards (representing environmental management) and ISO 18001 OHSAS (representing occupational safety) on the final value of economic value added EVA. The authors concluded that the negative correlation of ISO 18001 OHSAS is caused by higher costs related to the implementation of this certification standard and is also affected by a broad awareness of stakeholders who do not rather know about the ownership of this standard and do not pay much attention to it. This standard is also considered to be one of the youngest certification standard that corporations gradually introduce. About working capital management, the authors argue that in the automotive sector it is appropriate to implement a moderate policy of financing, in terms of the impact of changes on net working capital, by using long-term resources of the enterprise, which in turn will reduce the risk of financial structure and at the same time, it will reduce the costs of capital that correlates strongly negatively with economic profit. Since the impact of WACC on economic is more significant than the impact of larger amount of capital, the effect of proposed procedure on EVA indicator is positive.

The components of working capital confirmed a negative correlation between the ratio of capital ad sales and the economic profit at 1% significance level, which is decreased by the growth of this ratio. A similar negative impact occurred in the case of weighted average cost of capital, of which growth significantly reduces the economic value added of the enterprises analysed. On the contrary, return on sales, calculated using EBIT, confirmed a strong positive correlation on EVA indicator at 1% significance level, and therefore, it can be stated that the size of sales and EBIT significantly affect the economic profit.

About the impact of the implementation of environmental policy in the automotive industry on the economic value added, it was found that the ownership of the ISO 14001 standard causes high input costs in the form of investments, but its ownership is positively correlated with the economic value added and concurrently it reduces or eliminates the environmental impacts. This fact represents a very important effect for the automotive industry, since it positively contributes to the environmental area of CSR.

In the context of the research the assumption about the importance of non-financial factors in relation to economic profit was fulfilled. The authors recommend to implement moderate of net working capital management, since it has a positive impact not only on the risks associated with the business, but also on the economic profit. The ownership of certification standards ISO 14001 and ISO 18001 OHSAS, as representative elements of corporate social responsibility, increases not only the prestige of businesses, but also protects the environment, increase the occupational safety, initiate the innovation potential, and positively influence the economic value added. Based on the data obtained, future deeper research will be conducted to analyse the period, in which the standards ISO 14001 and ISO 18001 OHSAS were introduced, to understand the strength of its influence on the economic profit of businesses in different years.

Acknowledgement

This article was supported by the Internal Grant Agency of the Mendel University in Brno.

References

- Baños-Caballero, S., García-Teruel, P. J., & Martínez-Solano, P. (2014). Working capital management, corporate performance, and financial constraints. *Journal of Business Research*, 67(3), 332-338.
- Bei, Z., & Wijewardana, W. P. (2012). Working capital policy practice: Evidence from Sri Lankan companies. *Procedia-Social and Behavioral Sciences*, 40, 695-700.
- Bellouma, M. (2011). Effects of capital investment on working capital management: Evidence on Tunisian export small and medium enterprises (SMEs). *African journal of business management*, 5(30), 12133.
- Benn, S., Dunphy, D., & Griffiths, A. (2014). *Organizational change for corporate sustainability*. Routledge.
- Besley, Scott a Eugene F Brigham (2012). *Principles of finance*. 5th ed. Mason, OH: South-Western, c2012, xviii, 793. ISBN 1111527369.
- Bhattacharya, C. B., & Sen, S. (2004). Doing better at doing good: When, why, and how consumers respond to corporate social initiatives. *California management review*, 47(1), 9-24.
- Brooks, R. (2013). *Financial management: core concepts*. 2nd ed. Boston: Pearson, 617. ISBN 9780132671033.
- European Automobile Manufacturers' Association. (2015). *EU economic report*. Brussels : European automobile manufacturers' association [online]. Available from: www.acea.be.
- Filbeck, G., & Kreuger, T. (2005). Industry Related Differences in Working Capital management. *Mid-American Journal of Business*, 20 (2): 11-18.
- Fotr, J. (2012). *Tvorba strategie a strategické plánování: teorie a praxe*. 1. ed. Praha: Grada, 381. ISBN 978-80-247-3985-4.
- Greenfield, W. M. (2004). In the name of corporate social responsibility. *Business Horizons*, 47(1), 19-28.
- Hill, M. D., Kelly, G. W., & Highfield, M. J. (2010). Net operating working capital behaviour: a first look. *Financial management*, 39(2), 783-805.
- International Organization for Standardization [online]. Available from: <http://www.iso.org>.
- Kunz, V. (2012). *Společenská odpovědnost firem*. Grada Publishing.
- Lind, L., & col. (2012). Working capital management in the automotive industry. *Journal of Purchasing and Supply Management*, 18(2), 92-100. DOI: 10.1016/j.pursup.2012.04.003. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S1478409212000222>.
- Lindgreen, A., Swaen, V., & Johnston, W. J. (2009). Corporate social responsibility: An empirical investigation of US organizations. *Journal of business ethics*, 85(2), 303-323.
- Maignan, I., & Ralston, D. A. (2002). Corporate social responsibility in Europe and the US: Insights from businesses' self-presentations. *Journal of International Business Studies*, 33(3), 497-514.
- McWilliams, A., Siegel, D. S., & Wright, P. M. (2006). Corporate social responsibility: Strategic implications. *Journal of management studies*, 43(1), 1-18.
- Norma, U. N. I. (2004). EN ISO 14001. Punto, 4(5), 4-5.
- Nazir, M. S., & Afza, T. (2009). A panel data analysis of working capital management policies. *Business Review*, 4(1), 143-158.
- Nazir, M. S., & Afza, T. (2009). Working capital requirements and the determining factors in Pakistan. *IUP Journal of Applied Finance*, 15(4), 28.
- OHSAS, B. (2007). *18001 - Occupational Health and Safety Management Systems. Requirements*. British Standards.
- Pearce II, J. A., & Doh, J. P. (2005). *The High Impact of Collabor*. MIT Sloan Management Review.

- Pinkston, T. S., & Carroll, A. B. (1994). Corporate citizenship perspectives and foreign direct investment in the US. *Journal of Business Ethics*, 13(3), 157-169.
- Pirvutoiu, I., & Popescu, A. (2009). Analysis of Net Working Capital – A Basic Tool in Business Fainancing. *Agricultural Management/Lucrari Stiintifice Seria I, Management Agricol*, 11(3).
- Režňáková, M. (2010). *Řízení platební schopnosti podniku: řízení platební schopnosti... a praktických aplikací*. 1. ed. Praha.
- Růčková, P., & Roubíčková, M. (2012). *Finanční management*. 1. ed. Praha: Grada, 290. ISBN 978-80-247-4047-8.
- Tufail, S., & Khan, J. (2013). Impact of Working Capital Management on Profitability of Textile Sector of Pakistan. In *Proceedings of 3rd International Conference on Business Management*.
- European Commission. Directorate-General for Employment. (2001). *Promoting a European Framework for Corporate Social Responsibility: Green Paper*. Office for Official Publications of the European Communities.
- Vahid, T. K., Elham, G., khosroshahi Mohsen, A., & Mohammadreza, E. (2012). Working capital management and corporate performance: evidence from Iranian companies. *Procedia-Social and Behavioral Sciences*, 62, 1313-1318.
- Váchal, J., & Vochozka, M. (2013). *Podnikové řízení*. 1. ed. Praha: Grada, 685. ISBN 978-80-247-4642-5.
- Vochozka, M., & Mulač, P. (2012). *Podniková ekonomika*. 1. ed. Praha: Grada, 570. ISBN 978-80-247-4372-1.

Nonfinancial Risks and Financial Opportunities in Combating Climate Change

Oleksandr Sushchenko, Andrii Buryachenko

Abstract: *The problem of global warming in recent decades became especially important and is reflected in a number of international agreements aimed at intensifying the efforts to limit the rate of global warming below 2 degrees Celsius. Ukraine actively involved in the process of combating climate change by reducing the greenhouse gas emissions (under the Kyoto Protocol to the UN Framework Convention on Climate Change and Paris Climate Agreement). As a result, our country has been using the possibility of selling ERUs (Emission Reduction Units) as a part of the Joint Implementation mechanism (Joint Implementation - JI) and certificates AAU (Assigned Amount Units) to attract "green investments". The aim of the paper is to show how nonfinancial risks are influencing the global financial system and what kind of changes do the Ukraine need to undertake to attract resources from the financial market and fulfil our obligations under the Paris Climate Agreement and Association agreement with the EU.*

Key words: Climate Change · Non-financial risks · Financial Market · ESG Principles · Corporate Sustainability · Corporate Social Responsibility

JEL Classification: G150 · Q58

1 Introduction

The idea of socially responsible business was introduced by H. Bowen ("Social Responsibilities of the Businessman", 1953) and described in his concept of the CSR (Corporate Social Responsibility). But limited to voluntary responsibility this concept was unable to solve environmental, social and governance problems. As a response to that the new concept on "triple bottom line" occurred in 1997 and was described in the book written by J. Elkington "Cannibals with Forks: The Triple Bottom Line of 21st Century Business". Hence, the problem of climate change moved from the area of voluntary corporate responsibility to the new business models, the category of non-financial risks and corporate sustainability. So, with the signing of the Kyoto Protocol and Paris Climate Agreement the above-described transition was accomplished.

The most important outcome of that shift is the fact that the companies and financial institutions are carrying about the creation of the so-called "blended value" (introduced by Jed Emerson in 2003, "The blended value map. Tracking the Interest and Opportunities of Economic, Social and Environmental Value Creation"). According to this concept companies are trying to receive not only positive financial result but also carrying about creation of additional environmental and social value.

It was clear that only public funds are not sufficient to solve existing problems and the solution was elaborated by R. Coase (1910-2013) – introduction of the property rights to enact the market financial instruments. But introduction of the property rights and market financial instruments brought another problem – transaction costs. Hence, the main area of the current researches in the area of climate and social finance is about to find the ways to reduce those transaction costs. There is a need to elaborate not only new infrastructure on the financial market but also to establish a new legal framework in order to reduce transaction costs associated with market financial instruments implementation.

Thanks to the joint efforts of the biggest banks, investment funds, different financial institutions new framework on the financial market has been established and recipients of investments, loans forced to report on outstanding environmental, social, and governance risks in order to get an access to financial resources.

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In fact, owners of the funds want to be sure that their resources will contribute to the reduction of environmental, social and governance risks (ESG), and the planned activities will be conducted in the most efficient and transparent way.

In accordance with Directive 2013/34/EC, 2014/95/EC, starting from the beginning of 2017 big companies on territory of the EU will be obligated to report on their non-financial risks (according to the ESG Principles). And even the risks throughout the value chain must be taken into account in their reporting. That is why even the risks of the business partners (for instance, suppliers) located outside the EU, will also affect the risks and overall rating of the company in the EU.

In addition, the biggest stock exchanges in the world today require from the listed companies to disclose the governance risk and, in certain cases, report on all three components (for instance, on Singapore Stock Exchange).

Moreover, rating agencies, starting from September 2015, are preparing ratings for the companies, municipalities, sovereign borrowers based on non-financial indicators (risks). Even if the borrower or beneficiary has good performance on environmental and social components, inefficient governance system can lead to a drop in the overall rating, "price" of the financial resources.

However, ESG risks should not be considered as a problem, because thanks to the newest financial instruments all those risks can be seen as an attractive possible asset to investment. It means that financial market is ready to finance projects related to transform ESG risks into the assets or to improve their own non-financial rating due to such results.

Ukraine is trying to make its own contribution to combating climate change by reducing the GHG emission in accordance with submitted INDC (Intended Nationally Determined Contributions). At the same time our country needs approximately 200 billion USD to fulfil the obligations. Only public sources cannot cover these needs. It means that Ukraine should create an appropriate framework to attract financial resources from financial market.

2 Methods

The methodological basis of the research is the dialectical method, systematic and historical approaches, the fundamental provisions of the economic theory, sustainable development concept, and the theory of finance. We used the following methods: a method of logical generalization, comparative analysis (financial support for environmental protection).

3 Research results

3.1 Nonfinancial risks and its influence on the global financial system

Doing business means dealing with risks of different kinds and level of impact on the financial results. Companies should take into account not only financial (for example, currency or fiscal risks), but also non-financial risks. So, according to the report published by the World Economic Forum, climate risks are the most important nonfinancial risks both in terms of likelihood and impact (see Table 1).

Table 1 Five global risks in terms of likelihood and impact in 2015.

	Likelihood	Impact
1st	Interstate conflict	Water crisis
2nd	Extreme weather events	Spread of infectious diseases
3rd	Failure of national governance	Weapons of mass destruction
4th	State collapse or crisis	Interstate conflict
5th	Unemployment or underemployment	Failure of climate-change adaptation

Source: Global Risks 2015. 10th Edition (2015). Geneva: World Economic Forum: 14.

That is why we should look more precisely at the most important threats to be prepared for the upcoming challenges and possible damages. All this could lead to enormous losses and provoke next financial turmoil. In order to prevent possible negative consequences of such challenges the whole international community signed a wide range of agreements and set the so-called UN Sustainable Development Goals that reflect the needs of the modern economy (see Table 2).

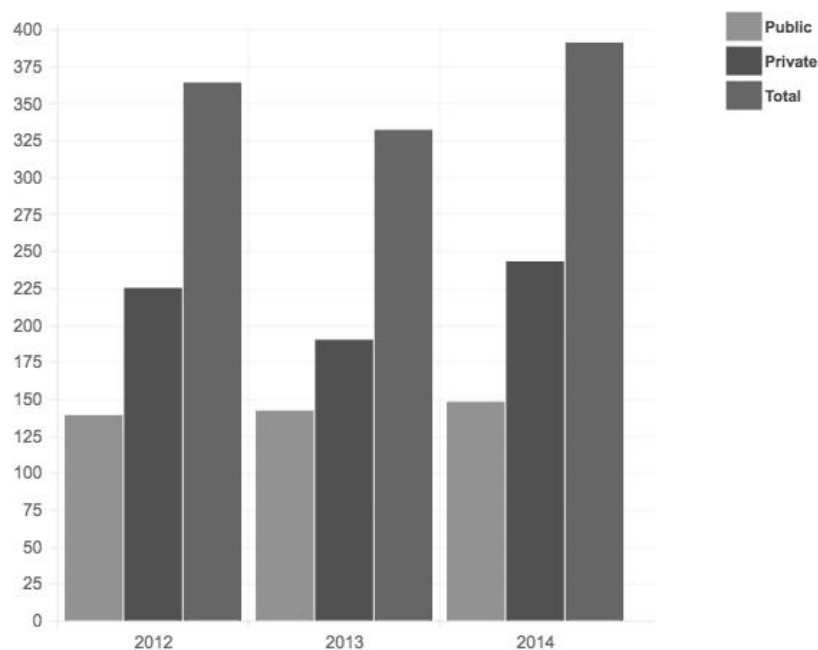
Table 2 Ranking of SDGs by level of transformational challenge in developed countries (maximum level – 8)

Goals	The overall rating of the goals
Goal 13. Take urgent actions to combat climate change and its impact	7.1
Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all	6.4
Goal 12. Ensure sustainable consumption and production patterns	6.3
Goal 14. Conserve and sustainable usage of the oceans, seas and marine resources for sustainable development	4.4
Goal 10. Reduce inequality within and among countries	3.6

Source: Osborn D., Cutter A. And Ullah F. (2015). Universal Sustainable Development Goals. Understanding for Developed Countries. Report of a Study by Stakeholders Forum: 6.

It seems like the problem of climate change needs engagement of representatives from different environmental organizations. However, if you count the cost of measures to reduce greenhouse gas emissions and saving the pace of global warming within 2 degrees Celsius, we get the amount that exceeds 100 trillion USD - this means that you need to accumulate 2030. In other words, every year we have to spend about 8 trillion USD due to fiscal and financial market instruments. In accordance with the report published by the Climate Policy Initiative, almost 400 billion USD being spent each year for the climate-aligned projects. Therefore, there is a gap and the problem of climate change can not be solved only by implementations of the fiscal instruments and becomes the responsibility of financial institutions (see Figure 1).

Figure 1 Climate finance in 2012-2014, billion USD.



Source: built by the authors, data from climate Policy Initiative

The main question that now faces the international community due to the need to choose between a tax and market instruments to accumulate the necessary volume of climate finance (or develop effective mix). If taxes are the most effective tool, the market opportunity is much larger and can draw on financial markets the resources needed.

For Ukraine, this problem is also of the great importance, as the German company DIW ECON estimates, our country needs about 200 billion USD to make our economy "green." One of the ways to this goal there is a choice between market financial instruments and introduction of a carbon tax at a minimum level of 1 USD.

In this regard, pretty symbolic seems to be a meeting of the representatives of the financial market on November 4, 2016 – the day when the Paris climate agreement entered into force. The purpose of this meeting was to harmonize mechanisms and instruments for the GHG emissions reduction projects. An important feature of this meeting was the fact that one of the organizers on this event was the platform for Climate and Sustainable Development Finance created

by the city of Paris. This platform brought together national and international financial institutions for the purpose of the climate finance mobilization.

However, Paris was not the only one example of such efforts. Shortly after the signing of the Paris climate agreement other platforms appeared. The next city that established almost the same platform for the purpose of climate finance accumulation, was London. The city of London is an example of a successful partnership between private and public sectors of the financial system - successful "Platform on Climate Finance". The main idea of this platform is to create institutional conditions for the issuance of financial instruments and to promote accumulation of climate finance needed to implement GHG emission reduction projects. The main advantage in this case is the fact that this platform is supported not only by the authorities, but also by the largest investment funds, banks (for example, BlackRock).

Another possible center of the climate finance mobilization could be a platform set up by the initiative of European Investment Bank, Luxembourg Stock Exchange and the Grand Duchy of Luxembourg (October 2016). An important advantage of this center is the Luxembourg Stock Exchange with (the first green bonds was issued here in 2007). Another important factor is the presence of representatives from different international financial institutions, accounting and consulting firms. This could create all the necessary conditions for the climate finance accumulation - reduce the GHG emissions and limit the global warming by 2 degrees Celsius.

Ukraine has signed the Paris climate agreement that not only imposes certain obligations on the country, but also provides opportunities for "green" investments, development of the financial market infrastructure. An important negative feature of the Paris climate agreement is the lack of instruments that can generate sufficient financial resources for the projects of the GHG emissions reduction. However, with the signing of Association Agreement with the EU (further, Agreement), Ukraine has committed to implement by 2017 its own Emission trading system (Directive 2003/87/EC). This market brings both threats and opportunities for domestic companies because in addition to emission limits gives them the right to use the received certified emission reductions as an asset on the financial market (sell or buy, etc.).

At the same time in the Annexes to the Agreement there are several directives (2013/34 and 2014/95 new Directive) that provide new requirements to prepare not only financial but also non-financial reports for the big companies. Non-financial reporting in accordance with new requirements foresees disclosure of environmental and social risks-information of the company in accordance with the ESG Principles (Environmental, Social and Governance).

All this requires specific accounting standards for the certified GHG emission reductions and the results of social projects. Proper accounting of the units (permits) of the reduced GHG is a prerequisite for the non-financial (sustainability) reports, which is an important communication tool with the shareholders and financial market in general.

In addition, implementation of the Emission trading scheme in Ukraine makes it possible to boost develop the financial market by providing the impetus for the use of derivatives, which mediate the purchase and sale of certificates (permits for greenhouse gases). It also makes possible to significantly improve disclosure of financial and non-financial information - primarily for the risk assessment.

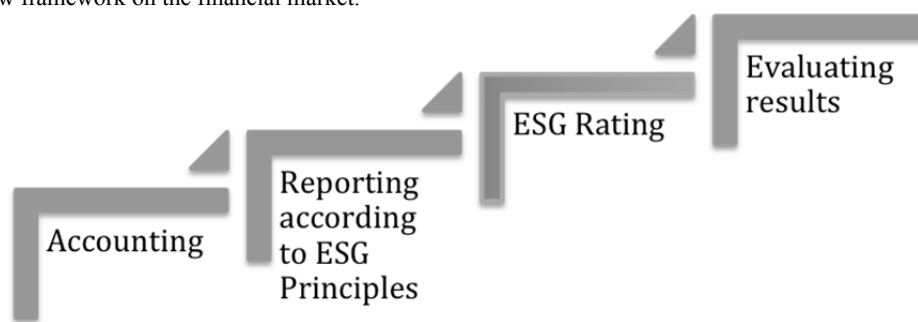
Major stock exchanges in the world (London, Frankfurt, Warsaw and other exchanges) require from their participants reporting and compliance in accordance with the ESG Principles. At the same time, investment companies and banks are actively offering new financial instruments to raise funds for implementation of the projects related to the reduction of GHG emissions and improve energy efficiency of production.

3.2 Role of the nonfinancial risks in shaping a new framework on the financial market

The most significant event took place by the end of 2015 – the Paris Climate Agreement was agreed by almost 190 countries (hereinafter, Agreement). This Agreement should replace the Kyoto Protocol after 2020 and according to which Ukraine has pledged to emit no more than 60% of the GHG (in 2030) compared to the level of 1990. But the most important treaty for Ukraine in terms of combating climate change is the Association Agreement with the EU, where the problem of global warming and climate change pervades almost all sections and annexes.

On the global market financial institutions have already agreed on the new framework, which will connect companies, municipalities, governments and investors. These new financial framework foresees new approaches in reporting and evaluation of the nonfinancial risks and results (see Figure 2).

Figure 2 New framework on the financial market.



Source: built by the authors

On each stage from the companies to the financial market there are different initiatives aimed at disclosure and evaluation of nonfinancial risks and results. For example, the most known and widely accepted initiatives in the area of nonfinancial reporting are Global Reporting Initiative (GRI) and Principles of responsible investments (PRI). The former initiative provides the necessary recommendations and standards to prepare the annual sustainability reports and the latter is dedicated to the evaluation of the investments projects.

Having nonfinancial information gives an opportunity for the rating agencies to evaluate those risks and results and to give a rating. This rating will show the extent to which companies, municipalities and governments are depending on the nonfinancial risks. At the same time, investors will be able to invest and creditors could give the credits.

Table 3 Climate-aligned categories of the sustainable developments bonds.

	Categories	Description
1	Development Finance Institutions (DIFs) Bond	Issued by Development Finance Institutions (for example International Bank for Reconstruction and Development) to finance their business operations
2	Environmental Impact Bond	Pay-for-performance contract
3	Environmental Performance Bond	The payment is only returned if the environmental damage of the activity does not exceed certain threshold
4	Environmental Policy Performance Bond	Governments use debt to “promise” investors they will stay true to their environmental policies, at no cost to themselves if they keep their promises
5	Forest bond	Fund forest preservation and transition to sustainable livelihood
6	Forest resilience bond	Pay-for-success funding for environmental conservation
7	Green bonds	Fund GHG reduction, energy efficiency and renewable energy production projects

Source: built by the authors, data from (European Impact Investing, 2016)

The market for climate financial instruments is developing very fast but the volumes are not yet sufficient to cover the needs in climate finance. Nevertheless, those instruments will play an important role in attracting financial resources not only for the GHG emission reduction projects, but also for improvement of social and governance indicators in accordance with the so called UN Sustainable Development Goals (SDG) (see Table 3).

All these instruments give the opportunity to build the bridge between financial market and real sector, fulfill climate-aligned obligations and limit the global warming. At the same time there left a lot of things to do, especially in the area of accounting, where no specific standards to account results of the GHG emission reduction projects exist.

3.3 Challenges and financial opportunities for Ukraine in combating climate change

In January 2015 President of Ukraine signed an economic development strategy "Ukraine 2020", according to our state in the coming years will be to create the conditions for building a "green economy". According to various estimates, our economy will need more than 170 billion. Dollars. for this purpose. It is obvious that the government funds and funds of

international financial institutions will not be enough for this. That is why the transition to new accounting standards and reporting will enable our companies to access funds on the international market, improve the ratings of both the companies and their financial instruments.

Another important problem is the lack of specialists in the field of climate finance, which could help introduce a system of trading permits for greenhouse gases, to provide the necessary infrastructure of financial markets, which will bring Ukraine to the resources required to fulfill its climate commitments. For the Ukrainian corporate sector (especially for the energy sector companies) ignoring environmental (especially climate change), social and governance risks could potentially lead to deepening of problems in commercial and financial areas (commercial and financial risks).

Commercial risks, first of all, associated with possible problems of selling "dirty" products on the EU market, and then on domestic market after the introduction of limits for the GHG emissions as a part of the national Emission trading system.

It is necessary, first of all, to point out the possible negative consequences for the exports of electricity to the EU, where starting from 2017 all the big companies should report not only on the own environmental, social and governance risks, but also on those risks that occur throughout the value chain from supplier to consumer products and/or services.

Non-financial risks could lead either to the growing cost of financial resources (for example, investors should collect the information and assess the risks) or its unavailability. Introduction of the price on GHG emissions could also create additional costs for the producers of electricity.

On the other hand, application of the non-financial reporting (environmental, social and governance principles) could reduce the uncertainty and give an access to the financial resources needed for the GHG emissions reduction projects. Acting in accordance with the Directive 2013/34/EC on the annual financial statements, consolidated financial statements and related reports of certain types of companies (implementation in Ukraine was planned for July 2015) should force big companies to report to the stakeholders on the level of outstanding non-financial risks. All this can give an access to the market financial instruments such as climate, green bonds, which purpose is to raise funds for conducting the GHG reduction, energy efficiency improvement, waste management, water quality improvement projects.

Also of the great importance is the Directive 2003/87/EC - foresees introduction of the Emissions trading scheme in Ukraine (hereinafter - ETS) in 2017 (realistically, by the end of 2018). This system will impose not only obligations for domestic companies to reduce the GHG emissions, but also an opportunity to sell on the market the outstanding surplus of those emission allowances. In addition, this system will enable the usage of existing certificates as an asset for the purpose of attracting investments or receiving the credits - they will have its price on the market.

It should be noted that the current EU ETS is forcing manufacturers to consider "carbon price" in their costs calculations (one certificate/allowance equals to as the 1 ton of the GHG emissions). And even if the Ukrainian company will delay the reduction of emissions and the introduction of reporting on environmental, social and management risks, European consumers of Ukrainian goods will impose disclosure requirements for the above-mentioned risks.

Importantly, according to the Decree of the Cabinet of Ukraine № 847-p (action plan for the implementation of the Association Agreement with the EU) of 17 September 2014, the implementation of this legal act was to take place until August 2016. However, to date there is even the previous version of the bill this document. Responsible for the implementation of the said Directive is the Ministry of Environmental Protection of Ukraine.

Important fact is the fact that the circulation of the certificates provided for in Directive 2003/87/EC, cannot take place without the use of derivative financial instruments (derivatives). That is why we should pay attention to the European Parliament and Council 2014/65 / EC on markets in financial instruments (MiFID-II), enactment of 2016 and Regulation 600/2014 of the European Parliament and of the Council on markets in financial instruments (MiFIR), (implementation - 2017). These Directives enable attributed certified emission reductions of greenhouse gases into the category of financial instruments. It is this step allows investors and lenders to be sure that as a result of investing in projects to reduce greenhouse gas emissions, you can get an additional asset. Responsible for the implementation of these regulations is the National Commission on Securities and Stock Market of Ukraine.

Indirectly, climate change reflected in Directive 2009/28 / EC on the promotion of the use of energy produced from renewable energy sources and Directive 2004/8 / EC (implementation August 2017) on the promotion of cogeneration. It is in these documents providing the possibility of introducing the system of certification of units produced renewable energy and energy during the production of which was to improve energy efficiency.

However, none of the above regulations (Directives and Regulations) have not been implemented so far, which does not allow Ukrainian companies-emitters of greenhouse gases to fully benefit from climate finance and to raise funds needed to maintain the rate of temperature increase on the planet in certain in Paris climate treaty limits.

4 Conclusions

Ignoring global trends and procrastination in the implementation of the necessary legislation (in particular, it is the Directive, the Agreement on association with the EU), could lead to the fact that centers flows of climate finance will bypass our country and we are unable to timely comply with the relevant obligations' Liabilities in the Paris climate agreement. Another possible consequence - we can get resources through intermediaries, which will increase the value of the resource. In both cases we will have to catch up or stated rate or pay extra for failing to implement necessary changes - to create institutional conditions not only for treatment of new financial instruments, but also for establishing links between investors, creditors and recipients of financial resources. In this case the non-financial reporting, which allows you to fully inform investors about the level of risk for individual projects on display and the possibility to create assets.

In order to use the opportunities of the Association Agreement with the EU, our team can offer the following solutions:

- development strategy of the company, taking into account environmental, social and governance risks;
- preparation of non-financial reporting required for reporting to the European buyers of electricity and the emission of climate, green bonds;
- establishment of a "road map" and support in the process of raising funds through sustainable development and green bonds;
- capacity building not only for the companies, but also for the municipalities and governments.

All these measures and implementation of the above mentioned Directives will help our companies and public agents attract financial resources - fulfill their obligations in combating climate change, improving social conditions and quality of governance on all levels of the economic system.

References

- Annex XXX. *Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part* [online]. Available from: http://eeas.europa.eu/ukraine/pdf/10_ua_annexes_to_title_v_economic_and_sector_cooperation_en.pdf.
- Bowen, H. B. (1953). *Social Responsibilities of the Businessman*. Harper, 276.
- Coase, R. H. (1960). The Problem of Social Cost. *Journal of Law and Economics*, 3, 1-44.
- Commission Regulation (EU) No 601/2012. *On the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council* [online]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012R0601&from=EN>.
- Directive 2013/34. *On the annual financial statements, consolidated financial statements and related reports of certain types of undertakings* [online]. Available from: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:182:0019:0076:EN:PDF>.
- Directive 2014/57/EU. *On market abuse (market abuse regulation)* [online]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0057>.
- Directive 2014/65/EU *On markets in financial instruments* [online]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0065&from=EN>.
- Elkington, J. (1997). *Cannibals with Forks: The Triple Bottom Line of the 21st Century Business*. Capstone, Oxford, 402 p.
- Emerson, J. (2003). *The blended value map. Tracking th Intersects and Opportunities of Economic, Social and Environmental Value Creation* [online]. Available from: <http://www.hewlett.org/wp-content/uploads/2016/08/BlendedValueMapFinal.pdf>
- WEF (2015). *Global Risks 2015*. 10th Edition (2015). Geneva: World Economic Forum: 14.
- Osborn, D., Cutter, A., & Ullah, F. (2015). *Universal Sustainable Development Goals. Understanding for Developed Countries. Report of a Study by Stakeholders Forum 6*.
- Regulation (EU) No 600/2014 *On markets in financial instruments* [online]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014R0600>.
- Regulation (EU) No 648/2012 *On OTC derivatives, central counterparties and trade repositories* [online]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012R0648>.
- Regulation 596/2014 *On market abuse (market abuse regulation)* [online]. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014R0596>.
- Sushchenko O., Schwarze R. (2016). Carbon Taxation and Market Financial Instruments for Mobilizing Climate Finance. *Discussion Paper Series RECAP15*, 23.
- Sustainable Development Bonds. *European Impact Investing*, Luxembourg, 10.

Influence of Creative Accounting on the Amount of Provable Loss in Public Transport

Martin Telecký

Abstract: *The provable loss is an integral part of living of the transportation company in charge of the public transportation under the contract on the traffic services in the real conditions of the Czech Republic. Without the subsidy policies the transportation company would not be able to continue to provide the traffic services within its business. The reason is the annual losses in providing the traffic services. It means that the revenues fail to fully cover the total costs occurring as a result of the public service contract in the public line transport and the passenger track-based transport. The paper points out to the provable loss and to affecting of its amount by creative accounting. The goal is to use the general linear model to ascertain which (transport or accounting) items have an influence on determining the amount of the provable loss and to show the affected areas which are most often manipulated.*

Key words: Public line transport · Public track-based transport · Provable loss · Creative Accounting

JEL Classification: M41

1 Introduction

The paper is concerned with the manipulation and evaluation of the quality of the accounting data related to a significant indicator – a provable loss. The provable loss is a part of the subsidy policies in providing the traffic services, i.e. carrying out the public service obligation agreed between the client (the orderer) and the carrier. The provable loss and the factors serving for its calculation were presented at the international INPROFORUM conference in 2015. Using the general linear model, the main explained variable "provable loss" and the influence of the partial economic and transport indicators, i.e. the explanatory variables, will be examined. The chosen statistical method gives the results which will be addressed in the doctoral thesis. The results of the method serve as the accounting data quality evaluation and also point to the accounting or transport factors which are mostly manipulated. The results will also show the cases of using the creative accounting in the transport area, which have an influence on the calculation of the total amount of the provable loss. Finally, also responsibility for manipulating the accounting, economic or transport data will be addressed.

2 Methods

2.1 Provable Loss in Public Line Transport and Track-based Passenger Transport

In case of the public line transport, the provable loss term is defined pursuant to Regulation No. 493/2004 Sb. as the difference between the sum of the economically substantiated costs and the adjusted reasonable profit and the earned receipts and revenue.

$$\text{Provable loss} = \text{economically substantiated costs} + \text{reasonable profit} - \text{receipts and revenue.}$$

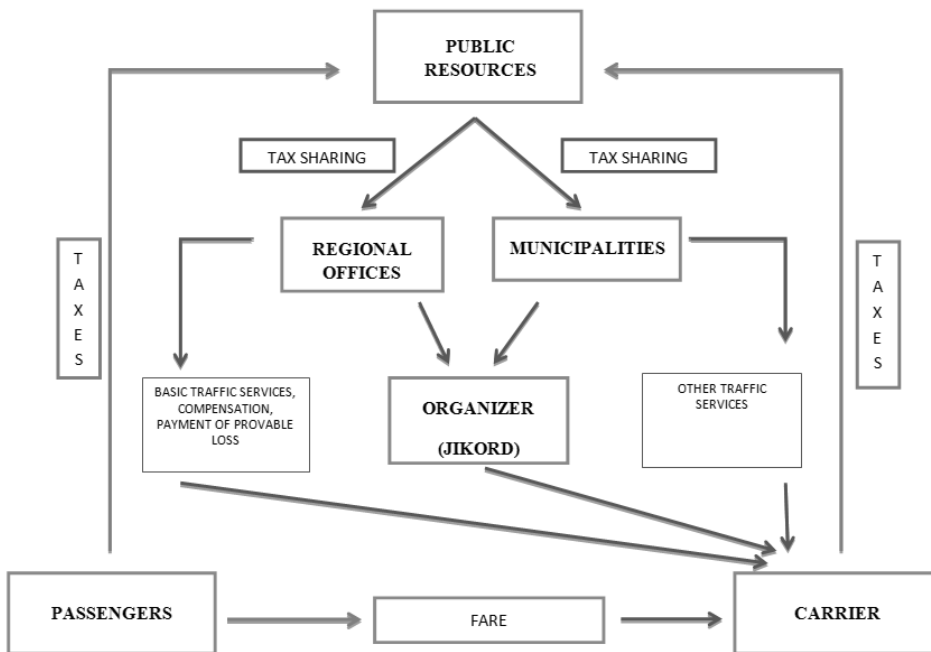
Regulation No. 296/2012 Sb. on the procedures for establishing the financial model and setting the maximum amount of the compensation analyses the deficiencies of Regulation No. 493/2004 Sb. and contains the more detail information and higher demands for the carriers which were not provided in the previous Regulation. The condition of the Regulation is that the carrier must not exceed the maximum permissible rate of return per the capital, being 7.5% annually from the operating assets. This condition is determined both for the public line transport and the public track-based passenger transport and the value of operating assets is considered on the basis of the amortised cost at the end of the immediately preceding accounting period. The transport companies (carriers) must use their assets which are procured and recorded as their property.

In case of the public track-based passenger transport, the provable loss is calculated as the difference between the amount of economically substantiated costs increased by the reasonable profit and the total revenue from the operation of the public track-based passenger transport using the regional and nationwide transport trains.

The economically substantiated costs are allocated to the sections of tracks separately for the trains serving the regional transport and the nationwide transport and are divided into the territorial districts. The total revenues will be ascertained upon all types of the income transport documents maintained in the carrier’s accounting system. The receipts from the fare will be divided for the regional transport trains and the nationwide transport trains according to individual territorial districts of regions.

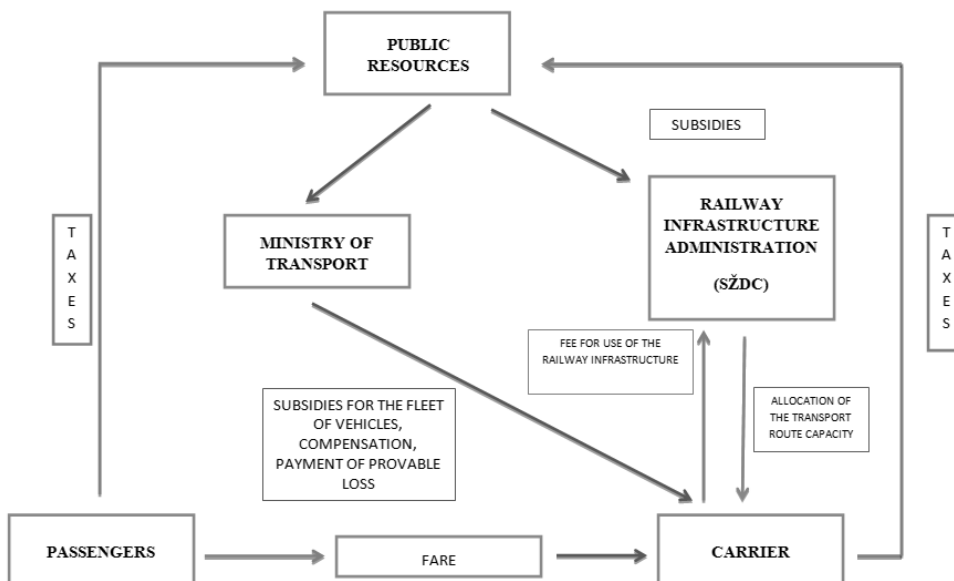
The provable loss is covered from the public budgets, especially the budget of the Ministry of Transport, regional offices and municipalities. The following diagrams show the method of distribution of subsidies and the payment of the provable loss to the carriers.

Figure 1 Financial flows in the regional bus transport

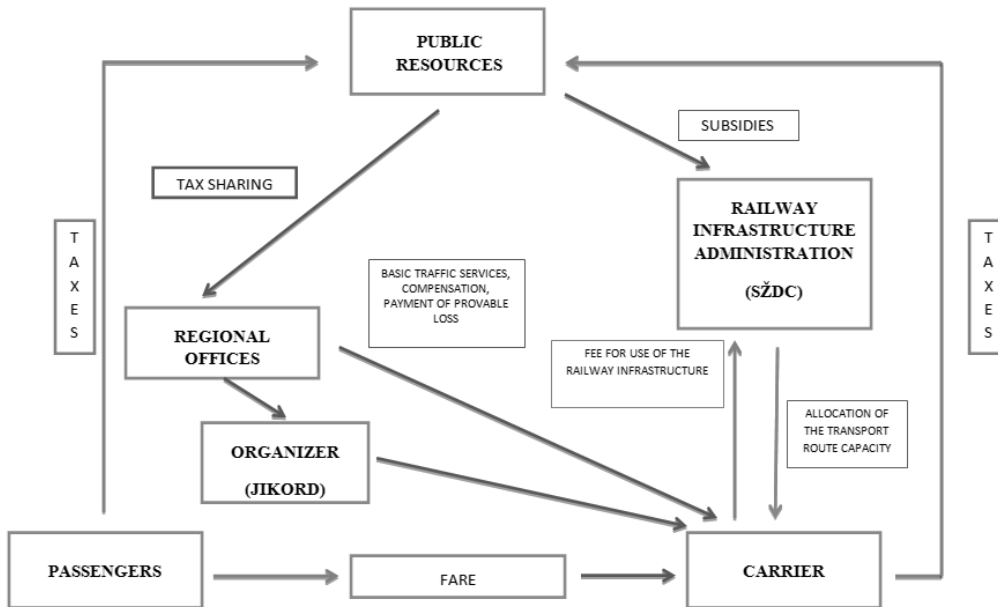


Source: author’s own processing of the source Sláma (2014)

Figure 2 Financial flows in the nationwide railway transport (long-distance trains)



Source: author’s own processing of the source Sláma (2014)

Figure 3 Financial flows in the regional railway transport (regional fast trains and passenger trains)

Source: author's own processing of the source Sláma (2014)

The passenger railway transport is divided into the three most important segments. The first of them is the regional railway transport funded from the regional office's budget with the contribution from the Ministry of Transport. The second segment is the long-distance railway transport ordered and paid from the Ministry of Transport's budget. The third segment is represented by the transport carried out at the carrier's own risk (most of the international long-distance connections, hotel and accommodation trains, etc.). The regional offices ensure the ordered traffic services by themselves or by means of the service organization (e.g. JIKORD, s.r.o.), most often the coordinator. Within the order the connections, times and lines are distributed. The service organization may pay for the performances upon the concluded public service contract.

Based on the order, the capacity of the transport routes is first allocated to the international long-distance trains, then the trains ordered by the Ministry of Transport, and only then the capacity is allocated according to the requirements of individual regions. Upon the allocated capacity of the means of transport type, the fee for using the railway transport route is charged.

In the regional bus transport, the regional office is an exclusive orderer. The bus transport can be further divided into

- international transport
- national long-distance bus transport

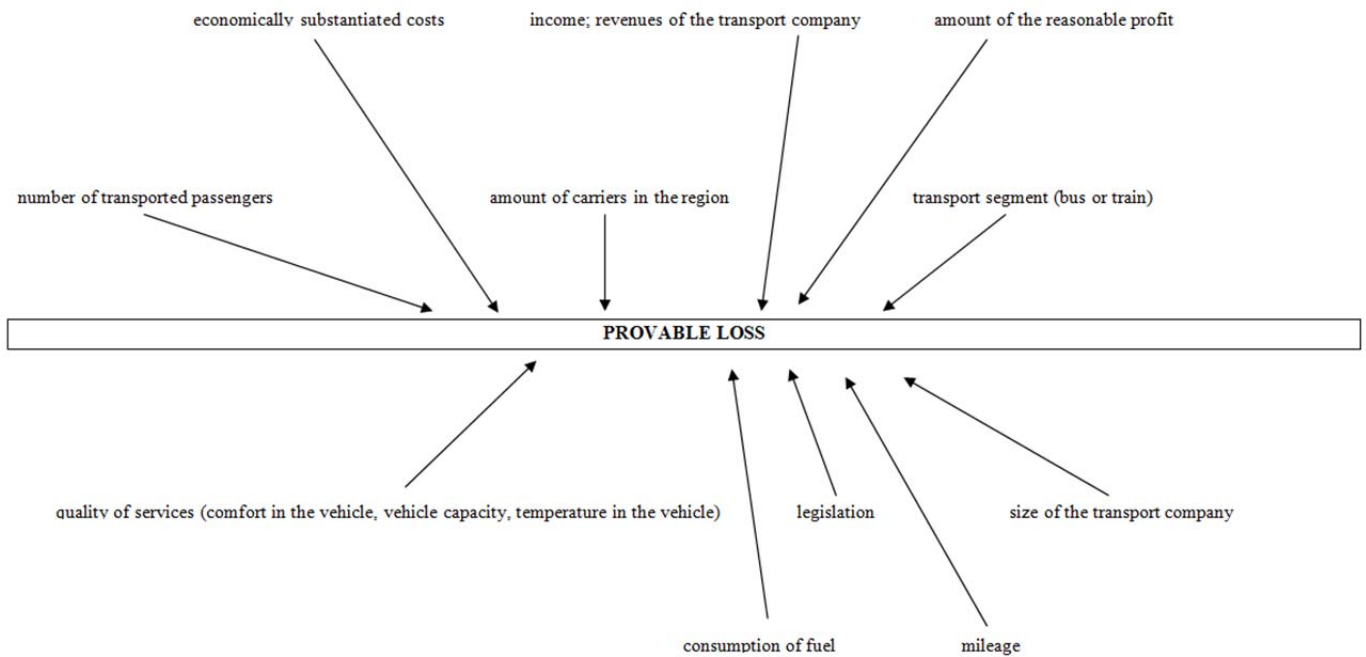
These two types are operated at the carrier's own business risk. The regional bus transport is covered from the budgets of the regional offices or municipalities. The specific transport is the urban transport which is funded from the budget of its operator.

2.2 Options of Influencing the Amount of Provable Loss using the Creative Accounting

The following figure shows the factors which may have an influence on the amount of the provable loss.

Especially the medium-sized and large transport companies with a complex structure overestimate the economically substantiated costs, underestimate their income and try to find the advantages stemming from the insufficient wording of the law and the regulations which govern determining of the provable loss and its partial parts.

In case of the public track-based passenger transport, the lines are often closed for traffic and the trains are replaced with other means of transport whose operating costs should be lower; however, the costs being advantageous for the carrier are reported

Figure 4 Financial and non-financial factors affecting the amount of the provable loss

Source: author

2.3 Prevention of Using Creativity beyond the Limit of Standard Accounting Adjustments

Upon the client's instruction, the transport companies document all information on the company's operation, including the performance of the means of transport, not for individual means of transport but as a whole. This way, the client loses track of the performances of individual means of transport, resulting in intentional increase in the mileage leading to an increase in the provable loss. The transport company is obliged to submit to the client the initial and real financial models; these reports, however, are not verified by an auditor and, as a result, the data submitted in the reports lose their credibility and quality. At the end of the accounting period at the time of compiling the financial statement, the carrier is obliged to have its accounting reports examined by an auditor. If the orderer finds significant deviations between the real financial model and the examined financial statement, he asks for the explanation of such deviations and for submitting the real financial model which does not include such a serious fraud. In most cases, the real financial model is re-drawn up under supervision of the orderer's authorized person. In some cases, the orderer asks the carrier to return a portion of the funds provided from the public budget.

3 Research results

The paper explains the primary transport and economic term "provable loss" in the public line transport and the track-based passenger transport. The goal was to set which factors have an influence on the dependent variable using the statistical model, a general linear model.

Using the statistical model application, or more precisely, the general linear model, those explanatory variables which have an influence on the explained variable, i.e. a provable loss, will be chosen. This model will help ascertain which explanatory variables have statistically the most relevant influence on the provable loss. Upon the results of the model, the examples of using the creative accounting and the ways of finding the measures which would considerably prevent this step will be given.

The general linear model is a statistical model based on the roots of mathematical thinking. It is characterized as an expansion of the linear multiple regression for one dependent variable.

The provable loss is chosen as the explained variable. In the model, it is characterized as the result of the effects of the explanatory variables. It is marked as Y. The explanatory variables act in the model like the causal variables. It means that their change will have an affect on the explained variable Y. They are marked as X. A total of six explanatory variables, namely:

- economically substantiated costs,
- income (revenues),
- number of deployed vehicles,
- mileage,
- company size (based on the staff headcount),
- type of transport (s – mixed transport; a – bus transport), were chosen.

A total of 42 carriers from various regions of the Czech Republic were chosen. At present, the data collection continues.

The results of the model are as follows:

Figure 5 "Provable loss" parameters

```

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      16.91139    4.31720   3.917 0.000361 ***
Náklady           0.66044    0.07029   9.396 1.87e-11 ***
Počet_ujetých_kilometrů 0.81680    0.33612   2.430 0.019930 *
Příjmy           -0.67321    0.06864  -9.808 5.83e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 10.04 on 38 degrees of freedom
Multiple R-squared:  0.7543, Adjusted R-squared:  0.7349
F-statistic: 38.89 on 3 and 38 DF,  p-value: 1.148e-11

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Source: author

The Figure shows the final results, i.e. the value of parameters is:

Provable loss: $16.91139 + 0.66044 * \text{costs} + 0.81680 * \text{mileage} - 0.67321 * \text{income}$

R – adjusted quadrate amounts to 0.7349 (73.49%). It determines the accuracy of the chosen regression model using the method of least squares. It says how many per cents of the dispersion of the dependent variable is explained using the model and how many per cents is not explained. Generally, the higher the value of R–quadrate is, the higher the dependency between the explained variable and the explanatory variable is.

The economically substantiated costs, income and the mileage, thus, become the main area of the manipulated data by means of the creative accounting.

We chose and analysed those factors who had "direct and indirect" influence on the provable loss, namely the economically substantiated costs, income (revenues), mileage, number of vehicles, size of the company and the transport type; the economically substantiated costs, income (revenues) and the mileage became the statistically important factors. There is no proportional correlation between the company size, number of vehicles and the transport type and the explained variable (provable loss) and, hence, they were gradually excluded from the model.

As a result, we moved towards the creative accounting and analysing of the final factors which could be manipulated. Using the general linear model, also the quality of accounting data was partially evaluated. The quality of accounting data is, on the other hand, also evaluated by the initial and real financial models which must be submitted to the orderer of the transport every accounting period, including the accounting reports (annual reports) which must be verified by an auditor. Under these conditions, the data are compared in individual reports and the links are being searched for in order to reveal whether the transport company presented a true and fair view of its data in its accounting system or used the elements of creative accounting.

Within the legislation, creative accounting is completely legitimate and truthful. The more important aspect is to recognize the level of creative adjustments which are either authorized or represent almost a crime.

The table below shows the percentages of individual cost items in the total costs (economically substantiated costs) in the public line transport.

Table 1 Structure of economically substantiated costs and their percentage in the total costs in the public line transport in 2016

Item	Line	Public line transport	
		Actual values as of 31/12/201x	
		Total thousand CZK in %	CZK/km %
Fuel, oils	1	26.0	26.0
Rubber rims	2	2.0	2.0
Other direct material	3	1.0	1.0
Direct wages	4	22.0	22.0
Buses in total	Depreciation	5	14.0
	Rental/leasing	6	0.0
	Repairs and maintenance	7	10.0
	Road tax	8	1.0
	Insurance (statutory, collision)	9	1.0
Other direct costs	Fare	10	1.0
	Payments to the funds	11	7.0
	Any other direct costs	12	5.0
Overhead costs	13	10.0	10.0
Total operating costs	14	100%	100%

Source: author

The table shows that the fuel and oils (26%) and the direct wages (22%) account for the largest shares of the costs. In case of the urban public transport and the public track-based passenger transport the percentages are approximately the same.

Examples from practice which increase the provable loss using the creative accounting:

- Intentional increase in the wages and salaries,
- Inclusion of the costs that are not related to the transport service,
- Purchase of fuel at lower prices x consumption of fuel is reported at higher prices
- Wrongly valued means of transport; the ancillary costs not related to the acquisition of the means of transport are included in the purchase price
- Intentional increasing of the depreciation based on the wrong appraisal of the fixed assets (see the appraisal of means of transport)
- Manipulation in increasing the mileage (shunting and parking travels not included in the timetable)
- Revenues from the sale of scrap not posted as revenues
- Fines collected from the passengers (a proportion is not posted as revenues)
- Purchase of the departure control systems (distance posts, alarms, computers) which are no longer used
- Purchase of the "overpriced" spare parts that are not used for the needs of repairs and maintenance of the means of transport and, after a few years, they lose its value and are undersold, thus creating a loss for the transport company.

4 Conclusions

The cases of using the creative accounting which are most often encountered in the transport companies in practice were stated. In general, the transport company size is what matters. Generally, the bigger the company is (and the more complex its organizational structure is), more accounting errors and the traces of creativity in its accounting we find. The economically substantiated costs most often become the main area of the data manipulation. Especially where the total costs represent the highest percentage, i.e. the fuel and wages and salaries. This paper partly analyses the evaluation of the accounting data quality and highlights the areas which are most often and most probably affected by the manipulation. All stated facts have an influence on the total evaluation of the financial health of the transport company as well as the system of the subsidy policies within providing the traffic services.

Acknowledgement

The paper was drawn-up with a support of the grant GAJU 149/2014/S.

References

- Decree of the Czech Republic Government No. 493/2004 Sb. regulating the provable loss in the public line transport and establishing the method of exercise of the professional government supervision in the road transport over funding of the traffic services.
- Dyrtl, Z. (2006). *Ethics in business environment*. Praha: Grada, 196. ISBN 978-80-247-6311-8.
- Road Transport Act No. 111/1994 Sb.
- Regulation of the Ministry of Transport No. 241/2005 Sb. on the provable loss in the public track-based passenger transport and the definition of the parallel public passenger transport.
- Regulation No. 296/2010 Sb. on the procedures for establishing the financial model and determining the maximum amount of compensation.
- Sláma, D. (2014). *Finance public transport from the state budget, regional and municipal budgets* [online]. Available from: <http://denik.obce.cz/clanek.asp?id=6677587>.
- StatSoft, Inc. (2013). *Electronic Statistic Textbook* [online]. Tulsa, OK: StatSoft. Available from: <http://statsoft.com/textbook/>
- Telecký, M. (2015). Financial and Accounting Issue in the Selected Area of Public Transport. In *Proceedings of the International Scientific Conference INPROFORUM 2015*, University of South Bohemia in Ceske Budejovice. Faculty of Economics. ISBN 978-80-7394-536-7, ISSN 2336-6788.
- Wonnacott, T. H., & Wonnacott, R. J. (1993). *Statistics for Business and Economy*. Praha: Victoria Publishing. ISBN 80-85605-09-0.

Evaluation of the Quality of Accounting Data in the Regions of the Czech Republic based on Audits by the Tax Offices

Miroslava Vlčková

Abstract: *The quality accounting data (QAD) allows manage many processes in a business. The main goal of this paper is evaluate the quality of accounting data in companies and analyze if this quality has interdependence with numbers of audits by the Tax Offices. Data quality is one of the decisive factors in making the right decisions and the overall functioning of the company. It's not the only one, but a very important factor. In practice, there is proved data quality relationship with the successful management of the company – non quality data costs companies around the world each year hundreds of billions dollars. The paper will confront the impact of the numbers of audits by the Tax Offices with the quality of accounting data. These audits are performed under on-the-spot investigations. On-the-spot investigations are conducted by experts from all units of the Tax Offices, most often by experts from tax audit units. This units provide activities such as: carry out the administration of taxes, payments and advances for these revenues, administer subsidies, conduct the offence proceedings, collect and enforce the payments, charges, settlements, considerations, fines and penalties, impose fines, decide on authenticity and amount of claims on taxes, payments and other revenues administered by them in the bankruptcy proceedings and others activities.*

A survey on the quality of accounting data was conducted on 5,489 enterprises, for each company were calculated individual indicators identified according to used model for determination the quality of accounting data and were calculated QAD by this model. Subsequently, values of quality of accounting data were compared and analyzed with information about financial audit provided by the Tax Offices. It was found that, because the used model is compiled especially for evaluating the quality of accounting data for management, there is no dependency between the various variables.

Key words: Quality of Accounting Data · Regions of the Czech Republic · Tax Offices · Audits

JEL Classification: M41

1 Introduction

Accounting is defined as a system which is characterized by using the accounting principles and methods. Nenadál, Noskievicová, Petříková, Plura and Tosenovsky (2002) like Easton, & Jarrell (1998) say that if the quality control is carried out effectively the company can have considerable results especially from the financial point of view. Enterprises that have successfully established management systems achieve higher performance and better financial results. Users of accounting information are generally interested in assessing current performance as well as estimating future performance. Some of a company's transactions require only a mechanical application of accounting rules while other types depend on the judgment of the managers and accountants. This can introduce intentional and unintentional errors. Those errors reduce the quality of accounting information (Parsley, Chaney, & Faccio, 2011).

Qualified accounting information is a source of information for managers in their decision making. Poor quality of data and information causes serious problems almost everywhere. Most significant problems are reflected in repeated processes and activities, where is created extra work due to poor information inputs, inconsistent, poor or even conflicting data or reports. Regarding intentional errors, it should also be minimized with respect to the number of audits by the Tax Offices.

According to the Tax Code, a tax subject is a taxpayer, a payer and a legal successor of a natural person or legal entity. A taxpayer is a person whose revenues, property or activities are subjected to tax. A payer is a person who, under own proprietary liability, transfers the tax collected or deducted from taxpayers to the tax administrator (Act no. 280/2009 Coll., Law the Tax Code as amended).

During the search activity the tax administrator especially focuses on the detection and analysis of tax operations of high-risk legal entities or legal entity groups. Detecting new types of tax evasions has besides the preventive effect also a direct fiscal impact. During the search activities are used technologies that enable to search risks indicating possible tax evasions in internal and external information sources, subsequently evaluate these risks and consider next steps. The searching activity is organized by the Tax Offices. Concurrently, nationwide search actions are directed by the General Financial Directorate in cooperation with the Police of the Czech Republic and the Customs Administration of the Czech Republic (Financial Administration of The Czech Republic, 2013). As a risk cases were by Financial Administration of The Czech Republic (2013) especially considered this three cases:

- tax subjects whose only economic activity was acquisition of goods from the European Union and its subsequent delivery to the EU with zero tax liability,
- cases of fictitious transactions in order to declare tax liability,
- cases where both received and realized taxable supplies were of the almost same value and therefore with very low tax liability ascribed.

The used model still has not used for any similar research based on evaluation the quality of accounting data in the regions of the Czech Republic based on audits by the Tax Offices.

2 Methods

The main goal of this paper is, based on the quality of accounting data formula, evaluate the quality of accounting data in companies and analyze if this quality has interdependence with numbers of audits by the Tax Offices. The concentration of interest is to determine the quality of the financial data of companies on the basis of established criteria and then determine whether there is a correlation between the quality of accounting data and numbers of audits by the Tax Offices.

Opinion on what is actually the quality of the data and how to measure it is constantly evolving. Because this is not an exact discipline, there are multiple attitudes to how to define data quality and how to measure it. Data quality has a variety of dimensions - you cannot simply say that good quality data is error-free or that the most accurate or the most up to date. Data quality cannot be assessed only by one indicator. Very often cited opinion about the quality of accounting data is that it should be credible, it should be prepared on the basis of the accounting methods and applicable laws and it should be reliable.

The output of financial accounting information for management is often inadequate for several reasons. These are primarily the possibility of influencing accounting data in the context of determined by law regulations and insufficient financial information needed for management. Quality of proceedings depends on the quality of accounting information and statements and their conformity with reality and legislation, as well as their presentation. For certain decisions may be enough available financial information, but the same data can be inadequate for a different decisions (Neely, & Cook, 2011).

Accounting should be a valuable information system and could be a valuable source of data for further analysis. This is mainly because of its accessibility, understandability and clarity, persuasiveness and a high truth value. From the perspective of the user requirements, the quality is defined as suitability to use in the economic calculations (Juran, 1992).

The main attribute of successful managers is that they can access the data they need and their ability this data correctly and timely analyze (Drury, 2012). The area of interest of managers is focused on profitability and financial stability (as opposed to the interests of the owners, who are interested primarily to appreciation of invested capital) and they are the target of manager decisions. The basis for the use of financial information, however, is its utility. Management commitment should be engage in and maintain behaviors that others achieve the goals (Cooper, 2006).

The quality of accounting information is a complex concept, containing the value relevance of accounting information, accounting conservatism, and earnings management. Information will be useful if it is understood and used by the user (Schiper, & Vincent, 2003).

In the application part, model compiled to determine the quality accounting data is used. The model was compiled based on indicators that are primarily based on the accounting information (especially on information from the balance sheet and profit and loss statement) and the indicators of financial analysis. The cornerstone of most indicators was the value of cash flow. The cause of using cash flow indicator is that this indicator is widely perceived as an indicator that

can be (compared to a profit) only difficult to falsify. Indicators based on the cash flows are used for deeper analysis of different situations in a company. Initially was determined 20 indicators what were used for analysis and further investigated. The indicators cover all major areas of accounting, for example income and expenses, assets and liabilities, equity and debt, profit and tax (Vlčková, 2014).

The model for determining quality of accounting data is:

$$\text{QAD} = 1,746 + 1,326x_1 + 0,002x_2 - 0,236x_3 - 0,378x_4 + 0,075x_5 \quad (1)$$

where:

- x1 is the value of indicator (Adjusting items + Reserves) / Total assets,
- x2 is the value of indicator Cash flow / Earnings before interests and taxes,
- x3 is the value of indicator Sales / Total assets,
- x4 is the value of the indicator Cash flow / Liabilities,
- x5 is the value of indicator Interests / Cash flow.

The formula for standard deviation is:

$$s = \sqrt{s^2} = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}, \quad \bar{x} = \frac{\sum_{i=1}^n x_i}{n} \quad (2)$$

where:

- n is the number of data points,
- x_i is each of the values of the data,
- \bar{x} is the mean of the x_i .

Standard deviation is a measure that is used to quantify the amount of variation or dispersion of a set of data values (Hendl, 2012).

The formula for coefficient of determination is:

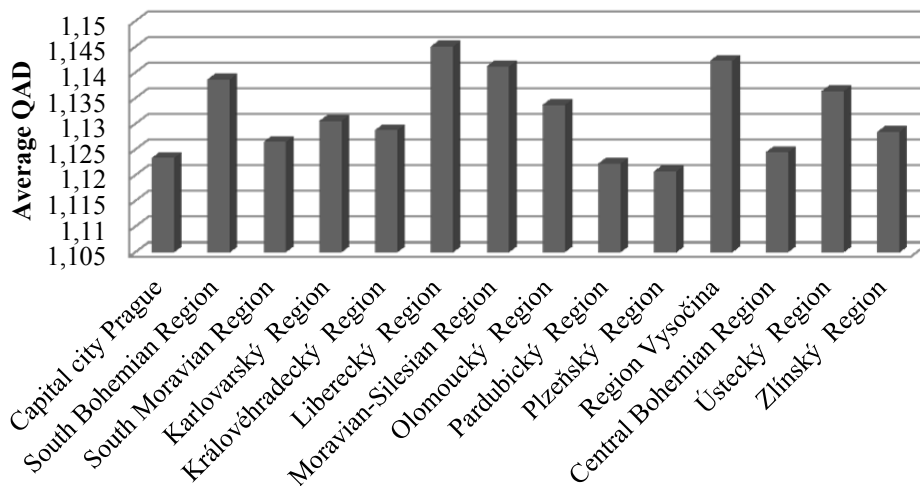
$$R^2 = \frac{\sum(\bar{x}_i - \bar{x})^2}{\sum(x_i - \bar{x})^2} \quad (3)$$

Coefficient of determination is a number that indicates the proportion of the variance in the dependent variable that is predictable from the independent variable (Hendl, 2012).

3 Research results

The research was applied to companies from 13 regions of Czech Republic and Capital city Prague, what have number of employees from 10 to 1999, with annual sales from 10 to 1000 mil. CZK and principal activity is in according to CZ NACE Section C – Manufacturing. The higher the value of QAD is the worst quality of accounting date in the company is. It is on base that the criteria by which was model compiled have negative impact to the company. The value of QAD could be from 0 to 4. Zero means that the accounting data quality is on the best level and four means that the accounting data quality is on the worst level.

Figure 1 Quality of accounting data in regions of the Czech Republic



The analysis was performed in the year 2014 at 5,489 enterprises, for each company were calculated individual indicators identified according to the model used to determination the quality of accounting data and were calculated QAD by this model. For determination the data for the calculation of financial indicators was used data of the balance sheet and profit and loss of individual companies obtained from the database Albertina CZ Gold Edition. The summarized results from research in regions are:

- the average value of QAD is 1.1316,
- the minimal average value of QAD is 0.1208,
- the maximal average value of QAD is 1.1451,
- the standard deviation is 0.0080.

The comparison of the quality of accounting data in the regions of the Czech Republic is on the figure 1.

Financial inspections and tax collections in the Czech Republic are performed by the system of Tax Offices that consists of Financial Directorates, Tax Offices and General Financial Directorate. The Financial Administration of the Czech Republic statistically monitors number of tax subjects registered at the tax administrators' and the number of entities. In 2014, the tax administrators registered 2 448 733 legal entities and natural people. The numbers of legal entities and natural people assorted by regions of the Czech Republic, number of audits per year 2014 and number of employees at audit department are shown in the following table. The research was conducted on the audit of income tax.

Table 1 Audits by Tax Offices in regions of the Czech Republic

Tax Offices	Number of employees at audit department	Number of companies	Number of companies per one employee	Number of audits per year 2014	Number of audits per one employee	Number of audits per one company
Capital city Prague	488	505 151	1 035	2 427	5	0.0169
Central Bohemian region	349	279 312	800	7 119	20	0.0076
South Bohemian region	218	147 994	679	1 612	7	0.0048
Plzeňský region	180	138 844	771	2 345	13	0.0255
Karlovarský region	86	62 137	723	564	7	0.0192
Ústecký region	198	151 053	763	1 316	7	0.0204
Liberecký region	130	100 849	776	1 078	8	0.0070
Královéhradecký region	173	118 146	683	828	5	0.0091
Pardubický region	148	104 772	708	798	5	0.0166
Region Vysočina	140	100 924	721	2 494	18	0.0087
South Moravian region	330	267 291	810	5 120	16	0.0109
Olomoucký region	155	121 114	781	2 014	13	0.0163
Moravian-Silesian region	274	221 587	809	3 601	13	0.0247
Zlínský region	169	129 559	767	2 648	16	0.0107
Total	3 038	2 448 733	806	33 964	11	0.1984

Source: Společnost e-office Czech Republic s. r. o. (2014), Own processing

Results of statistical analysis of relationship between the quality of accounting data and:

- number of employees at audit department $R^2 = 0.138$,
- number of companies per one employee $R^2 = 0.0897$,
- number of audits per year 2014 $R^2 = 0.0561$,
- number of audits per one employee $R^2 = 0.0002$,
- number of audits per one company $R^2 = 0.0041$.

When the quality of accounting data was compared with the number of audits by the Tax Offices no correlation was found between the variables. This may be caused primarily because the quality of accounting data model is compiled especially for evaluating the quality of accounting data for management, respectively it serves as a support model for companies' managers. It is based on the evaluation of information in terms of:

- errors and fraud – accounting fraud by management, unethical behavior of managers, accounting fraud by employees, unethical behavior of employees, creative accounting, accounting errors arising out ignorance, human error accounts,
- accounting methodology – methods of depreciation, methods of valuation, methods of accounting organization, processing technique, internal directive, internal control,
- influence of information system - lack of information, poor internal communication, legislation - too wide or narrow, confusion, frequent changes, requirements for managers in the enterprise's information system.

As you can see, audits by Tax Offices are focused on different criteria. Those audits focus especially on detecting fraud in tax reductions and it is the reason why there is not statistical significant relationship with the quality of accounting data.

4 Conclusions

The article is primarily concerned with comparison the accounting data quality and the number of audits by the Tax Offices. The analysis was performed on 5,489 companies from 13 regions of Czech Republic and Capital city Prague in the year 2014, for each company were calculated individual indicators identified according to the model used to determination the quality of accounting data and were calculated QAD. Then the numbers of companies assorted by regions of the Czech Republic, number of audits per year 2014 and number of employees at audit department were founded out and statistical analysis was performed. It was found that there is no dependency between the various variables. It is because the quality of accounting data model is compiled especially for evaluating the quality of accounting data for management and audits by Tax Offices focus especially on detecting fraud in tax reductions.

References

- Cooper, D. (2006). *The impact of management's commitment on employee behavior: A Field study*. American society of safely engineers.
- Czech Republic. (2009). Act no. 280/2009 Coll., Law the Tax Code, as amended.
- Drury, C. (2012). *Management and Cost Accounting*. 8th rev. ed. Hampshire: Cengage Learning.
- Easton, G. S., & Jarrell, S. L. (1998). The Effects of total quality management on corporate performance: an empirical investigation. *The Journal of Business*, 71(2), 253-307.
- Financial Administration of The Czech Republic. (2013). *The annual report of the Financial Administration of The Czech Republic in 2013* [online]. Available from: <http://www.financnisprava.cz/cs/financni-sprava/novinky/2016>.
- Hendl, J. (2012). *Přehled statistických metod. Analýza a metaanalýza dat*. 4. ed. Praha: Portál, s.r.o.
- Juran, J. M. (1992). *Juran on Quality by Design*. Reed. New York: The Free Press.
- Neely, M., & Cook, J. (2011). FifteenYears of Data and Information Quality Literature: Developing a Research Agenda for Accounting [online]. *Journal Of Information Systems*, 1 [cit. 2014-08-11]. Available from: <http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=9&hid=126&sid=d887487c-934e-4dcb-aa1e-f15210423f09%40sessionmgr14>.
- Nenadál, J., Noskievicová, D., Petříková, R., Plura, J., & Tošenovský, J. (2002). *Moderní systémy řízení jakosti*. 2nd reed. Praha: Management Press.
- Parsley, D., Chaney, P., & Faccio, M. (2011). The Quality of Accounting Information in Politically Connected Firms, *Journal of Accounting and Economics*, 51(1-2), 58-76.
- Shipper, K., & Vincent, L. (2003). Earning Quality. *Accounting Horizons*, Suppl., 97-110.
- Společnost e-office Czech Republic s. r. o. (2014). *Analýza činnosti finančních úřadů* [online]. Available from: <http://www.corporate.cz/e-office/analyza-cinnosti-financnich-uradu>.
- Vlčková, M. (2014). *The quality of accounting data in management-level of business*. České Budějovice [Dissertation]. 146. Faculty of Economics. University of South Bohemia in České Budějovice. Supervisor of the dissertation thesis: doc. Ing. Jindřiška Kouřilová, CSc.

Session 3

Economics of Agriculture

The Development of Agricultural Production and Factors Affecting Operating Economic Results of Farms in the Period 2000 – 2015

Daniel Kopta, Jana Lososová, Radek Zdeněk

Abstract: *The article deals with the development of agricultural production and operating factors affecting economic results in the period 2000 – 2015. Regarding the particularities of 2015 (drought, slumps in milk prices) the conclusion contains an analysis of economic results of this year. The source of data for evaluation is authors' own selective research into production and economic indicators of farms having been carried out at USB since 1996. The study uses the classification of farms according to the portion of land area in LFA to total farmland used. In 2015 there was a drop in profitability in comparison with the previous year. The research revealed that the volume and structure of costs remained roughly at the level of 2014, the main cause of this being the drop in yields. This drop in production value resulted from both the decrease of natural yields (especially in crop production) and the decrease of exercise prices at stable volume of natural yields (concerns livestock production). The impact of the drop of realization prices was more striking.*

Key words: Profit/loss · Profitability · Labour productivity · Subsidies

JEL Classification: Q12 · Q13 · Q14

1 Introduction

The aim of the article is to evaluate the status and development of Czech agriculture through indicators of selected set of farms divided according to the proportion of land in LFA (Less Favoured Areas). The development of agriculture from 2000 is characterized by structural changes as a drop in the number of physical persons and growth of land area per a subject. In contrast, the number of subjects of legal persons increased but their average land area decreased. The reason for that was a division of farms on the one hand, and transfer of cultivated farmland for non-agricultural use. The total land area is decreasing and also the numbers of all main kinds of farm animals were reduced. This is connected with the drop of land area of fodder plants in arable land and reducing areas of autumn barley. Also potatoes, grain legumes and vegetables areas are smaller. On the contrary trading with agricultural commodities had a positive impact on growing rape and other technical plants. The main impact on structural changes in agriculture lies in subsidy policy, which influenced the growth of permanent grass cover, vineyards, breeding cows without milk production. Another significant trend is a drop of workers in agriculture (MZe, 2015).

Doing comparative analyses various methods of classification of farms, e.g. according to the type of production orientation according to FADN based on economic category of Standard Gross Margins (Divila, & Sokol, 1999) are used, or according to farm region or legal form of entrepreneurship (Grznár, & Szabo, 2002). Tavernier and Tolomeo (2004) used for farm typology a relation between a farm size and sustainable agriculture. Daskalopoulou and Petrou (2002) use a division of farms with the aim to determine different types of farms according to their viability and a possibility to accept alternate ways of farming. Duvernoy (2000) successfully used land quality as a criterion for identification of farm types.

A lot of factors outside the field of farm policy influence farmers' income. Possible changes in macroeconomic milieu could have a big impact on agriculture, an example being contemporary global economic crises (Siudek, & Zawojka, 2012). The number of farms in Europe has been permanently decreasing (Glauben, et al. 2006; Breustedt, & Glauben, 2007). Terminating farmers will increase the growth of other farms and re-division of production factors.

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Decreasing number of farms influences not only farming, but also rural areas as a whole (Zimmermann, et al. 2009). The loss of farms can result in depopulating of the country, which is connected with the demand for services and infrastructure of local communities (Ballas, et al. 2006; Piorr, et al. 2009). Agriculture insures a physical existence of population and creates a fund of staple food. Besides it fulfils also nonproduction functions and a function of internal political stabilizing factor in the country (Vošta, 2012).

Čechura (2012) deals with an analysis of technical effectiveness and total productivity of production factors in the CR. Among the main factors determining technical effectivity and productivity of production factors are factors connected with institutional and economic changes, especially a dramatic increase of import of meat and increase of subsidies. Grznár and Szabo (2012) claim that the main cause of differences of Slovak agriculture compared with advanced EU countries is a low level of management costs and bad strategic decisions. Kopta (2009) found out through an analysis of failing farms that farms are endangered due to long –time negative profitability, rapid fluctuation of husbandry results, negative cash-flow from operating activities and financial insolvency. Permanent low profitability afflicts especially mountain farms.

Agricultural production is considerably supported by political and economic tools, especially as subsidy support and it is necessary to analyze continuously the effectiveness of invested means. Kroupová and Malý (2010) claim that analyzed political and economic tools of subsidy policy in the form of direct production support do not have an unambiguously positive influence on the increase of effectiveness of ecological farm.

Connected with the SPZ reform suggestions for removing direct payments after 2013 occur. To what extent such a change could influence dynamics of using of land in Europe, including impacts on structural changes and environment is solved by e.g. Uthes, et al. (2011). They concluded that the abolition of direct payments would affect most seriously regions with less favourable conditions for farming ; on the contrary relatively competitive sectors and highly diversified branches with agrotourist possibilities, good marketing and structure of sale will be affected the least. Acs, et al. (2010) show a real risk of leaving farmland in mountain areas and lowering the number of cattle. Offermann, et al. (2009) examines the status of ecological farms. The results show that a specific support for ecological farming will be important for profitability of ecological farms.

2 Methods

Presented results are outputs of research of selective set of farms classified into 3 groups according to the proportion of land area in LFA to total used farmland. According to the relation to less favourable LFA areas the conditions are classified according to methodology of FADN (2012): mountain areas (LFA M) – more than 50% of land area of used farmland and LFA mountain; the other LFA (LFA O) – more than 50% of used farmland in LFA other and specific if LFA M is smaller than 50%; NON LFA – more than 50% of used farmland is outside LFA. The article used authors' own database of selective research of farms in 2000-2015, in individual years the number oscillates between 82- 149 farms. In 2005 (preliminary results) 15.8 farms worked in mountain LFA areas, in the other LFA 41.5% and in NON LFA 42.7% of farms.

The study monitors the development of farm production in going and basic prices (acc. to 2000). The production structure is given by a proportion of income from individual commodities to total yields of a farm. Similarly the development of subsidies is described; they are related to total yields of a farm. The production structure is described (due to a high volatility of reached yields) through acreage of commodities in arable land.

The development of profit of ind. commodities is described via changes of these factors: the size of production basis (number of hectares, bred animals) , the total volume of production, volume of production to 1 production basis (hectare of farmland, 1 milk cow, etc.), costs for production basis, unit costs, exercise prices. Total farm profit is measured at EBIT level. Due to influencing of this index by the farm size ROA is alternatively counted.

3 Research results

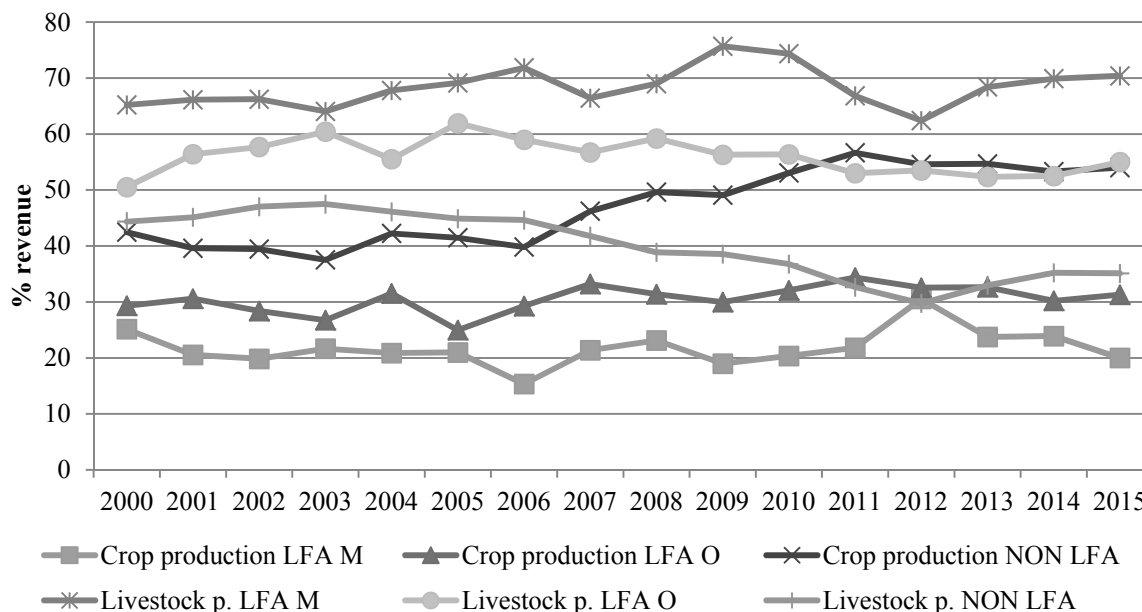
General trends in the farm development within 2000 – 2015

During the reporting period the increase in agricultural production is referred in all monitored categories. Measured in current prices, the volume of production equivalent per hectare of a farmland increased by 65% in mountain LFA, by 75% in other LFA and by 56% in NON LFA areas. The growth of production is therefore most evident in other LFA areas. At the beginning of the reporting period this category of farms appeared close to the mountain areas, but in the course of time this category has approached the NON LFA area. The outcome will show the effects of inflation. Measured in basic prices (i.e. net of inflation) the volume of production increased by 19% in mountain LFA areas, by 27% in other LFA and by 13% in NON LFA areas.

The structure of production is greatly affected by the altitude and the LFA proportion. With decreasing altitude the share of crop production grows and the share of livestock production declines. Such a productive approach of the farms is logical and can be seen from the beginning of the investigation. This trend towards the concentration to one type of production has accelerated in recent years. This can be observed particularly in the production (NON LFA) area in which the share of crop production revenues increased from 42% in 2000 to 54% in 2015 (figure 1). In the mountain LFA category the share of crop production decreased by 9 percentage points to 20% of the total revenues. In the other LFA category the share of crop production stagnates at 32%.

In LFA category the share of livestock production has been growing. In 2015 the LFA M was at 70% and in the other LFA at 55% of the total revenues. In NON LFA category the slight decreasing trend can be shown and amounted to 35% in 2015. The non-agricultural production forms the rest of the revenues (about 10%).

Figure 1 The development of crop and livestock production share on sales



Source: Own processing

Crop production development

The acreage of the farm remains roughly stable in the monitored sample of farms. The partial changes in the structure of agricultural land can be seen. In the mountain LFA areas the share of meadows and pastures increases (by 6 percentage points in meadows and 5 percentage points in pastures). In NON LFA areas, on the contrary, the share of arable land increases and the share of pasture declines (a decline by 4 percentage points).

The structure of the arable land has greater dynamics and the changes of the particular crops share on the arable land were stronger. The decline in the proportion of root crops in both LFA areas (monitored agricultural companies have almost finished with the cultivation of potatoes) and the increase in the proportion of rape may be considered as a significant phenomenon. Specifically, the acreage share of root crops to the arable land in LFA M decreased by 18%, in other LFA by 71% and in NON LFA by 3%. The acreage share of rape to the arable land increased in LFA M by 15%, in other LFA by 40%, in NON LFA by 7%. The structure of cereals on the arable land doesn't change dramatically, the cereals represent in LFA M 43% of the arable land, in other LFA 47% and in NON LFA 53% of the arable land. Natural cereal yields have a growing trend in all areas, the fastest growth can be observed in NON LFA, and the yields of other crops on the arable lands have the growing trend as well.

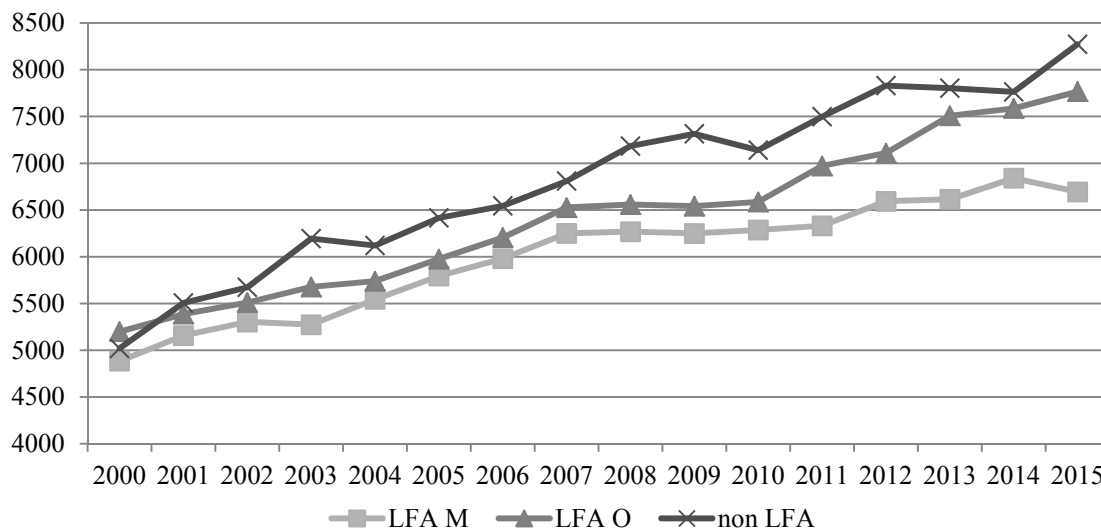
Livestock production development

The density of dairy cows per hectare of the agricultural land has stagnated for the whole period, the slight decline by 2% appeared in 2014. On the contrary, the density of beef cows has been increasing.

Milk production is characterised by growing milk yield (figure 2). An average annual milk yield compared to 2000 increased from 5,056 liters to 7,773 liters per cow in 2015 with the largest increase in NON LFA (by 65%), in LFA M (by 37%) and in LFA O (by 45%). Along with growing milk yield there is also an increase in the costs of a production base (per cow and a year) and due to that the unit costs haven't changed significantly over the period. A more

pronounced increase in a livestock performance in NON LFA area causes lower unit costs by circa 0.5 CZK compared to the mountain LFA. The high price volatility is the main issue of the milk production. Over the monitored period the price fluctuated from 6.2 to 9.7 CZK/l. It is not possible to compensate such high volatility either with unit costs saving or with livestock performance increase. The decline in prices thus represents one of the major sources of negative profitability.

Figure 2 The development of annual milk yield

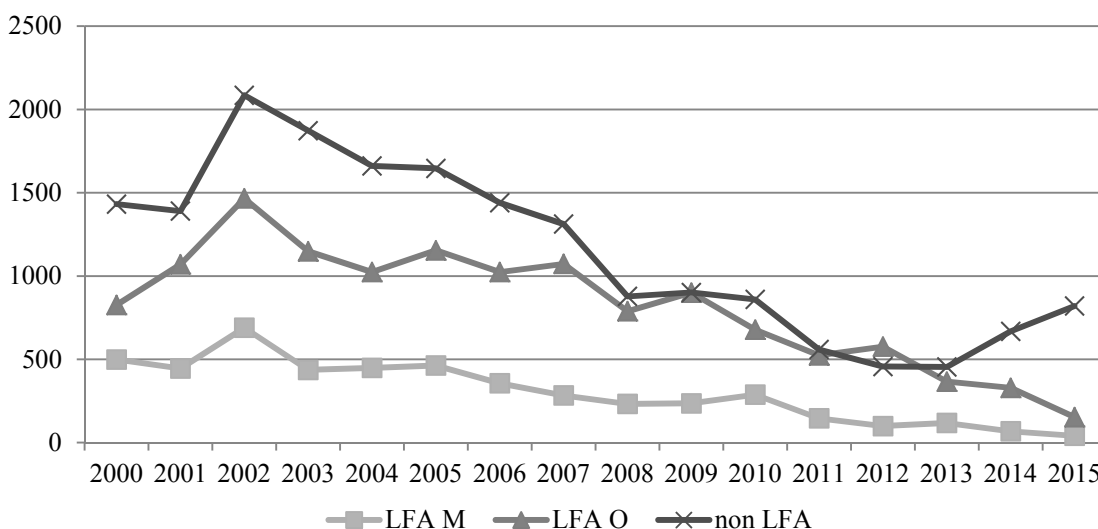


Source: Own processing

The reduction in the number of pigs represents the strong long-term trend (figure 3). Since 2000 the number of pigs has fallen by 55.5%, with the fastest declining stocks in LFA M. The profitability of this commodity represents a long-term loss. In NON LFA the yield of pigs increased by 20%, in LFA O by 17% and in LFA M the performance is largely unchanged compared to 2000. The growing yield results in a fall in the unit costs. The decrease of the unit costs was significant against the decrease of exercise prices and the profitability was negative throughout the period considered.

Over the monitored period, the density of cattle per hectare of agricultural land oscillates approximately at the same levels in all areas. The commodity profitability is positive but low, for the most period. The commodity profitability (profit/income ratio) does not exceed 3%. Meat production is associated with rising milk yield, whereas the increase has given 10% in LFA area and 20% in NON LFA area since 2000. This increase, however, has been associated with the growth of the productive base costs and therefore it has not shown with the unit costs. The high volatility of the production intensity within interfirm confrontation, given by the different ways of breeding cattle makes more detailed assessment difficult.

Figure 3 The number of pigs development in an average farm

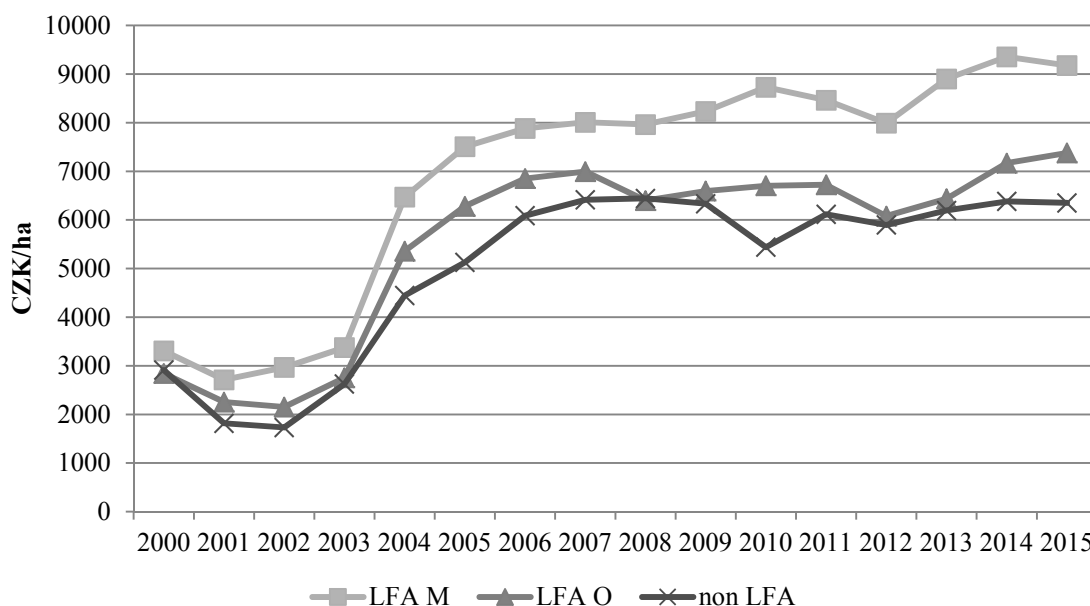


Source: Own processing

Subsidy development

The highest annual increase in the subsidies occurred with the CR entry into the EU in 2004, the first three years after accession the growth of the subsidies was the most dynamic (figure 4). The average annual growth rate of subsidies has given 9.4% in the mountain areas, 8.9 in other LFA areas and 7.6 in outside the LFA since 2000. Subsidies subtraction from the earnings before taxes the average farm is getting into losses in all aspects and this trend has been significantly increasing. The highest decline in the earnings after subsidies subtraction can be referred in the mountain regions. The indicator of dependence on subsidies (the value above 100% indicates the need for subsidies to cover the costs) illustrates rising dependence of the economic situation of the farms. The highest value of this indicator in all categories in 2009, the crisis year, was 145% in LFA M, 121% in NON LFA. In 2015 the indicator value was 126% in LFA M, 116% in LFA O and 111% in NON LFA areas.

Figure 4 The development of subsidies per hectare of an agricultural land in the basic prices in 2000

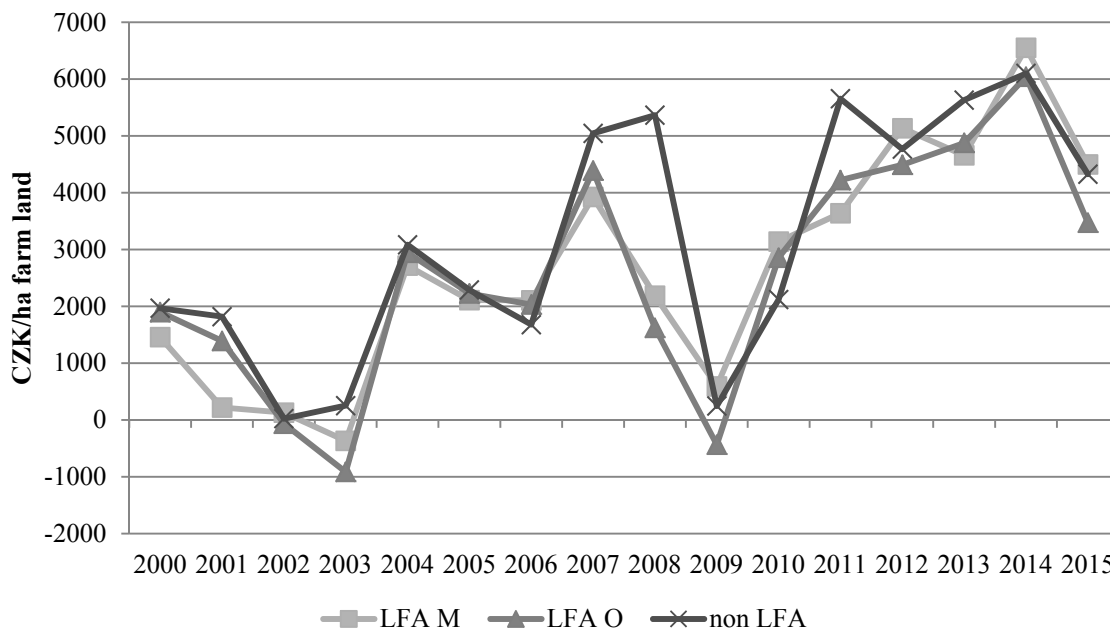


Source: Own processing

Economic result and profitability

The overall indicator of farm management is the economic result for an accounting period. For the needs of the own analysis and for maintaining comparability of particular data the economic result was monitored before interest and taxes (EBIT), expressed per hectare of the agricultural land. EBIT indicator is useful if we are aware of the farm economic result without the impact of taxation and financial costs. EBIT enables to concentrate on sales and costs at the operational level. The economic result expressed per hectare of the agricultural land has been following the upward trend with significant year-to-year fluctuations. The largest profit downturns occurred in 2002, 2003 and 2009. The best economic result was obtained in 2014. The economic result in 2015 in LFA area accounted for 4,497 CZK/ha, in other LFA 3,474 CZK/ha and in NON LFA 4,326 CZK/ha (figure 5).

ROA – profit rate is the most commonly used indicator of profitability. This indicator measures the economic result for an accounting period (i.e. after taxes) against the total assets. The required optimal values of this indicator taking into accounts the impact of risk (obtained, for example, from the INFA model) are above the values currently reachable in agriculture. As required acceptable bound of profitability was established the value of 4% was established as required acceptable value of profitability. The high level of profitability doesn't produce an adequate value for the owner but at least enables the simple replacement of fixed assets taking the inflation into account. After fifteen years of monitoring the average farm achieved this score only five times in 2004, 2007, 2011, 2013 and 2014.

Figure 5 Economic results (EBIT) in CZK/ha of farmland

Source: Own processing

Economic result development in 2015 and its reasons

In 2015 the profitability (ROA) decreased in all areas: in LFA M by 2.5 pp, in other LFA by 1.9 pp and in NON LFA by 2.1 pp.

A survey showed that the costs and their structure remained similar of that in 2014 and the profitability decrease was mainly caused by the decrease of revenues. In 2015 the production, compared to that of 2014, decreased by 2.4% in mountain LFA, by 11.9% in other LFA and by 1.4% in NON LFA, all expressed in going prices. Expressed in basic prices of 2000, the production decrease is more significant: in mountain LFA by 2.7%, in other LFA by 12.2% and in NON LFA by 1.7%.

This decrease of production value is caused by both natural yield decrease (especially in crop production) and the decrease of exercise prices of stable volume of natural yields (in livestock production). The effect of exercise price decrease seemed to be more significant.

Compared to 2014, natural yield decrease caused by dry periods of time was reported in all crops and all areas. The decrease was less significant in crops of shorter growing season (or crop of earlier harvest dates). The slump in yield of the sensitive rape was exceptional. The drought in the late summer played a major role; the slump in yields was referred in maize grains, beet roots, fodder plants and hops (table 1).

Table 1 Crop production in 2015

		Yield in t			Yield in t/ha		
		LFA M	LFA O	NON LFA	LFA M	LFA O	NON LFA
Winter wheat	2014	707	2 107	3 422	6.08	6.80	7.14
	2015	848	1 943	3 471	5.57	6.31	7.08
Spring barley	2014	468	392	626	5.69	6.03	5.90
	2015	427	435	998	4.79	4.70	6.06
Maize for grain	2014	0	47	825		6.66	8.23
	2015	0	6	349		0.31	4.25
Potatoes	2014	352	559	121	20.78	35.94	21.81
	2015	249	228	120	22.77	18.57	19.64
Beet roots	2014	0	0	4 186			68.01
	2015	0	0	4 373			59.25
Rape	2014	250	854	839	4.31	4.03	4.00
	2015	300	710	741	3.67	3.52	3.62

Source: Own processing

An inter-farm comparison of hectare yield volatility brings interesting results. Spatial yield volatility is very high in earlier harvested crops and it was decreasing during the year. It means that although the average impact of drought was lower in the first half of the year, some farms were affected very strongly. The effect of drought in the second half of the year was comparable.

The decrease of revenues on stable or slightly increasing costs per production basis (per hectare) caused a slump of profitability in these commodities which was not compensated with corresponding increase in price (except root crops and spring barley) (table 2).

Table 2 Profitability of crop production in 2015

	Price in CZK/t		Profitability	
	2014	2015	2014	2015
Wheat	3 955	4 053	0.173	0.162
Barley	4 149	4 327	0.177	0.183
Maize	4 063	3 716	0.166	0.025
Potatoes	3 415	4 434	0.031	0.132
Beet roots	831	1 517	-0.364	0.145
Rape	9 483	9 853	0.254	0.086

Source: Own processing

Within products of livestock production, milk production affected the decrease in profit most significantly (table 3). The average performance was increasing as in the previous period. The average milk yield, compared to 2014, increased from 7,514 l/dairy cow to 7,773 l in 2015 whereas the highest increase was referred in NON LFA (by 6.6%). The costs per production basis stagnated which, together with increasing performance, led to corresponding decrease in unit costs. At the same time the exercise prices of milk decreased by 2 CZK/litre. That resulted in loss of 4,487 mil CZK in average farms. This loss could only be declined by the decrease in unit costs and positive increase in performance.

Table 3 Profitability of milk production in 2015

	Price of milk in CZK/l		Profitability		Impact of exercise price on profit (thous.CZK)
	2014	2015	2014	2015	2015
Mountain	9.61	7.89	0.071	-0.153	-3 532
LFA O	9.74	8.13	0.086	-0.033	-6 259
NON LFA	9.26	7.57	0.076	-0.124	-3 162
Total	9.54	7.90	0.08	-0.083	-4 487

Source: Own processing

4 Conclusions

The reference period was characterised by moderate increase in agricultural production. Measured in basic prices (i.e. after adjusting for inflation) the production increased in mountain LFA by 19%, in other LFA by 27% and in non LFA by 13%. Farm specialization has become dependent on the altitude and LFA share. The share of crop production is increasing in NON LFA and the share of livestock production is increasing in mountain LFA. In terms of the structure of crop production, there is significant decrease in root crops and increase in rape in both LFAs.

Operating profit of the farms follows an upward trend but it is sufficient for required return. Moreover frequent slumps into loss are referred. Most commodities of livestock production end in loss. Unit costs of particular commodities remain stable (or decrease moderately) even though the costs per production basis increase. Higher costs per production basis are offset by significant growth in performance. The difficulties of livestock production consist in low exercise prices. It is a long-term problem in pig breeding, the exercise price in milk production is characterised by high volatility. Profitability slumped several times in the reference period thanks to this factor. The slump in exercise prices seems to be most significant in 2015. It was caused by both changes in milk quotas and Russian embargo.

Profitability of crop production is also characterised by high volatility. This volatility results from changes in hectare yield caused by weather conditions (together with the impact of exercise prices), e.g. the drought in 2015.

Acknowledgements

The authors thank the Ministry of Education of the Czech Republic for financial support, Research Program of the Department of Accounting and Finance (RVO160).

References

- Acs, S., Hanley, N., Dallimer, M., Gaston, K. J., Robertson, P., Wilson, P., & Armsworth, P. R. (2010). The effect of decoupling on marginal agricultural systems: Implications for farm incomes, land use and upland ecology. *Land Use Policy*, 27, 550-563.
- Ballas, D., Clarke, G. P., & Wiemers, E. (2006). Spatial microsimulation for rural policy analysis in Ireland: the implications of CAP reforms for the national spatial strategy. *Journal of Rural Studies*, 22, 367-378.
- Breustedt, G., & Glauben, T. (2007). Driving forces behind exiting from farming in Western Europe. *Journal of Agricultural Economics*, 58, 115-127.
- Čechura, L. (2012). Technical efficiency and total factor productivity in Czech agriculture. *Agric. Econ. – Czech*, 58 (4), 147-156.
- Daskalopoulou, I., & Petrou, A. (2002). Utilising a farm typology to identify potential adopters of alternative farming activities in Greek agriculture. *J. Rural Stud.* 18 (1), 95-103.
- Divila, E., & Sokol, Z. (1999). Problémy klasifikace a třídění zemědělských podniků. *Agric. Econ. – Czech*, 45, 459-466.
- Duvernoy, I. (2000). Use of a land cover model to identify farm types in the Misiones agrarian frontier (Argentina). *Agric. Syst.* 64(3), 137-149.
- Glauben, T., Tietje, H., & Weiss, C. (2006). Agriculture on the move: exploring regional differences in farm exit rates in western Germany. *Jahrbuch für Regionalwissenschaft*, 26, 103-118.
- Grznár, M., & Szabo, L. (2012). Disparities in the utilisation of production factors in the agriculture of Slovakia and of the European Union. *Agric. Econ. – Czech*, 58 (2), 49-55.
- Grznár, M., & Szabo, L. (2002). Niektoré faktory úspešnosti agrárnych podnikov v SR. *Agric. Econ. – Czech*, 48, 367-371.
- Kopta, D. (2009). Possibilities of financial health indicators used for prediction of future development of agricultural enterprises. *Agric. Econ. – Czech*, 55 (3), 111-125.
- Kroupová, Z. & Malý, M. (2010). Analýza nástrojů zemědělské dotační politiky – aplikace produkčních funkcí. *Politická ekonomie*, 2010 (6), 774-794.
- MZe (2015). *Zprávy o stavu zemědělství (Zelené zprávy)* [on-line]. [cit. 2016-09-20]. Available from: <http://eagri.cz/public/web/mze/zemedelstvi/publikace-a-dokumenty/zelene-zpravy/>.
- Offermann, F., Nieberg, H., & Zander, K. (2009). Dependency of organic farms on direct payments in selected EU member states: Today and tomorrow. *Food Policy*, 34, 273-279.
- Piorr, A., Ungaro, F., Ciancaglini, A., Happe, K., Sahrbacher, A., Sattler, C., Uthes, S., & Zander, P. (2009). Integrated assessment of future CAP policies: land use changes, spatial patterns and targeting. *Environmental Science & Policy*, 12, 1112-1136.
- Siudek, T., & Zawojcka, A. (2012). How does the general economy and the agriculture sector performance influence the farm producer support in the OECD countries? *Agric. Econ. – Czech*, 58 (3), 101-118.
- The Farm Accountancy Data Network (FADN): standard results*. [on-line]. [cit. 2015-05-14]. Available from: <http://www.vsbox.cz/fadn/index.htm>.
- Uthes, S., Piorr, A., Zander, P., Bienkowski, J., Ungaro, F., Dalgaard, T., Stolze, M., Moschitz, H., Schader, Ch., Happe, K., Sahrbacher, A., Damgaard, M., Toussaint, V., Sattler, C., Reinhardt, F-J., Kjeldsen, Ch., Casini, L., & Müller, K. (2011). Regional impacts of abolishing direct payments: An integrated analysis in four European regions. *Agricultural Systems*, 104, 110-121.
- Vošta, M. (2012). Agriculture under the conditions of globalisation focussed on the expansion of the EU. *Agric. Econ. – Czech*, 58 (4), 165-171.
- Zimmermann, A., Heckeley, T., & Domínguez, I. P. (2009). Modelling farm structural change for integrated ex-ante assessment: review of methods and determinants. *Environmental Science & Policy*, 12, 601-618.

Specifics and Financial Health Assessment in Agriculture

Kristýna Nývltová

Abstract: *There are many methods for the financial health assessment of a company; the most utilized include statistical methods that evaluate the business from multiple perspectives simultaneously. Since each model has been formed under different conditions and on a different date, it may not be suitable for the assessment of all businesses. In this article six models are assessed, some designed for the field of agriculture. The selected models are IN99, IN05, the Gurčik-index, the CH-index, the Taffler index and the Řezbová OP model. In the analysis, their reliability in identifying healthy companies and businesses with financial problems are compared.*

None of the models have achieved good results in both analyses simultaneously, which leads to the question: Why is this so? The cause may be the specifics of agriculture that are not taken into account in the models and thus they can influence the outcome of the assessment. The specifics are the value of the land that is not determined by its quality, but by the locations, the value of the leased land, which is not included in the value of assets, as well as the work of nature, the value of the subsidies, which affects the amount of assets and the net profit or costs of fertilizer, which has an effect even for three years.

Is there the ability to include these specifics into some of the methods of assessment and thus achieve greater reliability and the efficiency of allocation not only of private investors' resources but also the subsidies? This will be the subject of the further analysis.

Key words: Financial Health Assessment · Agriculture · Risk · Explanatory Power

JEL Classification: M41 · Q1 · G3

1 Introduction

This paper is focused on the financial health assessment of the farm. Financial health assessment through the credibility and bankruptcy model is widely-used. It has many advantages but the outcome of these models can be untruthful. These models use information from financial statements. Since agriculture is a rather specific field of business, it is assumed that the specifics are reflected in the results of this assessment. For example Kouřilová, Pšenčík & Kopta (2009), Valder, Dvořáková (2015) or Kouřilová & Drábková (2009) deal with some specifics of agriculture. Kouřilová, Pšenčík & Kopta (2009) follow up on subsidies in agriculture, Kouřilová & Drábková (2009) describe problems with calculations, Valder deals with land and its valuation and Dvořáková (2015) delineates problems in Czech accounting legislation, for example, with leasing (for example of land). These specifics are also the subject of this research. The fact that the actual rating through bankruptcy and credibility models is not enough, is also said by Šindelářová (2006) in her work. Gustafson (1989) also notes that not only financial indicators but also other information, for example the environment surrounding the agricultural enterprise, should be included in the financial health assessment

This article evaluates the reliability of the selected models in recognizing enterprises that are in trouble. The second part establishes significant indicators and their impact on the outcome of financial health assessment using these models. For example Kopta (2009), Maňasová (2008), or Sušický (2011 I., II.) deal with the evaluation of the reliability of credibility and bankruptcy models. For example Kopta (2009), Sušický (2011 I., II.) or Maňasová (2008) deal with the evaluation of the reliability of credibility and bankruptcy models. Kopta (2009) evaluated the reliability. He focussed on financial problems caused by two factors: profitability and cash flow. In his analysis of the prediction of problems due to profitability, the model for Rural Development Programme and the Gurčik index came out as the best. The CH-index and IN95 responded best to threats arising from cash flow. He also did an analysis of the reliability by determining the thriving enterprises. The 'Řezbová OP model' for the Operational Programme Rural Development came out as the best (reliability of 89.68%). The second was the Grünwald index (62.90%) and the third the Gurčik index (only 33.23%). Sušický (2011, I. II.) assessed bankruptcy models and their reliability by the recognizing thriving and bankruptcy companies. He assessed models from Altman, Neumaiers and the Taffler model. Model IN99 was the second best (after the ZETA model) in recognizing bankruptcy companies. By recognizing thriving companies the first was Taffler model with the reliability of 98%. Maňasová (2008) first evaluated the success rate of bankruptcy prediction models on enterprises that actually got into troubles in the following years. With no distinction between

sectors, the IN05 index was the best. She also dealt with the same evaluation depending on specific sectors. In the field of agriculture, the ZETA and Z-Score models generated the best results. The IN models of the Neumaier also achieved very good results.

The aim of this article is to define the reliability of models for recognizing companies with problems and thriving companies.

2 Methods

The first part includes an analysis of the reliability of the selected models in identifying thriving companies and an analysis of the reliability in predicting problems. For the analysis, the data set from the Albertina Gold database was used. The financial statements from 2010 to 2014 of enterprises which were in bankruptcy or liquidation in 2015 were used to determine the reliability by predicting the companies' financial problems. The same amount of data records of companies which were not in liquidation or in bankruptcy were used for the analysis of thriving companies. This data set was selected by random sampling in order to better representation. On selected dates, a test of normality - Shapiro-Wilk test was performed, which proved the normality of this data set. All available data records from the years 2010 to 2015 were used to analyse the most significant indicators by the financial standing assessment of companies. For this analysis the Generalized linear models, concretely the multinomial logit model is used. There is used the Wald statistic which is computed as the generalized inner product of the parameter estimates with the respective variance-covariance matrix, is an easily computed, efficient statistic for testing the significance of effects.

This included companies from all 14 regions, with the most prominent being the regions of South Moravia, Central Bohemia and South Bohemia. 70.4% of the financial statements are full, in their entirety. The number of employees ranges from 11 to 44. The most represented is the number 12, with almost 31%.

The analysis examined six selected models of financial health assessment, namely: IN99, IN05, the Gurčík model, the CH-index, the Taffler index and the 'Řezbová OP model' index for the Operational Programme Rural Development. The Gurčík model, the CH-index and the 'Řezbová OP model' index for the Operational Programme Rural Development were chosen because they were created within the context of the Czech Republic and Slovakia (which is very similar) and because they were intended for the assessment of enterprises in agriculture. Another three models were chosen for the comparison of the results of the analysis.

2.1 Index IN99

Index IN99 is creditworthy model constructed from the perspective of the owner by the Neumaier in Czech Republic in 1999. To create this new index the discriminant analysis has been used. Due to this analysis, the weights of the index IN95 were revised. During the revision their importance for achieving positive economic profit was taken in view.

$$IN99 = 0.017 * \text{Assets} / \text{External capital} + 4.573 * \text{EBIT} / \text{Assets} + 0.481 * \text{Revenue} / \text{Assets} + 0.015 * \text{Current assets} / \text{Current liabilities}$$

According to the resulting value, companies are classified as follows:

$IN99 > 2.07$	the company creates a new value for the owner
$1.42 \leq IN99 < 2.07$	the company rather creates a new value for the owner
$1.089 \leq IN99 < 1.42$	Unable to determine whether the company creates the value for the owner or does not
$0.684 \leq IN99 < 1.089$	the company does not rather creates a new value for the owner
$IN99 < 0.684$	the company does not creates a new value for the owner (Neumaierová, Neumaier; 2002)

2.2 IN05

This model was created by the Neumaier in the Czech Republic in 2005. It also takes into account the viewpoint of the owner.

The index equation is as follows:

$$IN05 = 0.13 * \text{Assets} / \text{Liabilities} + 0.04 * \text{EBIT} / \text{Interest payable} + 3.97 * \text{EBIT} / \text{Assets} + 0.21 * \text{Revenue} / \text{Assets} + 0.09 * \text{Current assets} / \text{Current liabilities}$$

According to the resulting value, companies are classified as follows:

$1.6 < IN05$	enterprise creates value
$0.9 < IN05 < 1.6$	grey zone
$IN05 < 0.9$	enterprise does not create value (Lososová & Zdeněk, 2014)

2.3 Gurčik model

The Gurčik model was created by Professor Gurčik in Slovakia and is designed to assess the financial health of Slovak agricultural enterprises. This is a credibility-property index that classifies businesses as thriving or ailing.

$$G = 3,412 * RE/A + 2,226 * P/A + 3,277 * P/REV + 3,149 * CF/A - 2,063 * INV/REV$$

Where: A assets
 RE retained earnings
 P profit
 REV revenues
 CF cash flow
 INV inventories

According to the resulting value of the Gurčik index, enterprises are classified as follows:

1.8 < G thriving enterprises

-0.6 < G < 1.8 grey zone

G < -0.6 enterprises going bankrupt (Gurčik, 2002)

2.4 CH-index

The CH-index (Chrastinová index) is a bankruptcy model. It was created by Zuzana Chrastinová for Slovak agricultural enterprises in 1998. The equation is as follows:

$$CH = 0.37 * P / A + 0.25 * P / REV + 0.21 * CA / CL - 0.1 * CL / REV - 0.07 * EC / A$$

They are: A assets
 P profit
 REV revenues
 CA current assets
 EC external capital
 CL current liabilities

Evaluation of the result of CH-index calculation:

2.5 < CH thriving enterprises

-5 < CH < 2.5 grey zone

CH < -5 enterprises going bankrupt

2.5 'Řezbová OP model' for the Operational Programme Rural Development (hereinafter 'Řezbová OP model')

This model was specifically designed for the Operational Programme Rural Development by the State Agricultural Intervention Fund of the Czech Republic Řezbová (Rosochatecká & Řezbová, 2004). It contains 10 indicators of financial analysis. Points are allocated according to the result achieved in the individual indicators. Financial health assessment is carried out for the last three closed accounting periods.

The calculation is made for every year and the final score is the arithmetic average of the results from individual years. Enterprises can achieve a score of 0 to 30 points. If the company obtains a minimum of 9.01 points, it is assessed as financially healthy. In the table below you can see the resulting assessment based using the index for the Operational Programme Rural Development Řezbová OP model.

Table 4 Resulting assessment of Řezbová OP model

Category A	from 22.01 to ∞
Category B	from 14.01 to 22.00
Category C	from 9.01 to 14.00
Category D	From 6.01 to 9.00
Category E	From 0.00 to 6.00

Source: State Agricultural Intervention Fund, 2016

The applicants in categories A – C meet the conditions for subsidy.

This model includes the indicators of return on assets and long-term profitability, return on performance from cash flow, added value / inputs, total debt, interest coverage, coverage of stocks by net working capital, maturity of debt from cash flow, overall liquidity and investment activity.

2.6 Taffler model

Taffler model is a bankruptcy model, which gives the probability of bankruptcy. The indicator was published in 1977 and contains four indicators.

$$TM = 0.53 * \text{earnings before taxes} / \text{current liabilities} + 0.13 * \text{current assets} / \text{external capital} + 0.18 * \text{current liabilities} / \text{assets} + 0.16 * \text{Revenue} / \text{Assets}$$

According to the resulting value, companies are classified as follows:

TM > 0.3	Low probability of the bankruptcy of the company
0.2 < TM < 0.3	the grey zone of undefined results
TM < 0.2	increased probability of the bankruptcy of the company (Taffler, 1984)

3 Research results

This paper contains three analyses. Two analyses were performed on the selected models, while the third used more than 10,000 data records to identify the statistically significant indicators. One chapter is devoted to specifics of agriculture, which can influence the results of financial health assessment through the selected models.

3.1 Analysis

The first analysis was performed on the data of companies which had no problems in the years of the data records. The results of this analysis are shown in table 2. There are percentages for the correct classification, for inclusion in the grey zone and for a wrong classification.

Table 5 The reliability of models in recognizing thriving companies

Classification by models	Correctly classified as successful		Grey zone	Incorrectly classified as threatened	
Řezbová OP model	98.62		-	1.38	
Gurčik index	15.9		59.34	24.1	
CH – Index	7.5		91.71	0.79	
IN05	29.65		38.89	36.46	
Taffler model	69.5		15	15.5	
IN99	6.5	8.5	7.5	21	56.5

Source: Own processing

The Řezbová OP model was the most successful in identifying thriving companies. The Taffler model had a success rate of 70%. The CH-index classified more than 90% of businesses into the grey zone. The biggest error rate in the classification of the thriving enterprises was exhibited by IN05.

According to the results of the analysis of Kopta (2009), the Řezbová OP model for the Operational Programme Rural Development is the best one, with the next being the Grünwald index. The Gurčik model achieved a success rate of only 33.23%. According to the analysis of Sušický (2011), the best model for recognizing thriving companies is the Taffler model with a reliability of 98%. Neumaier's models had a success rate below 50%.

By creating the Gurčik model, companies with a profit between 1988 and 2000 and with profitability higher than 8 percent were included among the thriving companies. This can be the cause why the Gurčik model achieved poor results.

The next part includes an analysis of the reliability of the selected models in predicting financial problems. The reliability in identifying problematic enterprises were evaluated. Table 3 shows the results with a success rate in percentage.

Table 3 Reliability (in percentage) of the selected models in predicting the enterprise's financial problems

Classification by models	Correctly classified as threatened		Grey zone	Incorrectly classified as successful	
Řezbová OP model	17.65		-	82.35	
Gurčik index	50.27		44.97	4.76	
CH – Index	86.08		6.19	7.73	
IN05	63.46		23.08	13.46	
Tafflerův model	19.74		22.37	57.89	
IN99	72.37	24.34	0	2.63	0.66

Source: Own processing

The analysis shows that the IN99 is the best for the prediction of the financial problems of a company, with a 96% success rate. The second was the CH-index with a success rate of 86.08%. In addition, only 7.73% of the companies were improperly ranked among successful businesses. The IN05 and Gurčik index achieved a reliability of over 50%. The Gurčik index also had the lowest error rate (4.76%). Conversely, the Řezbová OP model shows the highest error rates. It included 82.35% of businesses in liquidation or bankruptcy among the successful businesses.

IN99 and IN05 also came out as the suitable models for recognizing enterprises in difficulties in the analysis of Sušický (2011, II.). According to the analysis of Kopta (2009), the Gurčik index was evaluated as the best at recognizing problems due to profitability and the Řezbová OP model for cash flow.

My results are different from the results of other researchers as Kopta, Řezbová or Rosochatecká. The differences with the Řezbová OP model can be caused by the changing of the conditions of this model. This model was changed in April of this year. One indicator was added and the minimum number of points for the inclusion of the company among successful companies was reduced from 15 to 9.

Since neither of these models has achieved good results in both analyses at the same time, statistically significant indicators of the financial situation were determined in the next step. The analysis of generalized linear models was used to set the relationship between the actual state of the company and the individual indicators, both absolute and relative. Major indicators are highlighted in red in table 4.

Table 4 The analysis of individual and ratio indicator (red are statistically significant)

Individual indicator	Wald. Stat.	P	Ratio indicator	Wald. Stat.	P
Absolute term	262.0441	0.000	Retained profit/assets	1.497	0.221135
Total assets	262.0441	0.355	Profit/assets	23.56	0.0000
Current assets	0.8716	0.8060	Profit/revenues	0.0122	0.9120
Inventories	0.0603	0.7825	Cash flow/assets	12.0963	0.000505
Short-term receivables	0.0762	0.3091	Inventories/revenues	0.0176	0.8944
Financial assets	3.8303	0.050	Assets/net profit	0.0010	0.9749
Liabilities	0.00	0.9875	EBIT/interest expenses	0.4935	0.4897
Equity	0.7767	0.3781	EBIT/assets	14.8661	0.0001
Registered capital	0.5132	0.4737	Revenues/assets	7.8078	0.0052
External capital	0.4646	0.4954	Current assets/ short-term liabilities	1.4,002	0.2366
Long-term liabilities	0.8095	0.368	Short-term liabilities/revenues	0.1019	0.7495
Revenues	5.7779	0.016229	External capital/assets	7.0074	0.0081
Cost of sales	9.0489	0.002629			
Depreciation	3.8906	0.048556			
Profit of current reporting period	3.4178	0.1653			
Interest expenses	1.9245	0.5132			
EBIT	6.5199	0.01066			
CASH FLOW	5.5310	0.01868			

Source: Own processing

Among the most important indicators are the EBIT and cash flow; revenues from sales of products, goods and services; the cost of these products, goods and services and depreciation of tangible and intangible assets. Among the

ratio indicators the indicators of return on assets in various forms and the total debt are significant. These indicators will be used in the next step in setting up a model that would achieve greater success.

3.2 Specific of agriculture

The specifics of agriculture can also play a role in the not too big success rate of the evaluated models. These specifics may affect the final value models. We can include subsidies among the important specifics. The posting of investment subsidies according to Czech accounting standards is specific. The value of investment subsidies is not charged to income, but it reduced the value of the acquired assets. This leads to a distortion of the values of assets. The actual amount of the valuation of the acquired assets is shown in the balance sheet accounts, which are not part of mandatory disclosure requirements. Operating subsidies are posted to income. The profit or loss is contained in each model for financial health assessment.

For the valuation of animals from own breeding, the calculations are used. Each entity chooses the calculation formula. It can contain different items. It is the choice of the entity which product it determines as the primary and which as a by-product. The same animal can be valued by each entity in a different amount. (Kouřilová, Drábková, 2012)

In the field of agriculture, the valuation of land also plays a role. The land is valued at cost, which is determined by its location, not by the quality of the land. This can lead to improper valuation at the time of acquisition. In our conditions, it is impossible to revalue assets upwards. It may also lead to a distortion of asset values.

A very frequent phenomenon is also the renting of the land on which the farmer farms. Land renting is charged just like any other rental. The rented assets are the property of the lessor. Only the payments for the rent are in the statements of the lessee, posted as costs. So it may happen that the main asset used in agriculture is not included in the assets of the farmer.

Another specific is the work of nature. It is very difficult to determine its value, but to see the actual image of the company would be advisable to take it into account in the financial statements. One of the ways is listed in the Austrian text book 'Betriebswirtschaft und Buchführung'. This is calculated as the difference between revenues and variable costs. Changing costs, for example the costs of food, energy, health care, in the case of pig breeding on the meadow or dairy breeding with green feeding are calculated there.

Even the value of some indicators may be characteristic for some sectors. In agriculture, the value of current liquidity is especially high. This indicator is included in the indicators IN or in the Taffler model. Some non-standard indicators such as the ratio of assets / foreign sources (included IN95) can take extreme values and thus affect the overall value of the model. This should just be overridden by the scoring model Řezbová OP. Its results are not positive.

All of the above-mentioned specifics may negatively affect the outcome of the financial health assessment through models, if the specifics are not taken into account in this model. In models intended for agriculture, the influence of these specifics should be limited, but even they have not reached good results in analysis.

The aim of the next step of my research will be the possibility to take these specifics into account by financial health assessment.

4 Conclusions

This article is focused on the specifics and financial health assessment of agricultural companies. In the analysis of thriving companies, the Řezbová OP model was the most successful. The Taffler model had a success rate of 70%. The CH-index classified more than 90% of businesses into the grey zone. The analysis of companies with financial problems shows that the IN99 is the best for the prediction of financial problems of a company with a 96% success rate. The second was the CH-index with a success rate of 86.08%. Based on the analysis of the selected models, no model is suitable for the assessment of the financial situation of businesses and thus there is an analysis of statistically significant indicators.

Among the most important indicators are the EBIT and cash flow; revenues from sales of products, goods and services; the cost of these products, goods and services and depreciation of tangible and intangible assets. Among the ratio indicators the indicators of return on assets in various forms and the total debt are significant. These indicators will be used in the next step in setting up a model that would achieve greater success.

The cause of the poor results of the selected models may be the specifics of agriculture. Among the specific we can include subsidies, land evaluation, land renting, calculation or the work of nature. For models designed for farms, these specifics should be partly eliminated, but their results are not good in any way. The possibility of including the specifics of agricultural areas into financial health assessment models will be one aim of the further research.

Acknowledgement

This work was performed with the support of the grant GAJU 149/2014/S.

References

- Chrastinová, Z. (1998). *Metódy hodnotenia ekonomickej bonity a predikcie finančnej situácie poľnohospodárskych podnikov*. Bratislava: VÚEPP. ISBN 80-8058-212-2.
- Dvořáková, K. (2015). Shortcomings of Accounting Legislation to the Needs of the Agricultural Sector due to its Specifics with Focus on the Biological Assets. In *Proceedings of the 9th International Scientific Conference INPROFORUM* (pp. 211-216), České Budějovice, ISBN 978-80-7394-536-7.
- Gurčák, L. (2002). Gindex – metóda predikcie finančného stavu poľnohospodárskych podnikov (G-index – the financial situation prognosis method of agricultural enterprises). *AGRIC. ECON.*, 48(8), 373-378. ISSN 1805-9295.
- Gustafson, C. R. (1989). Credit evaluation: Monitoring the financial health of agriculture. *American Journal of Agricultural Economics*, 71(5), 1145-1151.
- Kopta, D. (2009). Possibilities of financial health indicators used for prediction of future development of agricultural enterprises. *Agricultural Economics*, 55(3), 111-125, ISSN 1805-9295.
- Kouřilová, J., & Drábková, Z. (2012). Vypovídací schopnost účetních výkazů (I). (The explanatory power of financial statements). *Finanční řízení a controlling v praxi*, 3(5), 24-27. ISSN 1804-2996
- Kouřilová, J. (2010). Multifunkční ekologické a konvenční zemědělství se zřetelem na podhorské a horské oblasti, část II., České Budějovice: Jihočeská univerzita v Českých Budějovicích. ISBN 978-80-7204-683-6.
- Kouřilová, J., Pšenčík, J., & Kopta, D. (2009). *Dotace v zemědělství*. České Budějovice: Jihočeská univerzita v Českých Budějovicích, Ekonomická fakulta. ISBN 978-80-7204-637-9
- Neumaierová, I., & Neumaier, I. *Výkonnost a tržní hodnota firmy*. 1. ed. Praha: Grada, 2002. ISBN 80-247-0125-1.
- Rosochatecká E., Řezbová H. (2004). Methodical approach to evaluation of financial health of agricultural enterprises in relation to the Sector Operational Program. *Agricultural Economics – Czech*, 50(3), 110-115. ISSN 1805-9295.
- Sindelarova, J. (2006). Approaches to assessment of financial health. In *Proceedings of Scientific Conference on Hradec Economic Days 2006: Business and Regional Development* (pp. 465-469). Hradec Králové, Czech Republic. ISBN 80-7041-895-8.
- Six et al. (1996). *Betriebswirtschaft und Buchführung A/2*. Graz: Leopold Stocker Verlag. ISBN 3-7010-0769-5.
- Sušický, J. (2011, I). Applicability of Bankruptcy Models at Agricultural Companies. *Economic Studies & Analyses/Acta VSFS*, 5(3), 241-252.
- Sušický, J. (2011, II.). *Využitelnost bankrotních modelů a jejich aplikace v podmínkách České Republiky* [Dissertation]. Praha: Česká zemědělská univerzita v Praze, Provozně ekonomická fakulta.
- SZIF (2016). *Metodika výpočtu finančního zdraví* [online]. Státní zemědělský intervenční fond. [Accessed: 05 May 2016]. Available from: http://eagri.cz/public/web/file/409515/Metodika_pro_vypocet_financniho_zdravi_2.kolo_MZe_aktualizace_11_4_2016.pdf,
- Taffler, R. J., & Tseung, M. (1984). The audit going concern qualification in practice-exploding some myths. *The Accountants Magazine*, 263-269.
- Valder, A., & Ryska, J. (2004) *Krise účetního hodnocení zemědělské půdy* [online]. Available from: http://www.agris.cz/Content/files/main_files/61/139144/valder.pdf.

Foodstuffs self-sufficiency of Czech Republic in the Context of Long-term Structural Changes in Primary Agricultural Production

Marie Prášilová, Radka Procházková, Pavla Hošková

Abstract: *Farming sector is a significant part of CR national economy. It belongs to sensitive economic areas, since its specifics are directly connected to natural and climate phenomena. Farming sector has accounted for 2.7% only of total employment, however, farmers have been cultivating about 60% of CR territory. The paper analyzes long-term development tendencies of Czech agriculture's efficiency and the impact of these upon self-sufficiency of Czech Republic in basic agricultural commodities production. It is aimed at an analysis of the development of selected natural indicators such as areas sown, crop production, livestock numbers and livestock production. Applying advanced statistical methods the long-term development tendencies have been described and modeled and future development forecasts set up. The solution connects to accessible EuroStat, Czech Statistical Office and CR Ministry of Agriculture data bases. Therefore, the time series have not been limited explicitly. Data analyzed have further on been applied in statistical modeling of the balance of agricultural production and food-stuffs self-sufficiency. Even in spite of the adequate soil-ecological conditions of Czech rural countryside there has not so far been much success registered at the efforts to reverse or at least mitigate the decline of economically demanding commodities' domestic production. The paper examines current self-sufficiency level in traditional commodities of Czech agriculture, regarding possible alternatives connected with the new CAP and with CR Ministry of Agriculture's efforts for sustainable development of farming and countryside and with CR nutrition policy.*

Key words: Agriculture CR · Natural indicators · Animal production · Plant production · Self-sufficiency

JEL classification: C8 · C22 · Q10

1 Introduction

Czech farming sector is a part of European markets and it is subject to the EU CAP rules. The CAP's target is to secure sustainable food production and stable food supplies within the EU. At the same time it answers to the questions of food security, rural economy, good living conditions for the animals, social interests and environment. Since CR accession to the EU a significant change of Czech agriculture arrived. It has been connected namely with commodities production profitability as given by the agriproducers' prices, the cost competitiveness of Czech producers, but with the competitors' strength from the neighbouring EU states, too.

Agriculture's share on GDP total has shown a decreasing trend similar as employment's development in the farming sector. The decline of relative indicators has been accompanied, in case of Czech agriculture, by a permanent decline of the industry size, too. Predominance of crop production and expansion of the extensive farming types can be considered a significant structural change. Species diversity of farm crops has been reduced. The strategy for Czech agriculture and foodstuffs industry is presuming a further expansion of energy crops and biofuel production. However, this should not endanger foodstuffs self-sufficiency of Czech Republic (Hlaváček et al., 2012). The Czech Republic is getting still more dependent on imports of some foodstuffs. The range of farm products where home production is below the consumption level is expanding.

There are different views concerning importance of food self-sufficiency and its healthy level. Most often it has been proclaimed that it should not fall below 80% for the important commodities (ÚZEI, ČTK, 2012). Toman (2012) states that, self-sufficiency of every State in the strategic industries of national economy, i.e., in foodstuffs and energy first of all, raises its sovereignty and security and it is the basis of its stability, too. According to the level of self-sufficiency also the degree of economy openness can be assessed (Mankiw, 2000). Some of the authors have stated that, a country should aim at such a sector where it can reach a comparable advantage against other countries. Other sectors, that the country cannot manage most efficiently, should be left to other countries and products or services from those sectors should be obtained by means of foreign trade and exchange. In such a case, of course, self-sufficiency cannot be considered any more.

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In reality, the concept of self-sufficiency can be considered in the sense of preservation a certain limit acreage of land, by means of which aiming at a threshold of foodstuffs security can be secured. This has been understood in developed countries to be a fuse for the case of an extensive failure of supply, due to some unexpected emergencies (Kraus, 2007). The self-sufficiency problem analysis and the comparison of it between separate countries are becoming complicated due to the wide scale of production conditions, varying structures of foodstuffs produced, varying consumer traditions and varying total agricultural production levels, too (Jurášek, 2012). Currently, food security is being secured by means of free markets, but the foodstuffs self-sufficiency in agricultural production is significantly influenced by the EU Common Agricultural Policy and it is oriented more at the crops for exports and energy crops.

2 Materials and Methods

2.1 Data sources

Statistical analysis here is mostly based on the resources of Czech Statistical Office and the CR Ministry of Agriculture. Data employed have been obtained based on the new ESA 2010 method. Other data sources for the analysis have come from the National Accounts and other official statistics of agriculture. The long-term time series have not been limited explicitly. Selected methods of time series analysis have been applied in the analysis of development of the Czech agriculture natural indicators.

2.2. Analytical smoothing of time series

Real economic criteria should form the basis of decision making based on the appropriate trend function type. Finding the appropriate trend function type is then mostly dependent on the analysis of empirical data. The paper offers a criterion based on the comparison of sums of squares of deviations of the empirical time series values from the smoothed ones:

Mean Absolute Percent Error (MAPE)

$$\text{MAPE} = \frac{100}{n} \sum_{t=1}^n \frac{|y_t - y'_t|}{y_t}, \quad (1)$$

where y_t, \dots empirical time series values,

$y'_t \dots$ smoothed time series values.

The model with the lowest MAPE criterion values is generally preferred. It is important to realize, anyway, that none of such criteria is of a universal nature, rather these offer a partial information on the quality of the model studied (Hindls, Hronová and Novák, 2000).

Besides trend functions, the adaptive models, too, have been applied in the trend description. Models of this type quickly react on the structural changes occurring in time, they are very suitable for prognosticating future course of the time series loaded by irregularities and breaks in the trend. For significance testing of the models and their parameters, the $\alpha = 0.05$ significance level has been chosen. Statistical computations have been performed using the STATISTICA software, version 12.

2.3 Self-sufficiency balance

Self-sufficiency balance is understood as reaching zero level of the balance of trade payments. It is expressed as value equality in money terms:

$$Q + D = P + V, \quad (2)$$

where: Q – value of production output volume, D - value of imports volume, P - value of consumption volume and V – value of exports volume (Jeníček, 1984).

In order to establish the balance level of the agrifood products foreign exchange it holds that, the degree of self-sufficiency balance is given as the relation of the domestic production volume value to the domestic consumption volume value:

$$S = (Q / P) \cdot 100 \quad (3)$$

3 Results and Discussion

The presumption for self-sufficiency balance analysis in selected agricultural commodities typical for traditional farm production and consumption in CR has been an analysis and statistical description of development trends in the agricultural primary production natural results.

Since CR accession to the EU a significant change of Czech agriculture has arrived. While the areas where wheat, maize and oilseed rape have been cultivated, increased until 2015 significantly, the areas of potatoes, vegetables grown,

or the numbers of pigs and poultry bred, sank strongly (Table 1). This has been connected namely with profitability of the commodities given, which is based on the agriproducers' prices, the cost competitiveness of Czech producers, but with the competitors' strength from the neighbouring EU countries, too.

Table 1 Principal changes in the production areas and livestock numbers after CR accession to the EU

Commodity	units	(Average 2001 - 2003)	Year 2015	Change (%)
Wheat	th. ha	808.1	829.8	+2.7
Barley	th. ha	512	365.9	-28.5
Maize	th. ha	67.6	93.6	+38.5
Potatoes	th. ha	42.8	22.7	-47.0
Oilseed rape	th. ha	302.7	366.2	+21.0
Sugar beet	th. ha	77.6	57.6	-25.8
Vegetables	th. ha	20.4	9.2	-54.9
Fruit orchard	th. ha	17.9	15.6	-12.6
Pigs	th. pcs	3465.8	1559.6	-55.0
Cattle	th. pcs	1525.3	1407.1	-7.7
Poultry	mill. pcs	29.6	22.5	-24.0

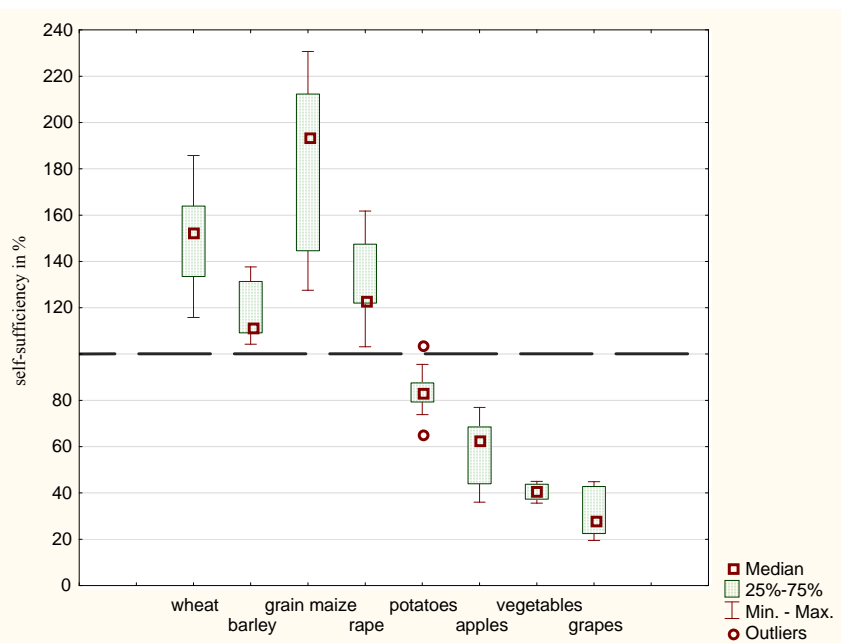
Source: CZSO, CR Ministry of Agriculture

3.1 Self-sufficiency balance in selected crop commodities production in CR

Czech Republic reports a negative balance in foodstuffs foreign trade in long-term look. A neuralgic point in the CR foodstuffs foreign trade first of all is its wrong structure seen from the VAT viewpoint. The largest share of foodstuffs exports accounts on the Cereals item, forming in the long-term look about one fifth of all the exports of foodstuffs. At the lowest was this share of exports in 2006 with 17.5%, at the highest then in 2012 with 23.5%. The volume of cereals exports has depended on harvest quality in the year and on price conditions on the world commodity markets. On the opposite, vegetables and fruits dominate in the imports.

In spite of good soil and climate conditions in the part of CR, almost 30% of potatoes consumed over the last years have been imported from abroad. Potato growers have continued reducing the planted areas due to low profitability and meeting the domestic demand to an increasingly lesser extent.

Figure 1 Self-sufficiency in the production of selected crop commodities in CR (2005 – 2015)



Source: own calculation

Imports of apples have shown a permanently increasing tendency over the last 10 years and the current volume of imports has doubled as compared with the imports volume before CR accession to the EU, it now represents 49% of total consumption. Similar it is, e.g., in plums where the imports cover full half of the consumption. Significantly worse is the situation in peaches, the Czech fruit growers have ceased to grow these. As it concerns the peaches and nectarines category, the share of imports on Czech consumption makes it 96%! In strawberries the share of imports is 75%. Con-versely, from CR mainly apples for ciders and other industrial processing go abroad.

In fresh vegetables, which the Czechs have learned to eat all the year round, even in winter time, when these cannot grow here, self-sufficiency fell to less than 40%. Also 70 to 80 percent of grapes come from imports (Figure 1). The consumers' growing demand for wine cannot be satisfied from Czech and Moravian vineyard areas.

3.2 Self-sufficiency balance in selected livestock commodities production

Following the long dated reduction of cattle and pig numbers the production of these animals fell. While in 1989 there were 525 th. tons of cattle live weight and 763 th. tons of pig live weight produced in this country, in 2014 the total weight of animals slaughtered reached 170 th. tons only (decline to 32.35%) in cattle, or 305 th. tons (decline to 39.97%) in pigs. The total numbers of poultry between the record year 1984 and 2015 fell by 34.2%. Numbers of hens only dropped by more than three fifths during this period.

During the period after CR accession to EU there has been a sharp increase of both imports and exports of pork. Foreign trade with pork shows a negative balance. Mainly due to unfavourable ratio between pork imports and exports, a gradual decrease of self-sufficiency can be registered despite the rising volume of foreign trade. The CR exports consist mainly of live pigs, being taken from the EU perspective to be feedstock only, raw material, i.e., goods with low added value. In case of goods with higher added value (sausages, salamis) the foreign trade balance is positive since 2007. Since 2006 the pork imports from Germany have increased, currently forming almost a half of all pork imported. A significant part of pork imports is coming from Poland, too. Pork consumption in CR is the highest one, compared with other meats, (52% of total meat consumption) and recently it fluctuates about 40 kg/person/year.

Before CR accession to EU the exports of beef prevailed over imports. Since 2004 the trend of foreign trade has turned opposite. Even in spite of the negative beef foreign trade balance, the live cattle trade has reported a positive balance. While previously mostly animals destined for slaughter were exported, in 2004 the structure of exports changed. Currently the cattle exports mostly consist of animals intended for further breeding. Austria can be taken the principal trade partner now, for live cattle exports.

The highest beef consumption in CR was registered in 1989 and 1990, at that time it gathered about 30 kg/person/year. Since then the consumption has declined, recently it has been fluctuating about some 8 kg/person/year. Over the last five years self-sufficiency in beef in CR has been moving between 114 – 132%, while as it concerns pork and poultry meat, there has been a long-term downward trend of self-sufficiency felt.

Poultry farming industry is characterized by substantial differences against other livestock sectors. Compared with other branches poultry is not tied to farmland. It is characterized by very fast growth and a short reproduction process. Regarding the fact that, poultry reproduction process is not limited by natality such as in the mammals, poultry farming is characterized by easy control and flexibility. Development of poultry meat foreign trade was affected by the CR accession to EU at most. Average poultry numbers declined, production stagnated, poultry meat consumption increased, production costs got reduced and prices by agricultural producers declined. A significant growth of turnover followed. Over the 2004 – 2009 years 90 th. tons of poultry in live weight were imported annually, at an average. Compared with the years 2001 – 2003, when average annual imports were at 31.3 th. tons live weight, it is an increase in imports at 189.4%. Over the 2001 – 2003 period 19.7 th. tons live weight were exported annually at an average, over 2004 – 2009 years there were 64.9 th. tons live weight. The increase in poultry meat exports made it 229.4%. Anyway, the foreign trade balance remained passive.

Total poultry numbers decreased by 34.2% between the record year 1984 and 2015 year. Numbers of hens only decreased by more than three fifths during this period. Poultry production kept increasing until 2008. While in 2008 there were 329 th. tons of poultry live weight produced in CR, in 2014 247 th. tons only were supplied to further processing. In just 6 years poultry production fell by a quarter. In 2015 a slight increase of production followed (+2.02%). Production of eggs declined since 1985 following the decline of hen numbers. In 1984 egg laying reached the historically highest level of 3.70 billion eggs, however, until 2015 it fell down to 2.17 bill. (decrease by 41.4%). In 2005 the highest consumption of poultry meat in CR so far was registered, at 26.1 kg/person/year. In the years following consumption kept decreasing slowly, currently it has been fluctuating about 25 kg/person/year.

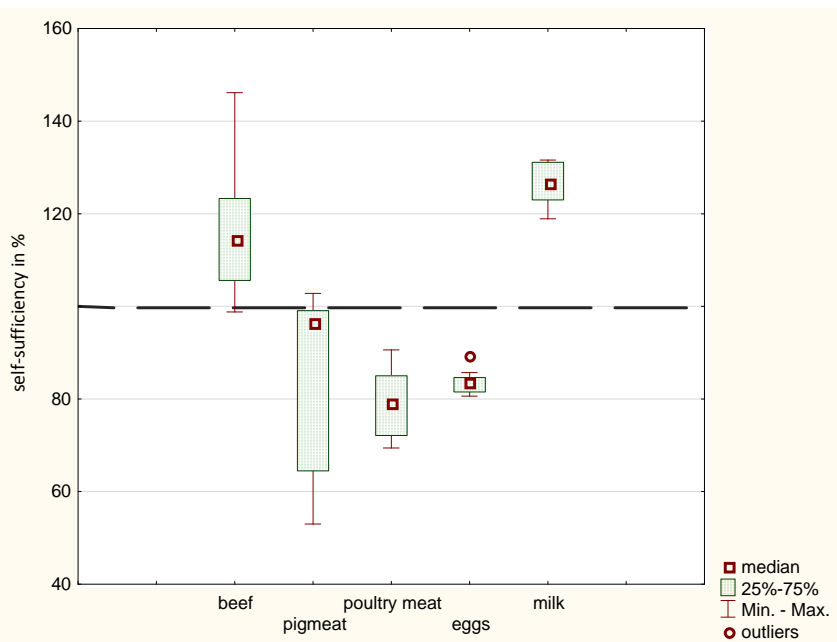
The decline of milk production in the Nineties connected tightly to rapidly reduced numbers of cows and low milk yield. If in 1989 in CR still 4.89 billion litres of milk were produced, in 1997 the domestic milk production reached 2.70 billion litres only. The following years have reported stagnation of production, but the 2011 – 2015 period shows a slight recovery due to higher farmer prices. In 2015 most milk was produced in CR over the last 19 years (2.95 bill. litres). Milk and dairy products represent the strongest commodity as seen from CR agrarian exports viewpoint. Share of milk and milk products exports on the total CR agrarian exports abroad is about 11%. The degree of total self-

sufficiency in milk has reached 125% recently. The mightiest contributors to imports into CR are dairy products such as cheese, cottage cheese, curd and butter. About half of exports volume is made of raw cow's milk. This situation is not favourable for Czech Republic, since a large part of the raw milk exported arrives back to CR in the shape of dairy products with higher value added. The largest imports of milk and dairy products into CR come mostly from Germany, Poland and Slovakia and they occupy 81.8% of total imports.

Consumption of fresh dairy products has been reported in CR since 2011. Change of the data according to EuroStat methodology occurred due to the need of comparison possibility of consumption data in CR and in EU. European Union and now the Czech Republic, too, report consumption of fresh dairy products without cheese, curds and canned milk, converted into the volume of milk needed for production of these. Further on, consumption of cheese is reported, inclusive of curds, and butter consumption.

Compared with other EU Countries the consumption of fresh milk products in CR is at an average level. Compared with Nordic countries, reaching the levels of 140 – 186 kg/person/year consumption of fresh milk products, the domestic consumption is low. In CR, consumption of fresh milk and dairy products has been fluctuating about 90 kg/person/year over the recent years. Consumption of cheese, inclusive of curds, ranks CR close to EU average. Its value has been fluctuating recently about 17 kg/person/year. Butter consumption in CR has been standing above the EU average with 5.2 kg/person/year.

Figure 2 Self-sufficiency in selected livestock commodities production in CR (2005 – 2015)



Source: own calculation

As to the main livestock commodities, CR was self-sufficient in milk and beef only, over the 2001 – 2003 period. At the average of 2004 – 2009 years, the level of self-sufficiency in these commodities, as compared with the pre-accession period of 2001 – 2003, deteriorated in milk by 8.4 p.p., in beef an improvement (slight) occurred, by 0.5 p.p. While purchase of milk slightly decreased at the average of 2004 – 2009 years compared with the preaccession period following the introduction of quota system, the domestic consumption increased. However, level of self-sufficiency has always remained at a high level (almost 130%). Beef is the only kind of meat where this measure's value stands rather high above 100%. The strongest self-sufficiency level decline has been registered in pork, over the 2004 – 2015 period the average inter-year decline made it 5.3%. Also in poultry meat, in spite of production increase, the parallel consumption increase caused a decline of self-sufficiency. The share of poultry meat imports on domestic consumption rose from 9.6% (2001 – 03 average) to 26.8% (2004 – 09 average) and now it is about 28%.

The differences in self-sufficiency of current livestock production follow after the structural changes in primary agricultural production and the changes in diet habits and nutrition recommendations. Compared with the period a quarter century ago, Czechs consume about one third of beef only, but two and a half times more poultry meat. Pork and milk consumption is remaining at about the same level, in long-term look. The consumption of eggs declined significantly, too. The picture above (Figure 2) depicts self-sufficiency in the selected livestock commodities production.

4 Conclusion

Species diversity of crops cultivated in CR has decreased, producers are receding from cultivation of cereals (especially rye and barley), on the other hand the technical crops' areas are increasing. Crop production has become, at a higher degree, orientated at growing profitable crops, especially rape.

The harvest level in CR depends first of all on climate factors during the period of crops vegetation. An important role, too, is played by selection of an appropriate crop variety, good soil preparation and compliance with the agronomic principles for maintaining long-term soil fertility. For the farmers, the chance to market the production at a corresponding profitability is substantial. An important role here is played by the State who can orientate farmers' decision making using subsidy titles. This year (2016) farmers could gain, besides the unified area payment, a support connected to the so-called „greening“ and a support bound to production of sensitive commodities, i.e., potatoes, fruit, vegetables, hops, sugar beet and protein crops. Long-term development time series of livestock numbers and performance have not reported extreme fluctuations recently. In spite of the performance increasing, CR is not self-sufficient in livestock production.

Self-sufficiency currently has become an object of frequent discussions. There are many different views of self-sufficiency. A conflict often arises concerning the approach, whether it is needed to strive for achieving self-sufficiency in basic commodities at any price, or not. The condition of a maximal possible level of food self-sufficiency means that the Czech Republic becomes fully competitive as to prices and quality as compared with other countries.

Czech farmers face hard competition on both the domestic and foreign markets, and in order to reach self-sufficiency it is very important to maintain strong standing and competitiveness. Outcomes of the analyses from above comply with conclusions of studies by Doucha (2008) and Bašek (2010). Level of self-sufficiency, especially in commodities not regulated to a higher extent by agricultural policy measures, can be connected with the achieved level of summary profitability of these, but with the competitiveness force of downstream processing industries, too. The commodity self-sufficiency level significantly rose in crops except rape, and in all the products domestic production has highly exceeded domestic demand. In livestock products, in all the main commodities, except beef, the self-sufficiency level declined. Only in monogasters a more significant excess of domestic demand (consumption) over domestic production and a more significant increase in imports have been reported. A credit for improving the balance belongs, according to CR Ministry of Agriculture, besides others, to growing shopping patriotism of Czechs. On the other hand, self-sufficiency in Czech fruit and vegetables is declining significantly. As Bašek (2010) gives it, the decreasing shares of domestic products processed here, on domestic consumption and exports have signalled a loss of competitive position of some elementary branches of processing industry.

Compared with other EU Countries, Czech Republic moves in the first half of the chart in terms of self-sufficiency in the production of basic agricultural commodities. Fully self-sufficient within EU in the main commodities selected is France and (except wine) Poland, too. A high self-sufficiency level is maintained in Germany, Austria and Belgium. On the other hand, Cyprus is not self-sufficient in any of the commodities considered. A standing worse than CR occupy, e.g., Italy, Great Britain and Sweden. The conclusions from above comply with conclusions by Svatoš (2008) and Horská (2011). The very dynamic development of the world economy together with the processes of globalization, internationalization and liberalization of world economy are significantly changing shapes of separate markets, agricultural markets not being an exception. These changes are not only caused by the growing demand for separate farm and food products but they are affected, too, by changes in the area of culture development and consumption habits, not at regional level only, but at the global level as well. Volume of global agriculture production has grown very significantly over the last several decades. Further reduction of production capacities is undesirable. Structural imbalance with manifestations of negative impacts on the landscape represent a threat to long-term competitiveness of Czech agriculture.

It can be expected that, the current mild growth of economics and the strengthening households' consumption will do good to Czech agriculture over the next years. In addition, also a gradual transition of Czech consumers towards the home production of higher quality could do good to it. The CR Ministry of Agriculture are then going to pay attention to food self-sufficiency as based on their Strategy until 2030, mainly through support of livestock production and vegetables, potatoes and fruit growing.

Acknowledgements

The knowledge and data presented in the paper have been obtained as a result of the Grant No. 20161011 of the Internal Grant Agency titled „Long-term Structural Changes of Czech Agriculture and The Impact of These on Self-sufficiency in Farm Production“.

References

- Bašek, V., et al. (2010). *České zemědělství šest let po vstupu do Evropské unie (výzkumná studie)*. Praha: Ústav zemědělské ekonomiky a informací. ISBN 978-80-86671-81-9.
- Doucha, T., & Foltýn, I. (2008). Czech Agriculture after the accession to the European Union – Impacts on the Development of its Multifunctionality. *Agricultural Economics*, 54(4), 150-157.
- Hindls, R., Hronová, S. & Novák, I. (2000). *Metody statistické analýzy pro ekonomy*. Praha: Management Press. ISBN 80-726-1013-9.
- Hlaváček, M., Doucha, T., Fialka, J., Bečvářová, V., Čechura, L., Eck, V., Sekáč, P., Špalková, J., Jílek, P., & Kreutzer, T. (2012). *Strategie pro růst – české zemědělství a potravinářství v rámci Společné zemědělské politiky EU po roce 2013*. Praha: Ministerstvo zemědělství ČR.
- Horská, E., Ůrgeová, J., & Prokešová, R. (2011). Consumers' food choice and quality perception: Comparative analysis of selected Central European countries. *Agricultural Economics – Czech*, 57(10), 493-499. ISSN: 0139-570X.
- Jeníček, V. (1984). *Zemědělství a soběstačnost ve výrobě potravin*. Praha: Státní zemědělské nakladatelství. ISBN 07-011-84.
- Jurášek, P. (2012). *Sebestačnost v potravinách*. Bratislava: Výskumný ústav ekonomiky poľnohospodárstva a potravinárstva. ISBN 80-8058-236-X.
- Kraus, J. (2007). *Reálný prostor pro snižování záporného salda českého agrárního obchodu: výzkumná studie*. Praha: Výzkumný ústav zemědělské ekonomiky. ISBN 978-808-6671-451.
- Mankiw, N. G. (2000). *Základy ekonomie*. Praha: GRADA Publishing. ISBN 80-7169-891-1.
- Svatoš, M. (2008). Selected trends forming European agriculture. *Agricultural Economics – Czech*, 54(3), 93-101. ISSN 0139-570X.
- Toman, M., Coudl, S., & Tuček, P. (2012). *České zemědělství: očima těch, kteří u toho byli*. Praha: Národní zemědělské muzeum Praha. ISBN 978-80-86874-39-5.
- ÚZEI – ČTK (2012). Potravinová soběstačnost ČR. *Zemědělský týdeník*, 15(31). ISSN 1212-2246.

Financial Situation of Crop and Animal Farms in Slovakia

Tomáš Rábek, Marián Tóth

Abstract: *This paper deal with financial situation of crop and animal production based on an analysis of a unique set of agricultural farms operating in Slovak Republic. Slovakia is perceived as a leader among the European countries due to its size of farms as up to 90 of the utilized agricultural land is farmed by large farms. We can observe the irregular nature of Slovak agriculture, where a minority of farms (14.98%) cultivates the majority (80.23%) of the agricultural land. In our paper farms are divided in our research to two groups (according to the share in sales of crop or animal production) and each is characterized by descriptive statistics for selected ratios of financial analysis. In the long run, crop farms are profitable and profit from crop production is used to cover the losses from animal production. 50% of animal farms with low profitability generate higher loss than the 50% of animal farms with better ROE results. Results also show, that 25% of best performing crop and animal farms are able to generate profit. . In the paper we use the evaluation of indebtness by using costs of debt capital (CoDC) with basic earning power (BEP) ratio. Costs of debt capital is relatively high. In average only 26.6% of farms satisfies the condition „BEP>CoDC“ and from these are more than 60% crop farm. For these farms we recommend to increase the debt ratio as it will increase the return on equity (ROE).*

Key words: Financial situation · Agriculture · Financial analysis

JEL Classification: Q14 · Q18

1 Introduction

The primary mission of agriculture, which is an integral part of each national economy is to ensure food security for the population. Supporting role in this case is held by the State and the European Union. But even this support is not always a guarantee of profitability or position on the market. Part of efforts to ensure the competitiveness is also the knowledge of the environment in which the company operates. For correct management, decisions and risk elimination manager needs to gain information about financial performance of the company, about financial performance of the competitive company, about the financial health and position of the company within the industry. The role of financial analysis, as well as other modern performance measurement indicators is the provision of such information.

Financial health and financial performance of the company, which is an essential prerequisite for financial condition of enterprises are subject to the ability to create added value respectively profit, as described Nývltová, R., & Marinič, P. (2010). Financial performance also assumes an optimal capital structure and adequate debt, which means that the company has a substantial amount of capital is adequately liquid and eligible to pay their financial commitments.

Rajčániová, M. – Sudzina, F. (2002) argue that the current problems, which persist for a longer period, it is precisely the issue of measuring business performance. Comparing the performance of the company expressed with other businesses that have the same line of business can point out many weaknesses and help its subsequent development. And this is one reason why economists effort to constantly develop newer methods of dealing with the assessment of efficiency of businesses.

According to the essential literature, there are many ways, how the economic performance, profitability and risk can be assessed (Váryová et al., 2015). In the recent period, there has been higher attention paid to the topic of risk and return of Slovak agricultural companies (Tóth et al., 2014, Serenčěš et al., 2016).

To increase the efficiency of farms is also an adequate so called benchmarking. Constantly reviewing of own performance in the enterprise and their subsequent comparison with the performance of the enterprises, which recorded the best results, are comparable in size and also the production specification. This modern method gives businesses the opportunity to examine and continuously improve critical processes, identifying and assessing the strengths and weaknesses of the company set aside less effective activities, detect threats and opportunities, and thanks to the objectives and strategies to positive growth of competitiveness, says Chrastinová, Z. (2012).

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2 Methods

The data used for the analysis are from the database of Ministry of Agriculture and Rural Development of the Slovak Republic, over the period 2009 - 2014. For our analysis, data were selected according to the production orientation to the subset of crop farms and animal farms. The selecting criterion was the share of animal production based on sales. We created 2 groups of farms. When the farm generated more than 50% of revenues from crop production, it was determined to be crop farm. Analogically, the selection was done for animal farms. The decision to focus on the classification by production is clear from results of scientific studies, authors dealing with differing experiences of the financial situation of agricultural enterprises. From the dataset the following farms were excluded: farms with negative equity (liabilities exceeding total assets) and farms, where is not possible to calculate the ratios (f. e. denominator equal zero) over the observed period. Last criterion was to exclude the outliers for every ratio. The minimum and maximum values of ratios (our outlier) are stated in results. The number of farms in our sample after excluding the outliers are presented in the Table 1. In each period we used the data of 37% of all farms on average.

Table 1 Definition of the sample of the farms

Year	2009	2010	2011	2012	2013	2014	Average
Number of the enterprises in a basic group	1383	1305	1412	1480	1483	1490	1425.5
Number of the enterprises in our sample	517	517	530	532	528	520	524
Sample/Basic Group in %	37,4%	39,6%	37,5%	35,9%	35,6%	34,9%	36,8%

Source: Database of Ministry of Agriculture and Rural Development of the Slovak Republic, own processing

We used these selected ratios of financial analyses for rating of financial situation of crop and animal production in our sample

$$ROE = \frac{\text{Earnings After Taxes}}{\text{Shareholders Equity}} \quad (1)$$

$$\text{Debt Ratio} = \frac{\text{Total Debt}}{\text{Total Assets}} \quad (2)$$

$$\text{Cost of Debt Capital} = \frac{\text{Interest Expense}}{\text{Long - Short Term Bank Credits and Financial Assistance}} \quad (3)$$

$$\text{Basic Earning Power} = \frac{\text{EBIT}}{\text{Total Assets}} \quad (4)$$

Achieved values of selected ratios - in particular indicators of ex-post financial analysis are characterized by selected descriptive statistics (quantiles, median, average). The results are demonstrated by Box plot charts, which shows the median, upper and lower quartile. The length of the box represents interquartile range (IQR), i.e. central 50% of values file. Right comma is 75 percentile and left comma 25 percentile.

3 Research results

Since 1989 the former socialist cooperatives and state-owned farms have been transformed into private business companies and cooperatives. In the year 2014 in Slovakia there were 2087 private companies (1968 Ltd. and 119 JSC.), and only 566 cooperatives. We can observe the irregular nature of Slovak agriculture, where a minority of farms (14.98%) cultivates the majority (80,23%) of the agricultural land (Table 2). In absolute terms, 2653 agricultural holdings farmed 1,5 million hectares of agricultural land in 2014. This phenomenon was also observed in the Czech Republic, although in Slovakia it was more prominent. Distribution of land, with many small farms sharing a low percentage of agricultural land and a few large holdings farming the vast majority of the UAA, explains the very high average area per farm in Slovakia. Large farms generally rent the land and therefore significantly influence the rent and land price.

Table 2 Size structure of Slovak farms

Legal form	Number of farms		UAA 2014		
	2014	Share on all farms (%)	Land (ha)	Share on all land (%)	Land per farm
Joint stock company	119	0.67%	132 472.01	7.03%	1113.21
Cooperative	566	3.20%	691 054.33	36.7%	1 220.94
Small – family farm	9 785	55.26%	53 291.14	2.83%	5.45
Ltd.	1 968	11.11%	687 429.45	36.5%	349.30
Farmers	5 046	28.50%	303 866.73	16.14%	60.22
Other	224	1.26%	15106. 39	0.80%	n.a
Total	17 644	100%	1 883 220	100.00%	n.a

Source: Data of the Agricultural Paying Agency of Slovakia (2015), own processing

3.1 Return on ekvity (ROE)

Our first analysed ratio is Return on equity (ROE). It is the amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested. We can conclude that overall profitability in the Slovak agricultural sector is at the low level. From the comparison of crop and animal farms it is obvious that the differences in ROE is small in each observed period. Animal and crop production is very closely related, and therefore their development trends are similar as well. However, the return of crop farms in each period is positive, while the animal farms are suffering loss. Median values of animal farms are higher than the average (except for 2014). This means that 50% of animal farms with low profitability generate higher loss than the 50% of animal farms with better ROE results. Results also show, that 25% of best performing crop and animal farms are able to generate profit.

Table 3 Return of equity of crop farms and animal farms

ROE	Year											
	2009		2010		2011		2012		2013		2014	
	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP
Count	251	266	270	247	248	282	224	308	232	296	228	292
Mean	-0.2%	-0.2%	0.4%	1.9%	-0.3%	5.5%	0.0%	2.7%	-0.5%	2.6%	2.4%	3.1%
Percentile 25	-3.7%	-4.5%	-2.2%	0.0%	-2.6%	1.4%	-2.2%	0.2%	-2.8%	0.2%	0.0%	0.2%
Median	0.4%	0.6%	0.2%	1.2%	0.3%	4.8%	0.2%	2.0%	0.4%	1.7%	1.5%	2.0%
Percentile 75	3.7%	4.1%	3.5%	6.1%	2.6%	9.4%	2.7%	6.7%	2.1%	5.8%	4.7%	6.7%
Minimum	-19.7%	-19.6%	-19.5%	-19.8%	-19.7%	-17.8%	-19.7%	-18.1%	-19.6%	-20.0%	-18.4%	-18.0%
Maximum	19.5%	19.8%	19.5%	19.7%	19.6%	19.8%	18.3%	19.4%	19.7%	19.2%	19.8%	19.8%

Source: Database of Ministry of Agriculture and Rural Development of the Slovak Republic, own processing

3.2 Debt ratio (DR)

Our second ratio is Debt ratio (DR). The debt ratio is defined as the ratio of total – long-term and short-term – debt to total assets, expressed as a decimal or percentage. It can be interpreted as the proportion of a company's assets that are financed by debt. Table 4 shows the average debt ratio of crop and animal farms which ranges from 40-46%. Financial theory states that debt capital is cheaper than equity, on the other hand we must respect issues of financial stability, of financial freedom and problems of financial distresses. In the paper we use the evaluation of indebtedness by using costs of debt capital with basic earning power ratio. The basic principle is that if earning power ratio is higher, than cost of debt capital, farm can benefit by increasing the level of debt ratio – financial leverage. Higher level of debt in this case increases return on equity.

Table 4 Debt of ratio of crop farms and animal farms

DR	Year											
	2009		2010		2011		2012		2013		2014	
	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP
Count	251	266	270	247	248	282	224	308	232	296	228	292
Mean	41.0%	45.5%	39.6%	42.5%	41.3%	45.0%	42.3%	45.8%	41.6%	48.0%	44.1%	46.3%
Percentile 25	26.2%	29.4%	23.6%	23.7%	24.9%	27.2%	25.5%	27.0%	25.6%	29.9%	27.2%	28.2%
Median	38.3%	44.8%	36.5%	40.2%	39.6%	42.2%	40.3%	44.2%	39.0%	46.6%	41.2%	43.8%
Percentile 75	54.5%	62.1%	53.8%	58.7%	56.1%	64.1%	58.3%	63.1%	57.6%	66.5%	58.6%	63.2%
Minimum	10.1%	10.8%	10.4%	10.2%	10.2%	10.2%	10.4%	10.5%	11.0%	10.5%	10.4%	11.9%
Maximum	89.9%	89.8%	89.4%	87.4%	89.3%	89.6%	88.1%	89.8%	88.1%	89.5%	88.2%	89.2%

Source: Database of Ministry of Agriculture and Rural Development of the Slovak Republic, own processing

3.3 Cost of debt capital (CoDC)

Therefore in the next step we focus on cost of debt capital. Cost of debt refers to the effective rate a company pays on its current debt. A company may use various bonds, loans and other forms of debt, so this measure is useful for giving an idea as to the overall rate being paid by the company to use debt financing. This ratio we could not adjust for the effect of timing of the loan. The problem arises due to the balance and income statement differences. Interest expenses as a part of the income statement include all payed interest to lenders over the year. On the other hand, debt as a part of the balance sheet reflect only the situation as of the 31.12. of each year. Therefore loans repaid during the year and new loans at the end of the year report not adequate interest expenses and therefore the ratio does not report correct values in these cases. Anyway the result in Table 5 show the change of cost of debt capital over the period of observed years.

Table 5 Cost of debt capital of crop farms and animal farms

CoDC	Year											
	2009		2010		2011		2012		2013		2014	
	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP
Count	251	266	270	247	248	282	224	308	232	296	228	292
Mean	6.8%	6.9%	6.9%	7.0%	6.4%	7.1%	7.1%	7.0%	6.0%	5.7%	5.5%	6.0%
Percentile 25	3.5%	4.2%	3.9%	3.8%	3.6%	4.0%	4.1%	3.8%	3.2%	2.8%	2.5%	3.1%
Median	5.8%	5.9%	5.8%	6.1%	5.7%	6.3%	6.5%	5.9%	5.1%	4.7%	4.4%	5.1%
Percentile 75	9.1%	8.7%	9.3%	9.7%	8.3%	9.5%	8.9%	9.3%	7.4%	7.9%	7.1%	8.4%
Minimum	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Maximum	20.0%	19.2%	19.5%	19.6%	19.9%	19.4%	19.6%	19.7%	19.9%	19.7%	19.4%	19.9%

Source: Database of Ministry of Agriculture and Rural Development of the Slovak Republic, own processing

3.4 Basic earning power ratio (BEP)

Second ratio for evaluating leverage opportunities is Basic earning power ratio (BEP). The BEP ratio is simply EBIT divided by total assets. EBIT, or earnings before interest and taxes, is a measure of how much money a company makes. The advantage of using EBIT is, that it allows comparisons of companies with different capital structure and tax situation. Results in Table 6 show that BEP of crop farms is higher in each observed period when compared to animal farms.

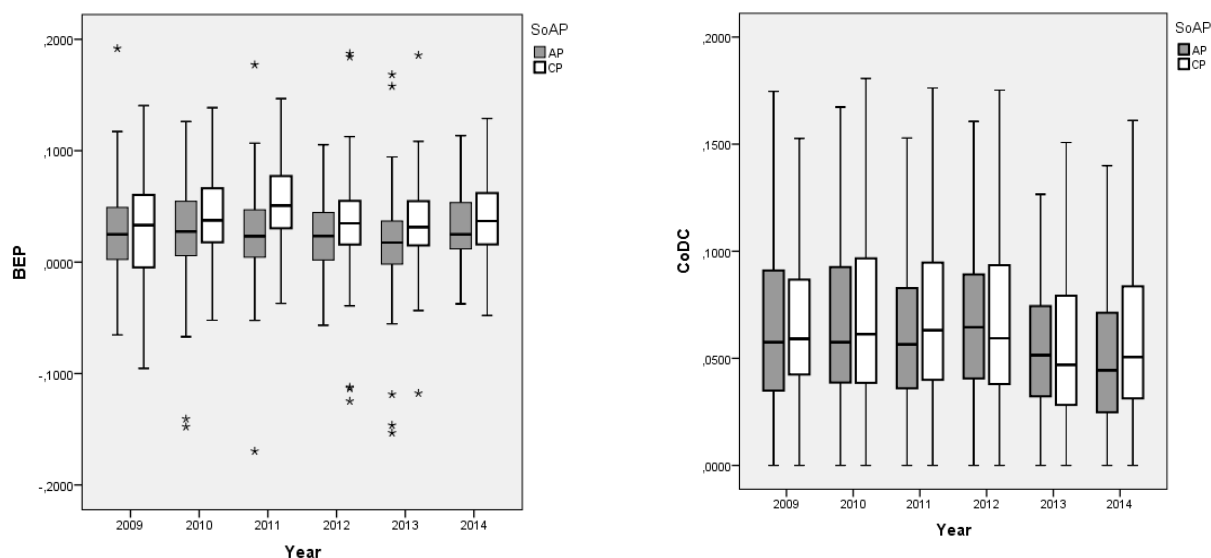
Table 6 Basic earning power ratio of crop farms and animal farms

BEP	Year											
	2009		2010		2011		2012		2013		2014	
	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP	AP	CP
Count	251	266	270	247	248	282	224	308	232	296	228	292
Mean	2.4%	2.6%	3.1%	4.0%	2.1%	5.5%	2.4%	3.5%	1.8%	3.5%	3.1%	3.9%
Percentile 25	0.2%	-0.5%	0.6%	1.8%	0.4%	3.0%	0.2%	1.6%	-0.2%	1.5%	1.2%	1.6%
Median	2.5%	3.3%	2.7%	3.8%	2.3%	5.1%	2.3%	3.5%	1.8%	3.1%	2.5%	3.7%
Percentile 75	4.9%	6.0%	5.5%	6.6%	4.7%	7.7%	4.5%	5.5%	3.7%	5.5%	5.3%	6.2%
Minimum	-11.8%	-15.5%	-14.8%	-10.0%	-17.0%	-10.0%	-11.0%	-12.5%	-15.3%	-11.8%	-9.0%	-10.3%
Maximum	19.2%	18.4%	15.7%	16.3%	17.7%	18.7%	15.7%	18.7%	16.8%	18.6%	16.0%	18.7%

Source: Database of Ministry of Agriculture and Rural Development of the Slovak Republic, own processing

3.5 Comparison BEP with Costs of debt capital

Finally we compare in Figure 1 and Table 7 costs of debt capital with basic earning power ratio to find farms for which we recommend increase of debt ratio. In this farms higher debt ratio will increase return of equity which in market economy is beneficial for owners. In Figure 1 we present Box-plots for both ratios (BEP and CoDC).

Figure 1 Comparison BEP with CoDC

Source: Tables 5, 6, Own processing

The comparison of ratios shows that in average only 26.6% of farms satisfies the condition „BEP>CoDC“, while the most farms meet the criterion in 2014 (Table 7). Group of farms is dominated by farms focused on crop production (60% of farms) as their profitability is higher. For these farms we recommend to increase the debt ratio as it will increase the return on equity (ROE). Of course the increase of debt may have negative effects on farms liquidity and financial distress. In the other group of farms with BEP lower than CoDC we recommend to decrease the debt ratio. This will increase the farms profitability (ROE).

Table 7 Comparison Costs of debt capital with BEP

Year	BEP<CoDC						BEP>CoDC					
	Together		AP		CP		Together		AP		CP	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
2009	407	78.7%	202	49.6%	205	50.4%	110	21.3%	49	44.5%	61	55.5%
2010	386	74.7%	209	54.1%	177	45.9%	131	25.3%	61	46.6%	70	53.4%
2011	375	70.8%	199	53.1%	176	46.9%	155	29.2%	49	31.6%	106	68.4%
2012	394	74.1%	178	45.2%	216	54.8%	138	25.9%	46	33.3%	92	66.7%
2013	392	74.2%	191	48.7%	201	51.3%	136	25.8%	41	30.1%	95	69.9%
2014	354	68.1%	161	45.5%	193	54.5%	166	31.9%	67	40.4%	99	59.6%
Average	385	73.4%	190	49.4%	195	50.6%	139	26.6%	52	37.8%	87	62.2%

Source: Tables 5, 6, Own processing

4 Conclusions

In 2004 Slovakia joined the EU. The agricultural market became a part of the EU agricultural market. Farms in Slovakia are large when compared to EU average. More hectares means more financial support. EU subsidies are decoupled from production which means they are not production linked. Farmers are not motivated to produce and the intensity of support is increasing. Farmers are since 2004 continually decreasing the animal production in favor of crop production. In the long run, crop farms are profitable and profit from crop production is used to cover the losses from animal production. 50% of animal farms with low profitability generate higher loss than the 50% of animal farms with better ROE results. Results also show, that 25% of best performing crop and animal farms are able to generate profit. In the paper we use the evaluation of indebtedness by using costs of debt capital (CoDC) with basic earning power ratio (BEP). The basic principle is that if earning power ratio is higher, than cost of debt capital, farm can benefit by increasing the level of debt ratio – financial leverage. Higher level of debt in this case increases return on equity. Costs of debt capital is relatively high. In average only 26.6% of farms satisfies the condition „BEP>CoDC“ and from these are more than 60% crop farm. For these farms we recommend to increase the debt ratio as it will increase the return on equity (ROE). In the other group of farms with BEP lower than CoDC we recommend to decrease the debt ratio. This will increase the farms profitability (ROE).

Acknowledgments

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-15-0552 with the title Impact of financial markets and agricultural policies on the agri-food sector and VEGA 1/0912/14 with the title The Common Agricultural Policy 2014-2020 and its impact on the financial situation of farms in Slovakia.

References

- Database of Ministry of Agriculture and Rural Development of the Slovak Republic.
- Chrastinová, Z. (2012). Ekonomická efektívnosť poľnohosp. výroby v rozdielnych prírodných podmienkach Slovenska. *Ekonomika poľnohospodárstva*. 12(1). 16. ISSN 1338-6336.
- Nývtlová, R., & Marinič, P. (2010). *Finanční řízení podniku: Moderní metody a trendy*. Praha: Grada Publishing, 2010. 161 s. ISBN 978-80-247-3158-2.
- Rajčániová, M., & Sudzina, F. (2002). Analýza rentability poľnohospodarských podnikov. In *Zborník vedeckých prác z medzinárodných vedeckých dní. IV. zväzok, 1. diel*, 1208. ISBN 16-17-05-2002.
- Serenčák, P., Čierna, Z., & Piterková, A. (2016). The development of value-added and net income of farms in Slovakia. In *The agri-food value chain: challenges for natural resources management and society: International scientific days 2016* (pp. 378-388). Nitra: Slovak University of Agriculture.
- Tóth, M., Lančarič, D., Piterková, A., & Savov, R. (2014). Systematic risk in Agriculture: A case of Slovakia. *Agris on-line Papers in Economics and Informatics*. 6(4), 185-193. ISSN 1804-1930.
- Váryová, I., Ferenczi Vaňová, A., Košovská, I., & Krajčirová, R. (2015). Information tools of cost controlling in entities of agricultural primary produce in Slovakia. In *Agrarian Perspectives XXIV* (pp. 502-509). Prague: Czech University of Life Sciences Prague. ISBN 978-80-213-2581-4.

The Productivity of Organic Farming in Different Agroecological Conditions

Radka Redlichová, Věra Bečvářová, Karel Vinohradský

Abstract: *The paper presents the results of organic farming productivity in LFA and non-LFA agricultural conditions in the Czech Republic during the period 2001 – 2015. The methodology of the research is based on the comparison of organic and conventional farms development and contains all the FADN file companies.*

In the period 2001 – 2015 have the organic farms reached 30 – 40% of the conventional farms agricultural production intensity. In the LFA conditions reach the organic farms around 25 – 30% of conventional farms agricultural productivity, in the less favourable conditions of non-LFA is the ration around 40%. The different level of land usage intensity between organic and conventional farms, as well as natural conditions associated with soil habitats, is involved by 50 – 60% by the different level of material and labour inputs and by 40% the different productivity of these inputs. Organic farms in the Czech Republic, having the half inputs for 1 ha, create the assumptions of lower environmental burden. However, the total labour and material intensity for one production unit is 1,4 – 1,7 times higher, compared to conventional farms, while the energy intensity is higher 1,7 – 1,8 times. These lead to the less favourable ecological footprint, taking the production for one inhabitant into consideration.

Key words: Organic Farming · Agricultural Intensity · Productivity · Material Intensity · Energy Consumption · Ecological Footprint

JEL Classification: O13 · Q11 · Q12 · Q13

1 Introduction

The organic farming is in the Czech Republic by the state accepted and supported system with 25 years old tradition. The total number of organic farms in 2015 is 4176, the total area of the organic agriculture is 12% of the total agricultural land. The governmental document “The Action Plan of the Czech Republic for the Organic Farming Development for 2016 – 2020” is oriented on the qualitative side of the future development of this system, among others on “the economic viability of organic farms” steaming from the production efficiency and organic products sales increase.

This paper deals with the important part of the organic farming economic efficiency – the productivity of the basic production factors. It presents the part of the research of the economic side of this agricultural sector, solved at the Mendel University in Brno. The aim of the work is the contribution to the decisive relations and connections conditioning the increase of the organic farming productivity, in the Czech Republic.

The attention to the organic farming productivity, as a part of the organic farms management system, has been paid by many of authors. In the discussion part the article refers namely to the works of Ofermann, Nieberg (2000), Sanders (2007), Niggli et al. (2008), Stefanos et al. (2012). The overall concept builds on the monography Redlichová, Bečvářová, Vinohradský (2014).

2 Methods

The source of the data is Farm Accountancy Data Network of the Czech Republic – FADN CZ, managed by the Institute of the Agriculture Economy and Information (Czech abbreviation = ÚZEI) standard outcomes. Total costs are methodological adjusted by adding the sum evaluating the inputs of unpaid work. These costs are signed like “adjusted cost” with the abbreviation “AdC”. The indicators used are mainly in common process. The reasoning and reflexions

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related to the trend in physical production and input developments are formed, taking the values of price development indexes of productions and inputs into consideration.

The comparison of the levels and trends in Organic Farms (OF) and Conventional Farms (CoF) developments are based on the decomposition of the time series 2001 – 2015 to the trend and residual components. For the trend modelling in the graphs the second order polynomial has been used. In the charts and tables, the trend values for 2001 and 2015 are stated, e.g. so called theoretical values from the trend levelling, further average annual increase and correlation index, allowing the indicative assessment of the annual variations around the trend.

The companies' classification according to the agricultural conditions is also based on FADN CZ data about the land distribution to the LFA (Less Favourable Areas). Because of the low number of the OF in the non-LFA, it was not possible to set the trend values for all the period 2001 – 2015. Therefore, the values are calculated out of the trend of period 2004 – 2015. These value are written in italic.

3 Research results

The development of the intensity of the farming systems is expressed by the changes in the levels of base factors/inputs productivity – land, labour and material. The analysis of the development and level of productivity of the farming system therefore regards the observation namely the indicators and relations listed below:

$$i = n * e_n, \quad \text{where:}$$

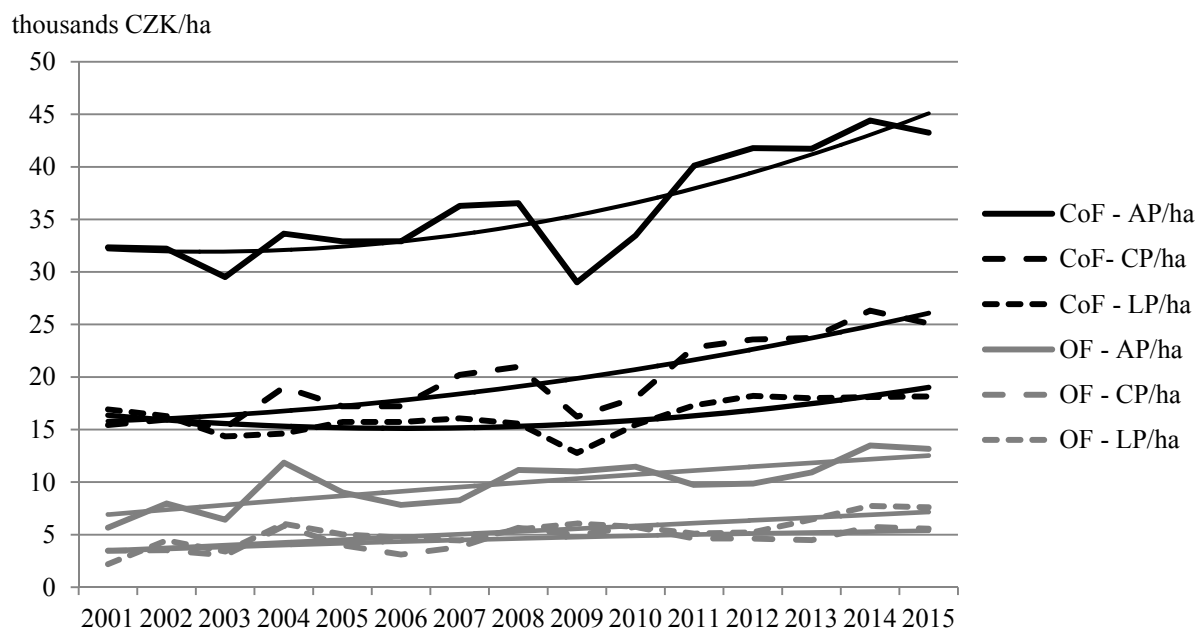
i the productivity, resp. intensity of the land usage and with the soil habitat connected agricultural conditions
 $i = Q/La$ (Q - the volume of agricultural production; La - the land area)

n the inputs of labour and tangible material (N) for the production unit

e_n the productivity of the labour and material inputs ($e_n=Q/N$).

The productivity of the labour and material inputs (e_n) and the agricultural production / land production intensity develop in the mutual interaction. From the above mentioned equation results that the agricultural production intensity increase could be caused by the input for hectare increase, as well as on the innovations increasing the productivity of these inputs. For the farming systems with higher productivity the qualitative innovations are significant. In this case there are higher level of “ i ” and “ e_n ” indicators.

Figure 1 Agriculture production for 1 hectare in OF and CoF



Source: FADN CZ, 2016; own processing

At the end of the observed period have the OF reached around 30 – 40% of the CoF agricultural production intensity (see Chart 1 and Table 1). In the LFA conditions was this ration 25 – 30%, in the non-LFA conditions 30 – 40%. The values of average increases for one hectare, derived from the development trends, show, that this differences have got the tendency to be the same or slightly deeper. The OF intensity in the Czech Republic is even lower compared to EU states like France, Germany and Austria. In these countries is the OF intensity at the level of 40 – 60% compared to the CoF intensity, as reported by Niggli, Slabe, Smid, Halber and Schüter (Niggli et al., 2008).

Table 1 Agriculture, crop and livestock production for 1 hectare

		Number of Farms	AP/ha CZK	CP/ha CZK	LP/ha Kč	LP / AP %	
OF	2001	38	6 913	3 432	3 480	48.26	
	2015	238	12 519	5 365	7 154	56.94	
	Δ	x	400	138	262	0.62	
	correlation index	x	0.77	0.81	0.81	x	
CoF	2001	1 166	33 071	15 801	16 357	51.03	
	2015	1 140	58 779	26 077	19 012	41.51	
	Δ	x	1 836	734	190	-0.68	
	correlation index	x	0.87	0.89	0.75	x	
OF/CoF 2015		x	0.25	0.22	0.29	x	
LFA	OF	2001	36	6 377	3 387	2 989	45,82
		2015	198	10 272	5 091	7 405	58,14
		Δ	x	278	122	315	0,88
		correl. index	x	0.93	0.81	0.93	x
	CoF	2001	661	30 253	13 671	16 582	54,82
		2015	457	39 982	19 128	20 854	51,60
		Δ	x	695	390	305	-0,23
		correl. index	x	0.88	0.87	0.81	x
	OF/CoF 2015		x	0.26	0.27	0.36	x
	non-LFA	OF	2004	9	•	•	•
2015			40	<i>21 309</i>	<i>9 500</i>	<i>11 808</i>	<i>41,15</i>
Δ			x	•	•	•	•
correl. index			x	•	•	•	x
CoF		2001	505	36 618	20 434	16 184	44,44%
		2015	683	50 153	32 793	17 361	34,50%
		Δ	x	967	883	84	-0,71%
		correl. index	x	0.83	0.89	0.40	x
OF/CoF 2015		x	<i>0.42</i>	<i>0.29</i>	<i>0.68</i>	x	

Note: AP = agriculture production; CP = crop production; LP = livestock production; Δ = average annual increase; italics – values are less reliably

Source: FADN CZ, 2016; own processing

The agricultural production intensity depends namely on two groups of factors. The first is based on the volume of inputs for one unit of cultivated land. The second one is based on the factors demonstrating themselves at the productivity level of labour and material inputs. While increasing of the input for one hectare could lead to higher environmental burden, the input productivity increase lead to decrease of labour, material and energy intensity for one production unit, so to the environmentally friendly effect.

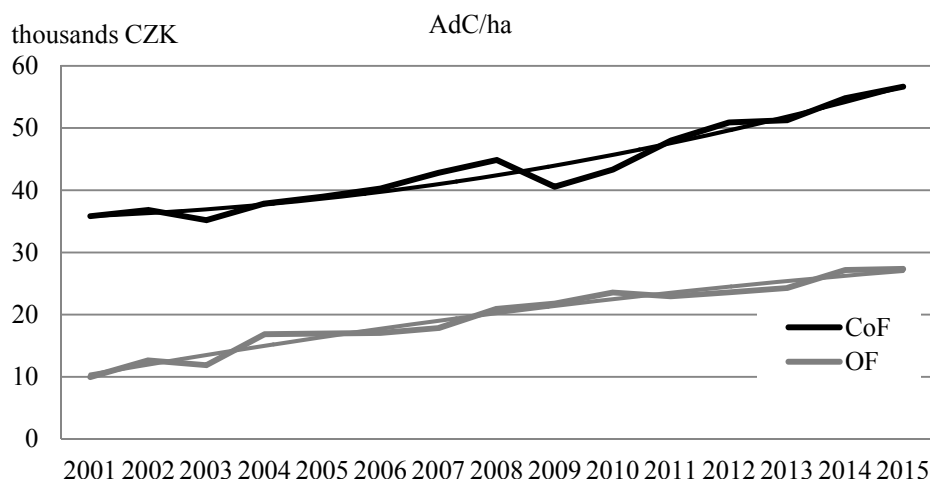
The overview of the Czech OF development, based on these factors, is presented at the Table 2 and Figures 2 and 3. According to the data, the OF expend on one hectare 50 – 55% of the CoF costs, while the productivity of these inputs reaches 60 – 70% of CoF. The total difference between OF and CoF is by 55% given by different amount of inputs and by the 45% the different input productivity.

Table 2 The agriculture production intensity, inputs and input productivity

		Number of Farms	AP/ha CZK	AdC/ha CZK	TP/AdC CZK	ha/AWU	TP/AWU CZK		
OF	2001	38	6 913	10 368	0.72	61.29	468 934		
	2015	238	12 519	27 013	0.54	49.86	661 006		
	Δ	x	400	1 189	-0.01	-0.82	13 719		
	correlation index	x	0.77	0.98	x	0.69	x		
CoF	2001	1 166	33 071	35 855	0.98	24.02	858 916		
	2015	1 140	58 779	56 703	0.98	35.66	1 798 375		
	Δ	x	1 836	1 489	0.00	0.83	67 104		
	correlation index	x	0.87	0.98	x	0.98	x		
OF/CoF 2015		x	0.25	0.48	0.55	1.40	0.20		
LFA	OF	2001	36	6 377	9 799	0.71	63.35	457 668	
		2015	198	10 272	27 077	0.53	46.39	652 626	
		Δ	x	278	1 234	-0.01	-1.21	13 926	
		correl. index	x	0.93	0.99	x	0.74	x	
	CoF	2001	661	30 253	33 945	0.97	24.14	810 188	
		2015	457	39 982	52 480	0.86	35.17	1 564 063	
		Δ	x	695	1 324	-0.01	0.79	53 848	
		correl. index	x	0.88	0.97	x	0.96	x	
	OF/CoF 2015		x	0.26	0.52	0.62	1.31	0.42	
	non-LFA	OF	2004	9	•	•	•	•	
			2015	40	<i>21 309</i>	<i>33 943</i>	<i>0.70</i>	<i>17.68</i>	<i>499 831</i>
			Δ	x	•	•	•	•	
correl. index			x	•	•	•	•		
CoF		2001	505	36 618	40 471	0.99	23.05	940 358	
		2015	683	50 153	61 032	0.95	34.69	1 914 145	
		Δ	x	967	1 469	0.00	0.83	69 556	
		correl. index	x	0.83	0.96	x	0.98	x	
OF/CoF 2015		x	<i>0.42</i>	<i>0.56</i>	<i>0.74</i>	<i>0.51</i>	<i>0.26</i>		

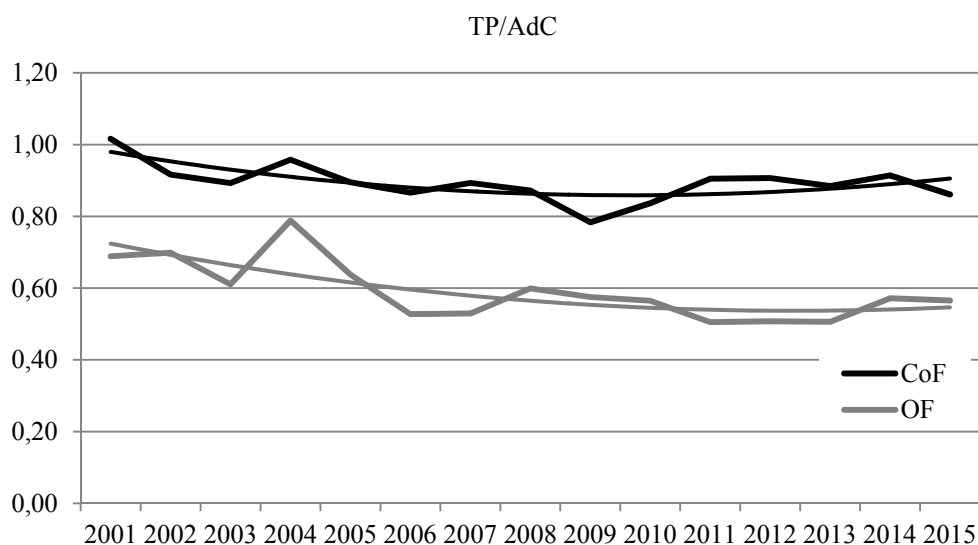
Note: AP = agriculture production; AdC = adjusted costs; TP = total production; AWU = average working unit; Δ = average annual increase; italics – values are less reliably

Source: FADN CZ, 2016; own processing

Figure 2 Input for 1 ha in OF and CoF

Note: AdC = adjusted costs

Source: FADN CZ, 2016; own processing

Figure 3 Input productivity in OF and CoF

Note: TP = total production; AdC = adjusted costs

Source: FADN CZ, 2016; own processing

From the character of the biotic part of the technology and technic, of the organic agriculture result the low industry fertilizers consumption as well as means of protection of plants against pests and diseases. Their low presence is the most significant difference in the material input structure and volume between OF and CoF, what can be seen in Table 3.

On the other hand, the abiotic part of the technology and technic of the organic agriculture is based on the mechanisation of production, using the unrenovable energy resources and is almost identical with the mechanisation in the agricultural-industrial systems. In table 4, there are the data presenting this energy consumption. This consumption is in case of OF half for one hectare, compared to the CoF, however, 1.2 – 1.7 times higher taking the one production unit into account.

Table 3 Consumption of fertilizers and plant protection agents in 2015

		Number of Farms	Fertilizers in CZK		Plant Protection Agents in CZK	
			for 1 ha	for 1 000 CZK of the AP	for 1 ha	for 1 000 CZK of the AP
LFA	OF	198	44	4	13	1
	CoF	457	2 828	75	2 148	57
	OF/CoF	x	0.02	0.05	0.01	0.02
non-LFA	OF	40	116	5	403	17
	CoF	683	4 415	93	3 550	75
	OF/CoF	x	0.03	0.05	0.11	0.23

Note: AP = agriculture production

Source: FADN CZ, 2016; own processing

Table 4 Energy consumption for 1 hectare and one production unit in 2015

		Number of Farms	Energy Consumption in CZK	
			for 1 ha	for 1 000 CZK of the TP
LFA	OF	198	2 432	168
	CoF	457	4 189	99
	OF/CoF	x	0.58	1.70
non-LFA	OF	40	3 085	106
	CoF	683	4 660	87
	OF/CoF	x	0.66	1.22

Note: TP = total production

Source: FADN CZ, 2016; own processing

The similar results were reached by Toumisto et. al (2014), Lavrence et al. (2013), Stefanos et al. (2012), who carried out the researches compared the energy consumption of organic and conventional agriculture in the Europe.

4 Conclusions

The organic farms volumes on inputs for 1 hectare are half, compared to the conventional farms. However, total labour and material consumption for one production unit is in the organic farming 1.2 – 1.7 x higher. Lower productivity of organic farming is straight connected with the level of natural resources usage, which is in organic farming only 30 – 40% of conventional farming level. This knowledge imply the “ecological paradox” – by using half of the inputs for 1 hectare, the OF in the Czech Republic produce lower environmental burden of landscape. However, their “ecological footprint” is 1.5 times less favourable while production of food for one inhabitant. These findings are consistent with the similar research of the period 2001 – 2012 (Redlichová, Bečvářová, Vinohradský, 2014). They also pay the attention to the low productivity of organic farming in the Czech Republic and to the fact, that the key change for the productivity increase is the land usage intensification, differentiated according to the agroecological condition character.

The quite similar conclusions are reached also by the authors dealing with the economic structure of organic farming from other European countries, namely Niggli (2008), Offerman, Nieberg (2000). These authors see the way to the economic sustainability of organic agriculture in the production intensification on the basis of organic principles. They use the term ecological intensification of organic food production.

Acknowledgement

This contribution was elaborated within the research project IGA 2016: “Agroecological condition like a factor of companies’ successful involvement to the commodity verticals in agribusiness” No. 2016/022

References

- Niggli, U., Slabe, A., Schmid, O., Halberg, U., & Schlüter, M. (2008). *Strategic Research Agenda for Organic Food and Farming. Vision for an Organic Food and Farming Research Agenda to 2025* [online]. IFOAM – EU a FiBL. 46 p. [cit. 2014 -10 -12]. Available from: http://www.tporganics.eu/upload/TPOrganics_VisionResearchAgenda.pdf.
- Laurence, G. S., Adrian, G. W., & Bruce, D. P. (2013). The Energy Efficiency of Organic Agriculture: A review [online]. In *Renewable Agriculture and Food Systems*. 1-22 [cit. 2014 -12-01] ISSN 1742-1705. Available from: <http://journals.cambridge.org/download.php?file=%2FRAF%2FS1742170513000471a.pdf&code=f6493a8b372b3be5d563057d88374391>.
- Offerman, F., & Nieberg, H. (2000). *Economic Performance of Organic Farm in Europe*. Stuttgart: University of Hohenheim. ISBN 3-933403-04-9.
- Redlichová, R., Bečvářová, V., & Vinohradský, K. (2014). *Vývoj ekologického zemědělství ČR v ekonomických souvislostech*. 1. ed. Brno: Mendelova univerzita v Brně, 2014. ISBN 978-80-7509-173-4.
- Sanders, J. (2007). *Economic Impact of Agricultural Liberalisation Policies of Organic Farming in Switzerland*. Frick: Research Institute of Organic Agriculture (FiBL).
- Stefanos, A. N., Evangelos, P., & Savvas, Z. (2012). Productive Efficiency of Subsidized Organic Alfalfa Farms [online]. *Journal of Agricultural and Resource Economics*, 37 (2), 280-288 [cit. 2014-12-01]. Available from: <http://ageconsearch.umn.edu/bitstream/134283/2/pp280-288,Nastis.pdf>.
- Tuomisto, H. L., Hodge, I. D., Riordan, P., & Macdonald, D. W. (2012). Does organic farming reduce environmental impacts? – a meta-analysis of european research [online]. *Journal of environmental management*, 112, 309-320. ISSN 0301-4797. [cit. 2014-12-01]. Available from: <http://www.sciencedirect.com/science/article/pii/S0301479712004264>.

Differences in the Performance of the Dairy Industries within the Visegrad Group Countries

Ivo Zdráhal, Gabriela Chmelíková, Ivana Blažková, Věra Bečvářová

Abstract: *The paper investigates the performance of firms in the dairy industry operating within the Visegrad group countries over the time period of years 2005-2014 based on the microdata obtained from the Amadeus database. Firms' return on assets indicator (ROA) was used to evaluate the economic performance of firms in the dairy industries. On the basis of the results, it may be stated that there are similarities as well as differences in the average economic performance of dairy processing enterprises among the Czech Republic, Poland, Slovakia and Hungary. However, some of the characteristics are typical for the countries under review. The average level of economic performance of the enterprises of the dairy industry is relatively low in the Czech Republic, but its level and dynamic in the recent years are still better in comparison to the average economic performance of the enterprises of the dairy industry in Slovakia, Poland and Hungary. The dairy processing firms in Slovakia and Hungary have very similar level and dynamic of the average economic performance. There is a noticeable positive trend in the values of average economic performance in Czech Republic, Slovakia and Hungary in the second half of the observed period. In the first half of the observed period, enterprises of the dairy industry in the Poland have higher value of the average level of economic performance in comparison to those in the Czech Republic, Slovakia and Hungary, however, the average level of economic performance of enterprises in Poland is declining.*

Key words: Dairy sector · Performance of firms · Visegrad group countries

JEL Classification: Q15 · Q18 · Q12

1 Introduction

The declaration of close cooperation of three Central European countries has been signed during the meeting of the president of Czechoslovakia, the Prime Minister of Hungary, and Poland's president in Visegrad in 1991. Czechoslovakia (later the Czech Republic and Slovakia), Hungary and Poland have always been a part of one civilization sharing cultural and intellectual values and common roots of religious traditions. Their integration into the European Union significantly increased their foreign political activity with the focus on promoting cooperation and stability in the wider region of Central Europe. Alongside these declared mutual understanding and cooperation among Visegrad group (V4) countries, their economies (and industries and firms) compete each other within the single market of the European Union, as well as they are facing to the competitors from other European Union countries and non-EU regions. Such patterns of competition are very similar to those in the milk sector.

Milk production, its processing and other segments of the milk value chain represent a significant and important part of the agribusiness in the European Union. Furthermore, the EU is the major player in the world dairy market and is the leading exporter of many dairy products. In 2015, the total milk production in EU28 was estimated around 159.6 million tons per year (93% is used for processing) and was produced by almost 1 million of dairy farmers. It also represents the 14% share on the value of EU agricultural output and 10% on the employment in the food industry. From the social and environmental perspective, it also contributes to the implementation of the European model of agriculture. For the same reasons, the milk industry also forms a very important part of the agricultural economy in the Visegrad group countries (European Commission, 2015a).

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Because of this importance, wide range of direct and indirect measures have been used to affect volumes, production-cost links and market prices in the milk and dairy sector. The milk and dairy sector belongs to the most regulated ones in the scheme of Common agriculture policy (Bečvářová et al., 2008). Volumes of production as well as links in the milk value chains differ significantly among the EU Member States. The largest producers of milk and milk products are Germany, France, Great Britain and Poland. Beside these major producers, some geographically small countries as Netherlands, Ireland and Denmark have also an important position in the EU milk and dairy industry.

The milk sector in the EU experienced significant economic, policy and structural changes in the last decades (Ernst & Young, 2013). The Visegrad group countries had to deal also with the specifics of transformation processes in transition economies. Currently, among the challenges of the European milk sector belong the ability to adapt on the market dynamic caused by the abolition of EU milk quotas (European Commission, 2015b) and the embargo on food imports imposed by Russia (European Commission, 2016). High performance and competitiveness of the dairy industry and ability to finalize the basic raw material into products with higher value added (and successfully face the competition within the European and global market) is an important prerequisite for keeping dimension of the milk production in the EU regions. This is valid not only for long-term development of these sectors but also in the periods of shocks and volatile markets.

The objective of the presented article is to analyse the performance of firms in the dairy industry operating within the Visegrad group countries with an emphasis on the identification of changes in levels and trends of economic performance that occurred within the period of the years 2005-2014.

2 Methods and data

The empirical analysis has been conducted using the data drawn from AMADEUS, the trans-European database of financial information provided by Bureau van Dijk. The dataset covers the period from 2005 to 2014 and consists of enterprises active in the dairy processing industry (NACE class 150) within the Visegrad countries, i.e. the Czech Republic, the Slovak Republic, Hungary and Poland. In order to have information on total number of dairy enterprises in particular countries, we employ the data published by European Commission in the Eurostat database.

The sample of the accounting data of enterprises is made out of 3,657 observations across 10 years and 4 countries. To see the representativeness of the sample, the shares of observations by countries in the sample with those in the population are compared in Table 1.

Table 1 Shares of observations by country within the sample and in the population

	The Czech Republic			The Slovak Republic			Poland			Hungary		
	Population (N)	Sample (N)	(%)	Population (N)	Sample (N)	(%)	Population (N)	Sample (N)	(%)	Population (N)	Sample (N)	(%)
2005	166	46	27.7	40	14	35.5	723	116	16.0	90	54	60.0
2006	146	47	32.2	49	21	42.9	736	186	25.3	91	35	38.5
2007	146	52	35.6	50	23	46.0	682	203	29.8	90	53	58.9
2008	178	52	29.2	38	23	60.5	724	225	31.1	100	58	58.0
2009	186	52	28.0	58	23	39.7	656	233	35.5	98	93	94.9
2010	207	51	24.6	229	41	17.9	663	236	35.6	116	93	80.2
2011	199	50	25.1	231	45	19.5	604	239	39.6	112	101	90.2
2012	188	52	27.7	197	49	24.9	603	238	39.5	108	98	90.7
2013	178	46	25.8	189	54	28.6	523	218	41.7	106	100	94.3
2014	181	36	19.9	168	51	30.4	521	154	29.6	115	96	83.5

Note: Population refers to all firms active in the dairy processing industries within the particular analysed countries.

Source: Eurostat, AMADEUS; authors elaboration

Firm performance is measured as the firms' return on assets indicator (ROA) that reflects the ability of a firm's management to generate profits from the firm's assets. ROA is calculated as a firm's profit/loss before taxation and interest (EBIT) divided by total assets. To assure that ROA is independent of the financial means used to create total assets, interest are added to the numerator. The formula is as follows:

$$ROA_i = \frac{EBIT_i}{Total\ Assets_i}$$

Where ROA_i stands for return on assets of a firm i , $EBIT_i$ stands for earnings before interest and tax of a firm i and $Total\ Assets_i$ represent sum of total invested capital.

Although ROA belongs to the profit measures most used in previous studies, it should be mentioned that accounting data might be biased due to profit smoothing or cross subsidization of subsidiaries, as stated by Hirsch and Hartmann (2014). Many authors have discussed the appropriateness of this indicator with the result that accounting profits are suitable to reflect real economic profits (e.g. Fisher and McGowan, 1983; Long and Ravenscraft, 1984). Because of the mutual comparability of the observed companies and the ability to characterise the average performance of a whole industry, for every company the return on assets has been relativised by conversion to a weighted return on assets in accordance to the following equation:

$$ROA_{iw} = \frac{EBIT_i}{Total\ Assets_i} * \frac{Total\ Assets_i}{Total\ Assets_s}$$

Where ROA_{iw} stands for the weighted return on assets of a firm i , $EBIT_i$ stands for earnings before interest and tax of a firm i , $Total\ Assets_i$ represents sum of total invested capital in the firm i and $Total\ Assets_s$ stands for the total capital invested into all firms in the sector, that have been included into the research sample.

Table 1 reports the descriptive statistics of ROA indicators for all firms involved in the analysis. The profitability indicator ROA of dairy processing firms varied considerably across the Visegrad group countries and over the study period. The average values of ROA indicate positive profitability in the Czech Republic and Poland, nonetheless, there are substantial differences among particular firms as seen in Table 1 – e.g. ROA in the Czech Republic with a mean of 4.31% reaches values from -112.32% to 107.51%, which follows from the use of microdata instead of sectors' averages. The high heterogeneity of microdata is confirmed also by descriptive statistics of ROA in other countries. In the Slovak Republic and Hungary there were observed negative average values of ROA, however the median is positive, which indicates that more than a half of firms reached positive profitability. The highest statistical dispersion of ROA was observed in the case of enterprises in The Slovak Republic and Hungary, in contrast to the Czech Republic, where the standard deviation is relatively low, which indicates the similar level of firm profitability among Czech dairy processing firms.

Table 2 Descriptive statistics

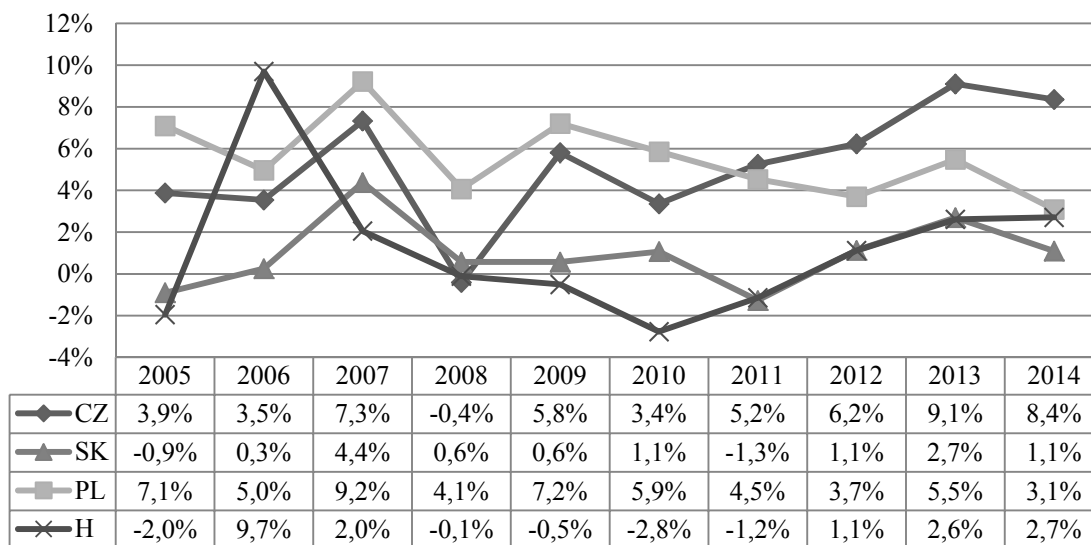
Indicator	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
ROA – The Czech Republic	0.0431	0.0390	1.0751	-1.1232	0.1599	484
ROA – The Slovak Republic	-0.0762	0.0101	5.8710	-9.5834	0.7233	344
ROA – Poland	0.0312	0.0283	5.4335	-9.4800	0.3722	2048
ROA - Hungary	-0.1692	0.0099	1.9717	-10.2199	0.8363	781

Source: authors elaboration

3 Research results

On the basis of the results of the conducted analyses, it may be stated that there are similarities as well as differences in the average economic performance of dairy processing enterprises among the Czech Republic, Poland, Slovakia and Hungary, as it can be seen from the figure 1.

The dairy processing enterprises in the Czech Republic reached an average ROA of 4% between 2005 and 2010. There can be seen the deviation in results of ROA in 2008, namely the decrease in the value to the level of 0%, which was the consequence of the crisis in the milk sector due to the global economic crisis and downturn in the price of processors in the fourth quarter of 2008 and in 2009. The increase in ROA back to a level of around 6% in 2009 was caused by the low producer prices of milk, which partly compensated the low prices of processors. Since 2010, it has been observed increasing values of ROA to the level of between 8% and 10% at the end of the reporting period.

Figure 1 Average weighted return on assets for the dairy sector in the particular V4 countries

Source: authors elaboration

Enterprises in the dairy industry in the Slovak Republic reached throughout the reporting period in average lower values of ROA compared to the enterprises in the Czech dairy processing industry with the exception of 2008, as mentioned above. Smutka and Malá (2014) investigated technology and efficiency differences between processing companies in the Czech and Slovak republic. They concluded significant differences in the technology between the Czech and Slovak dairy industry. These differences cause negative effects for Slovak dairy companies (productivity parameters, technological change). Also, technical efficiency is higher in the Czech dairy companies in comparison to the Slovak ones. Generally, the Slovak dairies achieved very low levels of profitability, ROA fluctuated mostly between plus 2% and minus 2%. It took longer time the dairy processing industry of the Slovak Republic to overcome the effects of the crisis in 2008 in terms of profitability, and only since 2011, the improvement in ROA can be identified.

If we use the mutual balance of foreign trade between the Czech Republic, the Slovak Republic and Poland as a measure of competitiveness of dairy food industries in these countries, The Poland's dairy processing industry can be seen as more successful in comparison with the dairy industry of the Czech and the Slovak Republic. This is in line with the research results published by Špička (2015), who found out the lower rate of technological progress in the Czech and Slovak dairy food industries in comparison with Poland in the period of years 2008-2013. This concept of competitiveness corresponds also with the average level of ROA of the dairy processing industry in Poland. In the years 2005-2010 the dairies in Poland reached higher values of ROA in comparison with the Czech Republic. It is worth mentioning the declining tendency of the average ROA in Poland, and the question arises, what are the causes of this development. This decline also caused higher reported ROA values in the Czech Republic compared to Poland.

In the period of 2005-2010 the dairy processing enterprises in Hungary reported the lowest values of ROA compared to other countries of the Visegrad group. From the viewpoint of the level and development of the average ROA values, Hungary is close to the Slovak Republic. Similarly to the Czech and Slovak Republic, there can be observed an increasing trend of ROA values in Hungary during the second part of the observed period.

4 Conclusions

The objective of the presented article was to analyse differences in the performance of the dairy industries within the Visegrad Group countries with the emphasis on the identification of changes in its levels and trends that occurred within the period of the years 2005-2014. Firms' return on assets indicator (ROA) was used to evaluate the economic performance of firms in the dairy industries. On the basis of the results of the conducted analyses, it may be stated that there are similarities as well as differences in the average economic performance of dairy processing enterprises among the Czech Republic, Poland, Slovakia and Hungary. However, some of the characteristics are typical for the countries under review. The average level of economic performance of the enterprises of the dairy industry is relatively low in the

Czech Republic, but its level and dynamic in the recent years are still better in comparison to the average economic performance of the enterprises of the dairy industry in the Slovakia, Poland and Hungary. Enterprises of the dairy industry in the Czech Republic have significantly higher average economic performance in comparison to the average economic performance of the dairy processing firms in the Slovakia and Hungary. The dairy processing firms in the Slovakia and Hungary have very similar level and dynamic of the average economic performance. There is noticeable positive trend in the values of average economic performance in Czech Republic, Slovakia and Hungary in the second half of the observed period. In the first half of the observed period, enterprises of the dairy industry in the Poland have higher value of the average level of economic performance in comparison to those in the Czech Republic, Slovakia and Hungary, however, the average level of economic performance of enterprises in Poland is declining. Certain limitation of this analysis is the interpretation of results, because the interpretation of results is based only on an average economic performance of the enterprises of the dairy industry in the investigated group of companies. In the further research, the authors will therefore focus on analysis, identification and interpretation of changes in the level of economic performance as well as causalities determining this economic performance in the total population of enterprises on the one hand, and in the specific segments of these enterprises on the other hand.

Acknowledgement

The article has been developed within the project financed by IGA FRDIS MENDELU (FRRMS MENDELU) no. 2016/013 The Dynamics of EU's Economic Relations (Dynamika ekonomických vztahů zemí Evropské unie).

References

- Bečvářová, V., Sadílek, T., Vinohradský, K., & Zdráhal, I. (2008). *Vývoj českého zemědělství v evropském kontextu*. 1. ed. Brno: MZLU v Brně, 2008. 64. ISBN 978-80-7375-255-2.
- Bureau van Dijk (2016). *Amadeus database: Company information and business intelligence* [online]. [Accessed 20 Aug 2016]. Available from: <http://www.bvdinfo.com/en-gb/home>.
- Čechura L., & Malá Z. (2014). Technology and efficiency comparison of Czech and Slovak processing companies. *Procedia Economics and Finance*, 13, 93-102. ISSN 2212-5671.
- Ernst & Young, (2013). *Analysis on future developments in the milk sector* [online]. [Accessed 10 Sep 2016]. Available from: http://ec.europa.eu/agriculture/events/2013/milk-conference/ernst-and-young-report_en.pdf.
- European Commission (2015a). *Milk and milk product statistics* [online]. [Accessed 10 Sep 2016]. Available from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Milk_and_milk_product_statistics.
- European Commission (2015b). *The end of milk quotas* [online]. [Accessed 10 Sep 2016]. Available from: http://ec.europa.eu/agriculture/milk-quota-end/index_en.htm.
- European Commission (2016). *EU responses to the Russian import ban on agricultural products* [online]. [Accessed 10 Sep 2016]. Available from: http://ec.europa.eu/agriculture/russian-import-ban/index_en.htm.
- Fisher, F.M., & McGowan, J.J. (1983). On the Misuse of Accounting Rates of Return to Infer Monopoly Profits. *American Economic Review*, 73, 82-97.
- Hirsch, S., & Hartmann, M. (2014). Persistence of firm level profitability in the European dairy processing industry. *Agricultural Economics*, 45(S1), 53-63.
- Long, W.F., & Ravenscraft, D. J. (1984). The Misuse of Accounting Rates of Return: Comment. *The American Economic Review*, 74, 494-500.
- Špička J. (2015). The Efficiency Improvement of Central European Corporate Milk Processors in 2008 – 2013. *AGRIS on-line Papers in Economics and Informatics*, 7(4), 175-188, ISSN 1804-1930.

Session 4

Causality of Socio-Economic Changes

Business in Waste Treatment

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Abstract: Waste seem to be one of the major phenomena of 21. century, mainly due to the growing consumption in the broadest sense. The waste must be collected, sorted, processed and as small as possible to store. Submitted paper focuses on activities in branch of waste treatment (including collecting, sorting proceeding waste) except dangerous waste. The amount and structure of this waste can be considered as fundamental factors influencing the business in this area, as well as factors of economic, administrative and environmental.

Key words: Waste treatment · Business

JEL Classification: D22 · Q53 · M21

1 Introduction

In the context of valid legislation, Act No. 185/2001 Coll., on waste, defines waste management, including but not limited to, as activity aimed at waste treatment and follow-up care for site where waste is permanently deposited.

Framework for all considerations regarding waste, both municipal and industrial, is fundamentally determined by the extent of sustainable consumption. Consumption behaviour and following waste treatment are determinative factors that create prerequisites for elimination of waste dumping. It is proofed that it is an activity of economic-environmental dimension in the Czech Republic by the 41. notice of the OPE, that enables applicants to get subsidies for projects aimed on construction and modernization of facilities for collecting, sorting and processing of waste in total amount of CZK 1,85 billion. Not negligible amount of money is considered also for the field of construction and modernization of facilities for waste material utilization and biogas stations. The goal of the waste processing is to effectively reduce amount of waste ending in waste dumps.

Economic dimension of considerations in the field of waste is partly depicted by following chosen financial characteristics of economy of business entities from the field of waste collecting, sorting, processing and elimination per CZ-NACE with more than 50 employees. For example, the outputs reached more than 41 billion CZK in 2011, almost 40 billion in 2014. The added value reached almost 2 billion in the whole period.

The chosen financial indicators in waste collecting, elimination and processing industry, 2011 – 2014, Czech Republic, (in CZK thousands)

Table 1 The chosen financial indicators in waste collecting, elimination and processing industry

CZ-NACE	Production (CZK thous.)	Production Index	Production Consumption (CZK thous.)	Production Consumption Index	Added Value (CZK thous.)	Added Value Index	Profit Margin (CZK thous.)
2014	39 220 683	104.1	27 463 073	102.7	11 757 610	107.5	337 651
2013	37 505 025	97.6	26 221 761	95.7	11 283 263	102.4	549 131
2012	39 261 593	95.1	27 767 207	94.3	11 494 386	97.1	720 164
2011	41 043 850	108.0	29 119 930	110.6	11 923 920	102.2	624 966

Source: www.czso.cz

Private firms as well as organizations in public property are involved in activities of waste management.

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Analysis made by Ochrana, Šumpíková, Nemeč, Pavel, J., & Meričková (2007) says that evaluation of efficiency of individual forms of providing services will not be possible before systematic reform of public sector accounting. It will be possible to correctly compare internal and external means of services arrangement only when the municipalities use actual accounting and cost centres. Pavel (2007), on the grounds of pilot study, it seems that municipal companies as such does not have to mean wasting of public finances. If the competition is permitted and municipal company gets a commission in fair public procurement, the costs are similar to the costs using external provider. The costs are even lower in some cases. This conclusion confirms argument that the key driving force in increasing efficiency of public sector is competition and not the change of ownership (Rais, Benko, Rod, 2016). Volek and Novotná (2012) also warn, in the context of time horizon, of influence of phases of entrepreneurial cycle productivity during investigation of productivity. Meričková and Nemeč (2013) conclude that probably the most important factor is level of competition in the field of the commission and that more satisfactory level of observance of contracts among involved sides in Slovak conditions requires interventions. The interventions lead to improvements in partial processes as well as to better overall results.

Soukupová and Malý (2012) state in the conclusion of their study that the form of ownership of a waste collecting company is important factor influencing the amount of costs. The considerations about lower possible expenditures are influenced by frequency of the collections.

Waste collection among individual municipalities improves efficiency of waste collection in terms of “returns to scale” via increased amount of waste as well as in terms of “optimization of transportation flows” via collection routes. Increase in volume of waste can lead to increase of competition in the field of public procurement, because of the increase of attractiveness of the business for potential entrepreneurs.

On the other hand, if the waste is dealt with in the place of its origin, the large amount of costs connected with its collection and transportation is saved. It is especially important in rural areas. This fact has increasing importance in developing countries (Wu, Zhang, Lü, Shao, He, 2014). Sorting and separation of waste is generally hard to execute in rural areas both from economic and ecological perspective. Jana Pöldnurd (2015) states that there is no direct pressure coming from law regarding sorted waste in rural areas, if the mixed waste is being burned. Specifically, separated waste collection can be applied in cities and rural municipalities with higher density of population, for example in case of bio-waste. If an anaerobic rotting reservoir was too far away and so the decrease of CO₂ emissions would be degraded by an increase of emissions related to transportation flows. Even Uz Zaman and Lehmann (2011) analysed optimal positioning of waste collection place station. They concluded that the optimal position is in the centre of a city, because the companies pay transportation costs and decide whether to collect waste together simultaneously or gradually. The waste collection station behaves as centripetal force that attracts companies with the goal of cost minimalization. This way involved companies are located closer to each other which can result in lower prices. In this fact Homolka, Slaboch and Švihlíková (2014) did research of operating efficiency at biogas plant in years 2010 – 2013 in Czech Republic.

Tendency of the society towards crucial changes in the pricing method of waste and its recycling are constantly growing. However, changes of behaviour and educational programs with the goal to increase awareness about this area are necessary to make recycling the reality in the economy of 21st century. Consumers must be informed about the fact that the waste is rare resource. For example, the value of food waste, electronic waste, glass and cardboard – the waste is valuable. Also the legislation must be valid and enforceable so that producers and construction companies were more material efficient and less wasteful (Bárcena-Ruiz, Casado-Izaga, 2015). Pakpour et al. (2014) on the ground of extensive research in Iranian households, that attitude, subjective norms, control of behaviour, moral obligation, identification with the problem of waste, intention, prospect and behaviour in the past play important role in “production” of waste as well as in the process of waste treatment.

Slavík and Pavel (2013) had a thought about motivation potential of variable fees set in dependence on the amount of sorted recyclable waste but also on the amount of waste saved in dumps. This way set fees which reflect costs fulfill also satisfactory fiscal as well as informative role. Households would get information about preciousness of capacities for waste processing and could adjust their behavior accordingly.

Systemic solution that has the character of holistic approach to problems connected with waste in 21st century is concept of so called zero waste. Professionals have come up with various ideas, plans, policies and strategies and applied them in their cities to achieve goals of zero waste. However, it is essential to rebuild holistic strategy in dependence on its execution and practicality of its feasibility. In this moment, the zero-waste strategy is focused towards zero dumps via redirection of waste. However, it is currently not possible to achieve 100% degree of redirection, neither in production nor in consumption. It is need to universally transform contemporary systems

of mining, production, market entry and consumption. It follows that the partial goals need to move towards zero waste (Uz Zaman, 2015).

In December 2014, the government of the Czech Republic approved Waste Management Plan for period 2015-2024. Main goals of the strategy are to prevent formation of waste, increased recycling and usage of waste as a material. The plan is a key document for realization of long term strategy for treatment of waste, wrappers and expired products.

Kalina (2012) in connection with these intentions speaks about second definition according to which “Integral Waste Management System is functional, environmentally acceptable, cost effective and socially acceptable system for waste management in area that requires minimal state interventions, the system has minimal or no negative effects on environment and is able to ensure fulfilment of waste management policy approved at the given area.”

2 Methods

In this paper are analysed enterprises with prevailing activity in category 38110 – Waste collecting, waste treatment, except dangerous waste according to classification CZ - NACE. In terms of analysis in total 116 companies were monitored on the basis accounting dates availability having legal form joint-stock company and limited liability company. These enterprises were at the same time under reviewed also according to their ownership structure – private (owner is personal entity or corporate body, total 34 companies), municipal (owner is town or municipality, total 49 society) and mixed (co - ownership private and public sector, in total 16 companies). At remaining 17 joint - stock companies authors were unsuccessful in finding owner. At these companies in years 2008 – 2014 values of average and median chosen indicators of financial analysis were analysed (assets profitability, operating profit margin).

The indicators of financial analysis were found according to following relations:

$$ROA = \frac{EBIT}{A} * 100 \quad (1)$$

$$OPM = \frac{EBIT}{sales} * 100 \quad (1)$$

where:

OPM is operating profit margin

Further productivity of labour was monitored in years 2010 – 2014 (accounting value added/personal costs), indebtedness (extraneous sources/capital in total), portion of short - term loan capital (short-term liabilities + short - term bank loan and aid/external sources), portion of loan load (bank loan and aid/extraneous sources), portion of personal expenses (personal expenses/costs in total) and further index of gross value added, index of long - term property at above - mentioned companies.

Source data was gained from portal www.justice.cz, database Czech Statistical Office referred to as Registr economic entity and database Albertina.

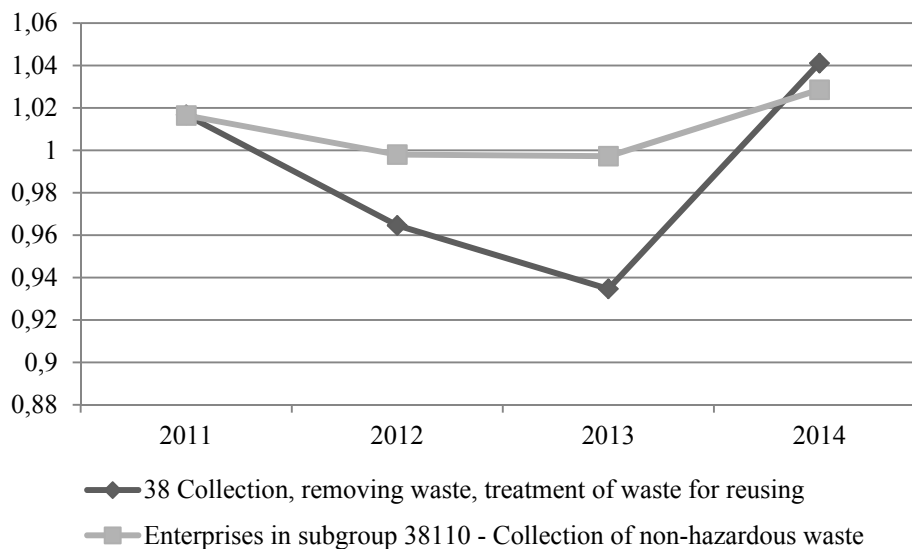
Sources and methodology:

- Analysis of companies with predominant activity in category 38110 – Collection of non-hazardous waste per classification CZ-NACE
- Time series 2008 – 2014
- 116 companies (municipal, mixed, private ownership)
- Assets profitability
- Operating margin
- Added Value Index
- Productivity Index

3 Research results

Analysed sample of companies was compared with chosen indicators on level line 38 Collection, removing waste, treatment of waste for reusing. In graph 1 is evident that at monitored companies the lowering of value added was happening. This decline wasn't however so expressive, as a change in whole branch. This is to some level caused by the fact, that in division 38 Collection, removing waste, treatment of waste for reusing are included enterprises whose aim at waste disposal and processing wastes for reuse.

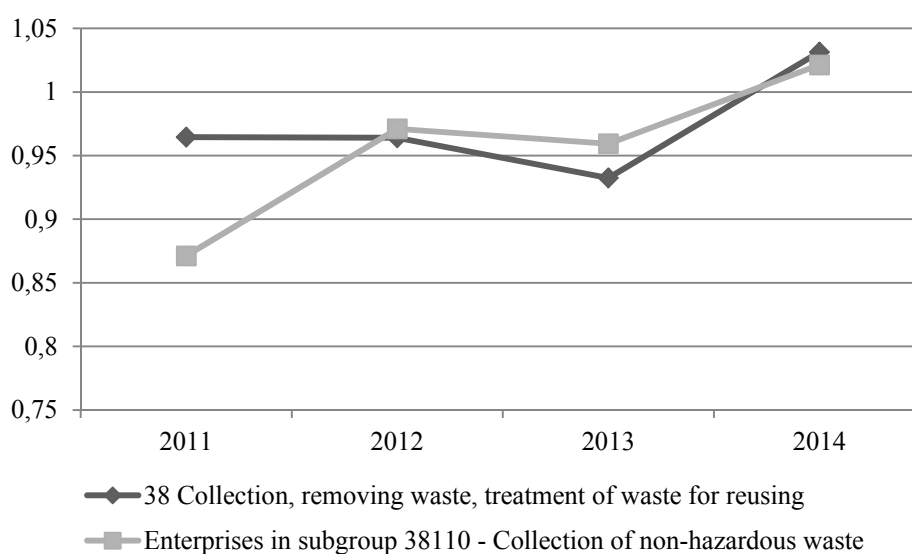
Figure 1 Added Value Index



Source: Own processing

Year by year labour productivity index was dropping down until 2013 in whole section 38 Collection, removing waste, treatment of waste for reusing also in monitored sample of companies. The moderate growth was reached as far as in the year 2014. Value added was gently dropping down in the framework of all branch, while employees allowance was approximately same in the whole time series. Branch 38 Collection, removing waste, treatment of waste for reusing and analysed companies so didn't correlate much with general economy development.

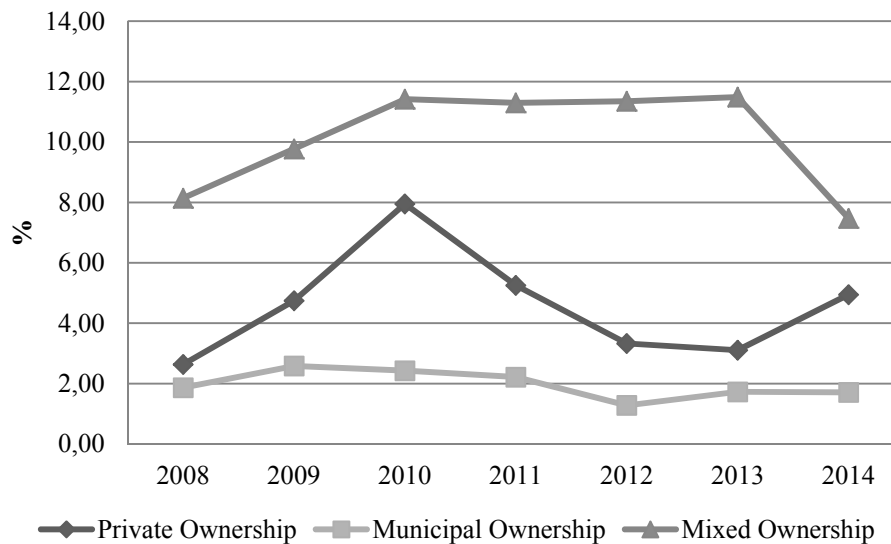
Figure 2 Labour Productivity Index



Source: Own processing

Companies in mixed ownership, in the framework of monitored period, reached maximum value of assets profitability. Median value of assets profitability was in interval 8 – 12%, as can be seen on picture 1. This form of ownership didn't record any loss-making enterprise in the year 2014. On the other hand the highest percent representation of loss-making enterprises in same year was recorded at private ownership forms, where approximately 25% of all companies with this ownership form gained loss. Municipal companies in case of this indicator recorded steadiest tendency along the whole time period.

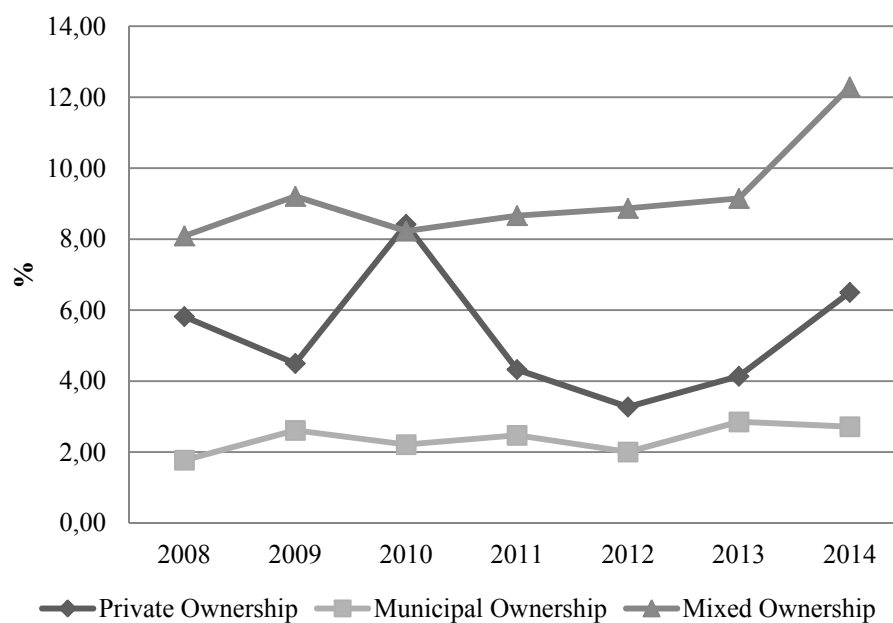
Figure 3 Median of Assets profitability



Source: Own processing

The indicator of operating profit margin is closely connected with assets profitability indicator. Considering this linkage municipal companies were the most stable at this indicator, when median of operating profit margin was moving in interval 2,8 – 5% in the framework of all monitored period. The highest value of operating profit margin median was recorded at companies in mixed ownership form, whereas no company in those group reached negative operating profit margin. On the other hand, most companies with negative operating profit margin were found in case of private ownership form, when average negative operating profit margin in the year 2014 got in value - 12%.

Figure 4 Median of Operating margin



Source: Own processing

Considering positive economic development in recent years this paper also aims at development of basic indicators related with development of personal expenses and financial resource of particular companies. In abbreviated time series following indicators were to be monitored.

Table 2 Development of chosen indicators - companies with prevailing activity in category 38110 – Collecting waste, waste treatment, except dangerous waste

	2010	2011	2012	2013	2014
Labour productivity in CZK	2.16	1.88	1.83	1.76	1.79
Portion of personal cost in %	28.00	28.56	29.09	29.72	29.91
Indebtedness in%	28.92	29.09	33.97	32.85	33.31
Portion of short - term loan capital in %	75.74	77.91	79.50	83.92	80.89
Portion of loan load in %	10.55	11.37	10.64	9.90	9.50

Source: Own processing

From above - mentioned table is evident downward trend of labour productivity, which was in relation to increasing portion of personal expenses probably caused by growth of wages at steady development of value added. Short - term indebtedness of monitored companies gently grows in time series, whereas at the same time the lowering of companies loan load was happening and recorded. Companies were operating with approximately thirty per cent of loan capital.

Table 3 Development of chosen indicators – companies with above - average labour productivity and with prevailing activity in category 38110 – Collecting waste, waste treatment, except dangerous waste

	2010	2011	2012	2013	2014
Labour productivity in CZK	5.36	3.61	3.50	3.14	3.39
Portion of personal cost in %	14.66	18.26	20.10	20.52	21.41
Indebtedness in%	43.75	35.05	32.42	36.40	37.07
portion of short - term loan capital in %	63.99	69.44	65.20	73.86	61.12
portion of loan load in %	7.89	10.38	11.04	7.23	10.76

Source: Own processing

Relative percent occurrence of companies with above - average labour productivity in monitored time series proceed between 20 and 30% from the whole sample. In case of these companies (with above - average labour productivity) It was possible to record markedly lower portion of personal spending on all-in cost in comparison with all analysed companies. by all means These companies operated with higher average indebtedness and higher portion of loan load.

4 Conclusions

When thinking about business in the field of waste, it is necessary to take account of several things. First, is it really the field which is primarily about business? Or is it primarily about public interest satisfaction? It turns out that currently it is probably about business with more or less obvious entry of public resources. Another thing that needs to be taken in account is fact that realization of systemic solution in the form of so called zero waste is perspective goal. The fulfillment of the goal requires longer time horizon. Corresponding framework have to be build step by step via legislative and educative tools and measures during the horizon. The goal can be fulfilled only if the framework connects utility and costs as well as their individual and social dimension.

References

- Bárcena-Ruiz, J.C., & Casado-Izaga, F. C. (2015). Regulation of waste management under spatial competition, *Journal of Cleaner Production*, 92(1), 216-222, ISSN 0959-6526.
- ČSÚ (2016). *Vybrané finanční ukazatele v průmyslu* [online]. Available from: <https://www.czso.cz/csu/czso/vybrane-financni-ukazatele-v-prumyslu>.
- Havelka, P. (2016). *Hrozí v komunální sféře zrušení hospodářské soutěže?* [online]. Available from: <http://www.caoh.cz/odborne-clanky-a-aktuality/hrozi-v-komunalni-sfere-zruseni-hospodarske-souteze.html>.
- Homolka, J., Slaboch, J., & Svihlíková, A. (2014). Evaluation of Effectiveness of Investment Projects of Agricultural Bio-gas Stations. *AGRIS on-line Papers in Economics and Informatics*, 6(4), 45.

- Kalina, J. (2012). Alternativní pohled na integrovaný systém nakládání s odpady. *Odpadové fórum*, Praha: České ekologické manažerské centrum, 2012(1), 18-19. ISSN 1212-7779.
- Merickova, B. M., & Nemeč, J. (2013). Factors determining the success of contracting local public services: Waste collection and waste disposal, management of cemeteries in Slovakia. *Lex Localis*, 11(3), 375-385.
- Ochrana, F., Šumpíková, M., Nemeč, J., Pavel, J., & Meričková, B. (2007). *Efektivnost zabezpečování vybraných veřejných služeb na úrovni obcí*. Praha: Oeconomica.
- OPŽP (2016). *Výzvy 2014 – 2020* [online]. Available from: <http://www.opzp.cz/vyzvy/41-vyzva>
- Pakpour, A. H., Zeidi, I. M., Emamjomeh, M. M., Asefzadeh, S., & Pearson, H. (2014). Household waste behaviours among a community sample in Iran: An application of the theory of planned behavior, *Waste Management*, 34(6), 980-986, ISSN 0956-053X.
- Pavel, J. (2007). Efektivnost obecních obchodních společností při poskytování služeb. *Politická ekonomie*, 55(5), 681-693.
- Pöldnirk, J. (2015). Optimisation of the economic, environmental and administrative efficiency of the municipal waste management model in rural areas. *Resources, Conservation and Recycling*, 97(April), 55-65, ISSN 0921-3449.
- Rais, J., Benko, T., & Rod. A. (2016). *Efektivita českého systému třídění odpadu v kontextu Evropské unie* [online]. Praha, Centrum ekonomických a tržních analýz. Available from: <http://eceta.cz/wp-content/uploads/2016/04/Studie-CETA-042016.pdf>.
- Slavík, J., & Pavel, J. (2013). Do the variable charges really increase the effectiveness and economy of waste management? A case study of the Czech Republic. *Resources, Conservation and Recycling*, 70(January), 68-77, ISSN 0921-3449.
- Soukopová, J., & Malý, I. (2012). Vliv konkurence na výši výdajů na nakládání s odpady obcí Jihomoravského kraje. *Waste Forum*, 4, 173-183.
- Uz Zaman, A. (2015). A comprehensive review of the development of zero waste management: lessons learned and guidelines, *Journal of Cleaner Production*, 91(15), 12-25, ISSN 0959-6526.
- Uz Zaman, A., & Lehmann, S. (2011). Urban growth and waste management optimization towards 'zero waste city'. *City, Culture and Society*, 2(4), 177-187, ISSN 1877-9166.
- Volek, T., & Novotná, M. (2012). Branches Productivity in the Crisis Period. In *The 6th International Days of Statistics and Economics* (pp. 1199-1209). Prague, September 13-15.
- Wu, D., Zhang, C., Lü, F., Shao, L., & He, P. (2014). The operation of cost-effective on-site process for the bio-treatment of mixed municipal solid waste in rural areas. *Waste Management*, 34(6), 999-1005.

Dilemmas of using the Quality of Life's Concept for Region's Socioeconomic Development

Jan Mandys, Martin Šanda, Tetiana Korovchenko

Abstract: *Socio-economic development of the region is not derived only from the performance of the local economy and riches of inhabitants. In an effort to achieve equilibrium of the social society, regional management is facing numerous obstacles. The main obstacle is finding the method of measuring the degree of satisfying the needs of inhabitants, citizens. One of the way for retrospective evaluation of effectivity and effectiveness measures, which are promoting the development of region, is using of concept of quality of life. In the following text are briefly described the basic dilemmas in definition of quality of life. Then weaknesses of individual procedures are discussed in the examples of specific measurements. The result is a reasoning - how to measure quality of life so as to deliver the expected results for the needs of regional management? The primary issue in our considerations is the minimum number of publicly available data on the subjective quality of life. We consider objective indicators simplistic and often misleading (in relation to an abstract concept to most definitions of quality of life). Because the subject of interest of this concept is the man, we have to look for the intersection of these two approaches. Another important question is to use data obtained by regional management in decision making and very definition of the expectations of the regional management of these data.*

Key words: Quality of Life · Public Policy · Region · Socio-economic Development

JEL Classification: C69 · H79 · H83 · I31 · O21 · R59

1 Introduction

Public policy is responsible for the local socio-economic development. Public policy is accountable to its citizens to the general target. With this objective public policy is ensuring decent conditions for life, consequently optimum for the development of all aspects of life. Public policy cannot give attention only to individuals but they must be viewed from a broader perspective - for realizing of general target.

Quality of life (inhabitants' satisfaction with the place where they live) is one of the indicators of a successful region. As is evident, quality of life is a variable which is empirically difficult to be grasped. The following text attempts to show the quality of life as a key attribute of socio-economic development of the region. And this text highlights the complexity of definitions and specific examples of the complexity of its applicability to a useful practice. These dilemmas are illustrated with specific measurements of quality of life on real data.

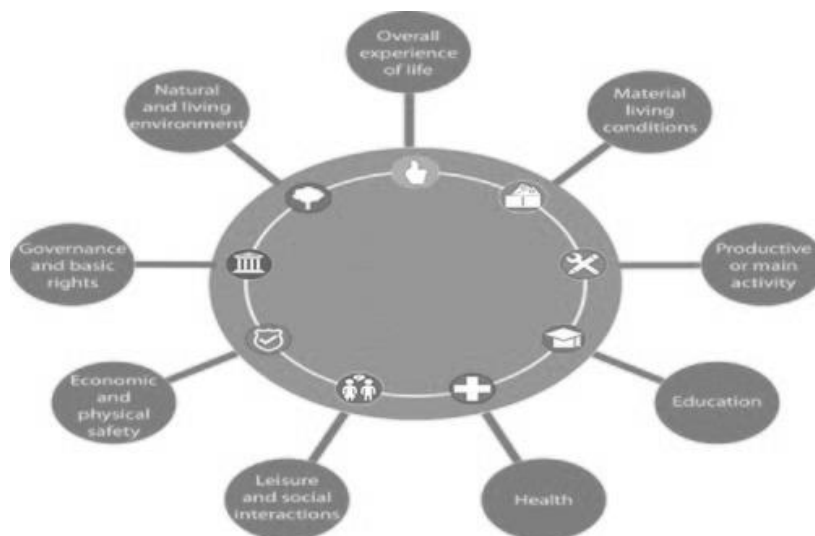
If we occupy ourselves with defining the term 'quality of life', we have to consider influence of historical, cultural and social changes, which take place in given society. Quality of life should be looked upon as a multidimensional variable, which contains information about the psychosocial status of an individual influenced by, for example, age, gender, education, social status, economic situation or an individual's values. Quality of life needs to be viewed as the subjective appreciation of one's own living situation. Quality of life can be viewed as the availability of options from which an individual can choose during the course of his/her life (Phillips; 2006, Royuela, V., & Moreno, R., & Vayá, E.; 2010).

Defining the term quality of life brings many dilemmas. Currently, there is no consensus what does the quality of life define. Multidimensional aspect demonstrates a lot of indicator systems, for example, set by the European Statistical System Committee. See figure 1.

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Figure 1 Quality of Life indicators for the Europe Union

Source: Eurostat; 2016

Quality of life thus represents universal category determining welfare of citizens of a certain region. This category relies on:

a) Objective factors: Objective factors of quality of life are considered the following:

- Gross domestic product: (Český statistický úřad; 2016, Kubátová; 2010).
- Living standards of a single individual or a household: income levels and consumption, wealth and poverty (Kubátová; 2010). Direct quantification of amount of consumed goods and services, or financial incomes and property, leisure, means spent on public services from the budget. Also amount of harmful substances discharged into water or air, average life expectancy, infant mortality, level of insecurity/insecurity index (Červenka; 2010).
- The human development index: contains these three components: wealth, health and level of education. Within these items minimal and maximal fixed values have been established (Kotýnková, Kubelková; 2011)
- Other examples: Economic welfare index, Index of Social Health – ISH (Ayvazyan; 2016).

b) Subjective aspect: Subjective aspect of quality of life derives from individual well-being. Regarding the issue of wellbeing, authors state (Dvořáková, Dušková, Svobodová, et al.; 2006) that well-being represents long-term emotion state of satisfaction of an individual with his/her life. This emotional state is relatively constant over time. Life satisfaction, morality or happiness can be considered as components of well-being.

- Other examples (Ayvazyan; 2016): Quality of life index from World Health Organisation, Consumer Confidence Indexes – CCI, Eurobarometer.

2 Methods

Quality of life evaluation is very complicated issue. Therefore it is appropriate to "take the help of" software or programming tools such as expert systems, multi criteria decision making systems and models, rule-based systems and using special methodologies and methods of system engineering for solving these problems. Particularly advantageous are extensions of these methods using fuzzy set theory (Škrabánek P., 2014). The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method is one of Multi Attribute Decision Making algorithms, which is widely adopted. TOPSIS ranks the available networks, which are based on their scores, with the highest being the best solution (Senouci, M. A., & Hoceni, S., & Mellouk, A.; 2016). TOPSIS method is presented by Chen and Hwang and it is a multiple criteria method to recognize solutions from a limited set of variants or alternatives. The fundamental rule is that the preferred alternative should have the shortest distance from the ideal solution and longest distance from the negative-ideal solution (Chen S. J., & Hwang C. L., 1992). TOPSIS method was used in this way in 10 selected indicators, for all of NUTS3 regions of Czech Republic for each year in the range 2000 – 2015. In order to help the agency STEM/MARK, a survey, whose goal was find important indicators (by inhabitants in Czech Republic), was created. Altogether, 506 respondents (from differently regions, education, age and etc.) were participated in the STEM/MARK's survey in august 2016. Indicators used in the survey are summarized in Table 1. In our study, ten most important indicators were selected from them. Specifically, indicators that more than 30% from all respondents have identified as important were used.

Table 1 Selected indicators

Signification	Indicator	Ranking (%)	Important indicator
K1	Life expectancy at birth	50.4	yes
K5	Doctors per 1,000 inhabitants	49.6	yes
K9	Gross domestic product per capita	47.6	yes
K18	Dust emissions	41.7	yes
K10	Long-term unemployed	37.9	yes
K4	Crimes per 1,000 population	37.5	yes
K24	A household with Internet access	36.2	yes
K12	Median gross monthly wages	35.0	yes
K19	Share of developed areas	31.0	yes
K8	Share of population living in houses connected to public sewage	30.4	yes
K21	Cars per 1,000 population	28.1	no
K15	Number of unsuccessful applicants for the elderly	26.7	no
K23	Proportion of university-educated population	26.7	no
K11	Number of applicants for one position at the labor offices	25.5	no
K20	Waste of companies per capita	24.9	no
K6	Occupational diseases per 100,000 inhabitants	22.5	no
K7	Average duration of incapacity	21.1	no
K14	Value of social aid benefits paid per capita	20.9	no
K2	Total population increase per 1000 population	20.0	no
K13	Number of businesses	19.8	no
K17	Number of small protected areas	18.6	no
K3	Traffic accidents per 1,000 population	13.8	no
K22	Voter turnout in elections to the regional assemblies	13.4	no
K16	Share of the surplus budget to the expenditure in region	12.6	no

Source: STEM/MARK

Data matrix for the individual indicators for all years and all indicators were compiled from the Czech Statistical Office. In the next section, the results for the NUTS3 regions, in individual years and the progress status of regions within the Czech Republic by method TOPSIS, are presented. Weight for indicators was determined 0.1 - for each equally.

For arguments of useful using subjective quality life concept, we will briefly outline results of the two surveys (Mandys, Jirava, Křupka, Kašparová, Duplinský; 2012, Mojžíšová; 2016) which analysed public perception in relation to social issues in the city of Pardubice in the years 2012 and 2015. Under the terms of this analysis, there was a first, and subsequently a second, survey on views of citizens on quality of life in this region. In both cases, the responses were carried out by means of a questionnaire with the help of trained questioners. In both cases, the same methodology of data collection was used (based on age category and residence in one of the 8 Pardubice districts).

The first survey was focused on the situation in social services within the city of Pardubice (Mandys, Jirava, Křupka, Kašparová, Duplinský; 2012). Enquiries directed to the public were merely a partial component. Altogether 384 respondents took part in the analysis in the given region. Respondents answered nineteen questions. The second survey was focuses on mapping satisfaction with social services in the city of Pardubice (Mojžíšová; 2016). Data collection and analysis was carried out in the year 2015. Under the terms of pre-research, the questionnaire from the 2012 analysis was tested in the second place. Subsequently, slight modifications have been made which resulted in a 22-item questionnaire. Questions related to the quality of life have not been modified. 387 respondents took part in the survey in 2012 and 337 in 2015. Both surveys equally asked following questions:

- How does the respondent assess his quality of life?
- How secure does the respondent feel in everyday life?
- Does the respondent have access to information which is necessary for his/her life?

3 Research results

In this part we shortly introduce both of our analysis of objective and subjective approaches to problem definition quality of life.

3.1 Quality of life evaluation results in NUTS3 regions in Czech Republic

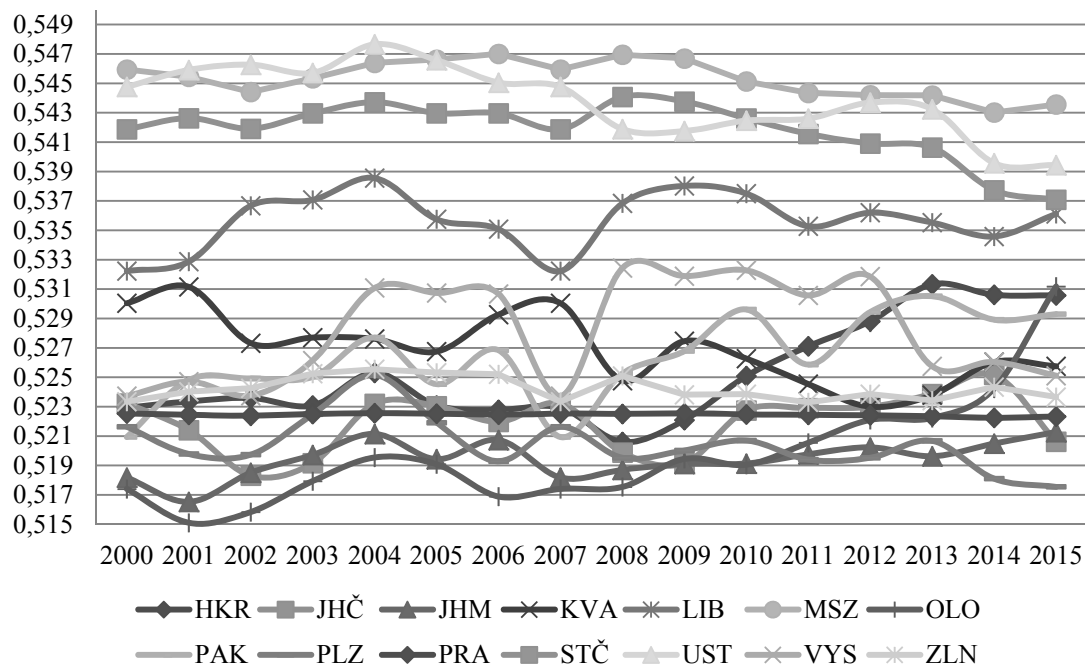
Quality of life evaluation results in NUTS3 regions in Czech Republic are shown in Table 2, and visualized in Figure 2. In this figure, values of coefficient c_i in years 2000 – 2015 are shown, where coefficient c_i is a result of TOPSIS method, and $c_i \in \langle 0;1 \rangle$.

Table 2 Data matrix

Region / c_i values	C ₂₀₀₁	C ₂₀₀₃	C ₂₀₀₅	C ₂₀₀₇	C ₂₀₀₉	C ₂₀₁₁	C ₂₀₁₃	C ₂₀₁₅
HKR	0.52336	0.52308	0.52308	0.52293	0.52209	0.52711	0.53133	0.53058
JHČ	0.52140	0.51916	0.52304	0.52322	0.51916	0.52290	0.52387	0.52062
JHM	0.51652	0.51972	0.51943	0.51818	0.51910	0.51976	0.51963	0.52128
KVA	0.53115	0.52770	0.52675	0.53004	0.52746	0.52454	0.52379	0.52575
LIB	0.53287	0.53707	0.53575	0.53223	0.53802	0.53527	0.53552	0.53611
MSZ	0.54544	0.54534	0.54662	0.54594	0.54669	0.54435	0.54417	0.54356
OLO	0.51510	0.51794	0.51908	0.51740	0.51945	0.52054	0.52223	0.53117
PAK	0.52482	0.52503	0.52452	0.52093	0.52678	0.52586	0.53052	0.52930
PLZ	0.51978	0.52248	0.52191	0.52163	0.52003	0.51940	0.52067	0.51754
PRA	0.52245	0.52250	0.52253	0.52253	0.52255	0.52245	0.52235	0.52233
STČ	0.54263	0.54296	0.54297	0.54187	0.54376	0.54156	0.54063	0.53708
UST	0.54591	0.54571	0.54658	0.54476	0.54175	0.54260	0.54324	0.53944
VYS	0.52470	0.52614	0.53074	0.52372	0.53188	0.53057	0.52574	0.52511
ZLN	0.52402	0.52525	0.52532	0.52334	0.52381	0.52330	0.52342	0.52366

Source: Own processing

Figure 2 Results of coefficient c_i



Source: Own processing

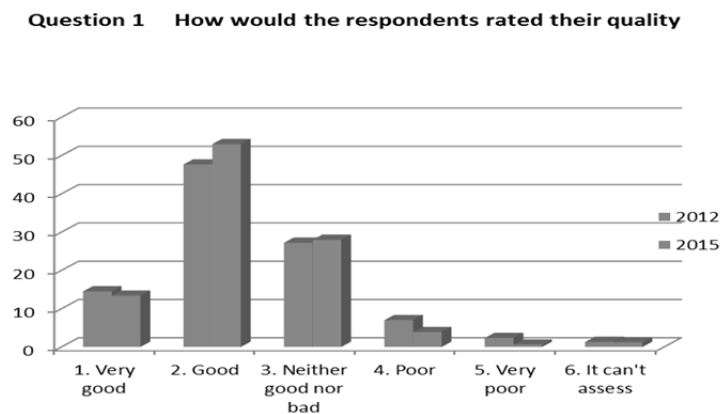
In Table 2, following marking of the NUTS3 regions is used: : HKR - Hradec Králové Region, JHČ - South Bohemian Region, JHM - South Moravian Region, KVA - Karlovy Vary Region, LIB - Liberec Region, MSZ - Moravian-Silesian Region, OLO – Olomouc Region, PAK – Pardubice Region, PLZ - Plzeň Region, PRA - Prague, STČ - Central Bohemian Region, UST – Ústí n.L. Region, VYS - Vysočina Region and ZLN – Zlín Region.

As this figure shows, the differences among the regions are not significant. Thus, we can say, that quality of life is in all regions alike good. For certain regions, we can see constant development; however "interesting" trend or fluctuations can be recognized in other ones. It is worth emphasizing that the graph seems to be confused. It is caused by many similar curves that overlap each other. Contrary to our expectations, regions MSZ and UST did well. Indeed, these regions are rather taken as a "regions with problems" in terms of crimes, environment, employment, etc.. This fact can be taken as an advantage of the used method TOPSIS. Even when using relative values, the quantity had not a great significance. As further evidence can be taken "unpleasant" surprise which was born in Prague. The indicator has stable value for this region; however, the region has moved up to around 10-th place in the ranking.

3.2 Quality of life in City of Pardubice

Here we make comparisons of results from both analyses. In both cases, very similar samples, without principal difference in terms of number of respondents, their education structure and economic activity, were considered. Considering this fact, it can be stated that it is a real view of reality. In various opinion polls and charts, Pardubice ranks highly over a long period of time. Indeed, the city has a favourable geographical location including good transport facilities. Moreover, there are a lot of working opportunities in this region. These facts are also reflected in results of our surveys.

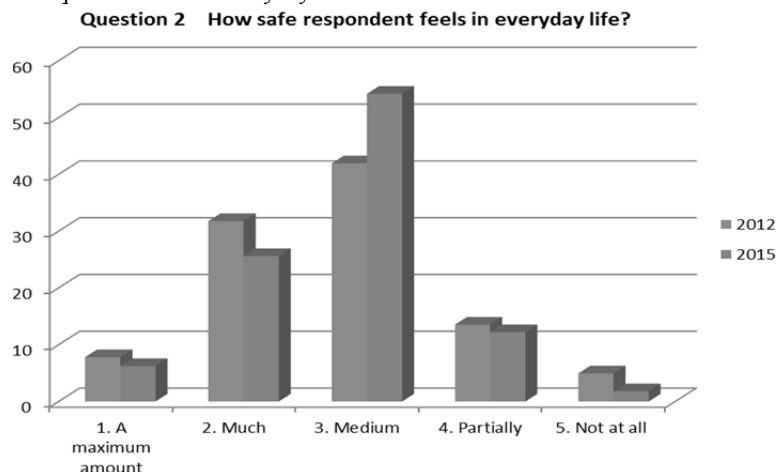
Figure 3 Quality of life assessment



Source: Mandys, Jirava, Křupka, Kašparová (2012), Mojžíšová (2016)

The answers of the first question show that only a small part of the respondents do not value the life in Pardubice in a positive way. The most of the respondents think that the city is a good place to live. A neutral answer within similar classification is usually caused by the fact that the respondent profits from the possibility of escape and avoids giving a definite answer. This is the usual problem that the most of researchs solve.

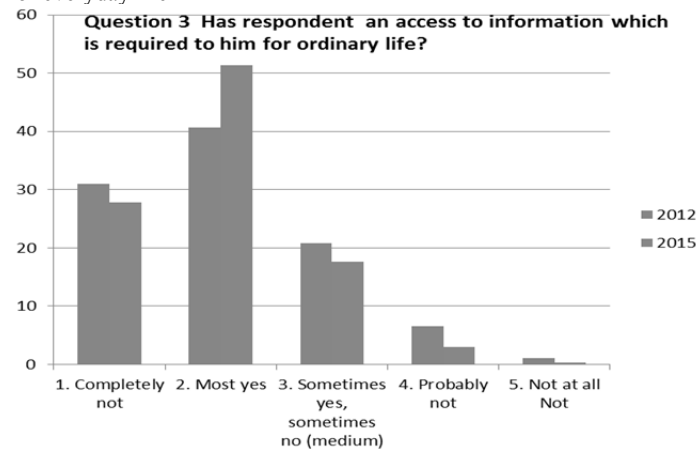
Figure 4 How secure do the respondents feel in everyday life



Source: Mandys, Jirava, Křupka, Kašparová (2012), Mojžíšová (2016)

Security is among the key attributes of the quality of life. We see again that there are generally no major changes in the results. Slight increase in neutral assessment can be seen in the year 2015. Yet most of the respondents perceive security in the city in a neutral or rather positive way. It can also be influenced by the fact that people are more trying to solve their problems with the help of Pardubice city police (Statutární město Pardubice; 2016).

Figure 4 Enough information for everyday life



Source: Mandys, Jirava, Křupka, Kašparová (2012), Mojžíšová (2016)

Awareness within the city of Pardubice can also be considered as good. We consider adequate information to be a principal attribute of the quality of life a specially with respect to current information overload in society. In this point, we recommend particularly concrete definition of typology of information, which the public administration considers to be essential for life in a municipality (region).

It is merely a schematic procedure while analysing quality of life. Quality of life is quite challenging. This is mainly due to the fact that there is a significant number of indicators which may be important in assessing the quality of life. Actually, this was primarily a test about how the respondents will react to these questions, what results they will bring, and whether these results will be useful for local administration management. Our results do not bring complex view on given problems on a selected region. We consider as a partial success the fact that questions on quality of life have been successfully integrated into sub segments of analytical work for the needs of the city of Pardubice.

4 Conclusions

As was shown in this paper, evaluation of the quality of life is fairly problematic issue. Its practical implementation is usually challenging; however, tools like rule-based systems, expert systems, multi criteria decision making systems, method of system engineering may simplify this process. Despite this drawback, the concept of the quality of life has one big advantage. This concept monitors the quality of life from many facets. Thus, this concept allows a complex assessment of the quality of life.

As follows from the findings and our experiences, the concept of the quality of life is a useful tool for management of the socio-economic development of regions. However, the concept has to be used in an appropriate way. At first, a regional management has to manifest a real (not only declarative) interest about needs of the community (region). It is also necessary to define local indicators which will be used for regular surveys. Regular evolution of the survey's results is a foregone conclusion. These activities have to be carried out systematically. Using of this concept, without following all these assumptions, is meaningless.

We realize that definition of the indicators, aimed on measurement of citizen's satisfaction with regions, is really not a simple task. Nevertheless, information about public opinions is fundamental for political representations. Indeed, members of political representations are elected representatives who build their programs on this information. Unfortunately, Czech political representation is based rather on clientelism than on understanding real needs. In order to overcome this drawback, we suggest combining of measures aimed on both objective and subjective quality of life. Such an approach allows preventing theoretical debates about selections of criteria or about choices of approaches. However, it is necessary to sensibly select monitored indicators. The indicators have to be selected with respect to local regional specifics.

Acknowledgement

The paper was supported by the University of Pardubice, Faculty of Economics and Administration, Project SGS_2016_023 „Economic and social development in private and public sector“.

References

- Ayvazyan, S. A. (2016). *Quality of Life and Living Standards Analysis. An Econometric Approach*. Berlin: de Gruyter, 2016. ISBN: 978-3-11-031625-4.
- Červenka, J. (2016). *How to measure the standard of living?* [on-line]. Socioweb [cit. 2016-10-24]. Available from: <http://www.socioweb.cz/index.php?disp=teorie&shw=114&lst=103>.
- Chen S. J., & Hwang C. L. (1992). *Fuzzy Multiple Attribute Decision-Making: Methods and Applications*. Springer-Verlag, New York. ISBN: 978-3-540-54998-7.
- Czech statistical office, (2016) *Gross domestic product (GDP)* [on-line]. [cit. 2016-10-24]. Available from: https://www.czso.cz/csu/czso/hruby_domaci_produkci_hdp.
- Dvořáková, Z., & Dušková, L., & Svobodová, L. et al., (2006). *The world of work and quality of life. Effect of changes in the world of work of quality of life*. Prague: Occupational safety research institutE, 2006. ISBN 80-86973-08-5.
- Eurostat. (2016) *Quality of Life indicators for the Europe Union* [on-line]. [cit. 2016-10-24]. Available from: <http://ec.europa.eu/eurostat/web/gdp-and-beyond/quality-of-life/data>.
- Kotýnková, M., & Kubelková, K., (2011). *Indicators of human development, focusing of the poverty in the Czech Republic. Reproduction of human capital - mutual linkages and connections III*. Praha: Oeconomica, 2011. ISBN 978-80-245-1697-4.
- Kubátová, H., (2010). *Sociology of lifestyle*. Praha: Grada Publishing a.s., 2010. ISBN 978-80-247-2456-0.
- Mandys, J., & Jirava P., & Kašparová, M., & Křupka, J., & Duplinský, J. (2012). *The situation in social services in the city of Pardubice*. Final research report. Pardubice: Univerzity of Pardubice.
- Mojžišová, M., (2016). *Satisfaction analyses of social policy in Pardubice* [Dissertation]. Pardubice: Univerzity of Pardubice.
- Phillips, D. (2006). *Quality of Life: Concept, Policy and Practice*. London: Routledge. ISBN 978-0-415-32355-0.
- Royuela, V., & Moreno, R., & Vayá, E. (2010) Influence of Quality of Life on Urban Growth: A Case Study of Barcelona. *Regional Studies*. 44(5), 551-567.
- Senouci, M. A., & Hoceini, S., & Mellouk, A. (2016). Utility function-based TOPSIS for network interface selection in Heterogeneous Wireless Networks. In *2016 IEEE International Conference on Communications (ICC)*. IEEE (pp. 1-6). DOI: 10.1109/ICC.2016.7511563. ISBN 978-1-4799-6664-6.
- Stem/Mark. (2016). *Quality of life: importance of indicators*. Netbus 11. - 15. 8. 2016. Czech Republic.
- Škrabánek, P. (2014) *Teorie fuzzy množin a její aplikace* [online]. [cit. 2016-10-24]. Pardubice: Univerzita Pardubice. ISBN 978-80-7395-875-6. Available from: https://e-shop.upce.cz/fcgi/versot.fpl?fname=eo_priloha&id=164598.

Labour Productivity Growth of SMEs in Food Industry and Financing Sources

Martina Novotná, Tomáš Volek

Abstract: *The basis for the growth of enterprises competitiveness are innovative activities leading to increasing of quality produced goods and services and labour productivity. Small and medium enterprises must use external financial sources to finance the economics growth of enterprises. The aim of this paper is to assess the development of labour productivity in relation to sources of funding of small and medium-sized enterprises in the food industry. It was found that small and medium-sized enterprises use from halt to finance of investment activities leading to the growth of labour productivity external financial resources. The importance of these resources has declined during the monitored period. Enterprise analysis showed that companies with above-average labour productivity using less external financial resources.*

Key words: Labour productivity · SMEs · Value added · Indebtedness

JEL Classification: D22 · M21 · L66

1 Introduction

Increasing the competitiveness of enterprises is nowadays conditional on innovative activities of individual subjects targeted to improving the quality of produced goods or services and to raising labour productivity. Given the often limited resources of small and medium enterprises it is necessary to use to finance economic growth external funding sources. The question is what is the scale of businesses from foreign sources to finance investments aimed to growth in small and medium-sized enterprises in the sector food industry.

The economics productivity of enterprises we can measure by indicators of productivity. Productivity is the ratio of outputs to inputs (Coelli et al., 2005). The basic indicator is labour productivity. Indicator of labour productivity shows the efficiency of utilization factors of production and the production possibility of all economy. Generally, labour productivity is affected by many factors, such as the sector in which the company operates, the technology used, the number of employees and employment structure, employee motivation (Rolcikova et al., 2013), investment or region (Leitmanova and Krutina, 2009). Labour productivity can be affected by size of the enterprises (Mura and Rozsa, 2013) or by the type of enterprises ownership (Petrách and Leitmanová, 2013). We have other types of productivity as capital productivity or total factor productivity. The capital productivity shows how productively capital is used to generate value added. Total factor productivity measures technological change. TFP is a combination of scale effect, technical efficiency effect, technological change effect and management effect (Čechura, 2012).

Growth in labour productivity depends on many factors. One of the main factors that influencing the growth of productivity are investments. Financial resources for investments can be divided into internal financial resources and external financial resources. Own (internal) resources are those resources that a firm makes on the basis of its own activities. They include mainly the result of the period, private investment and the creation of reserves. If the resources come from outside the company, we are talking about foreign (external) sources of funding. These include bond issuance, supplier credits, venture capital (Fotr and Soucek, 2011) or subsidies (Homolka and Švecová, 2012). The size of the capital structure depends primarily on the following factors: 1. company size (the bigger the business, the greater capital demands) 2. level of mechanization, robotics and automation (the more machines in the enterprise, the greater the capital required) 3. turnover rate of capital 4. sales organization (enterprises with their own sales networks require higher capital) (Synek, 2011).

Small and medium-sized enterprises (SME) are the engine of economy, generator of development, innovation and regional growth (Mura et al., 2015). The efficiency (productivity) of SME is influenced by many factors: human capital, management style (Vrchota and Marikova, 2015) or innovations. Innovations are necessary in the labour

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market to increase the flexibility of employees on the labour market (Pavelka and Loster, 2013) and can lead in companies to labour productivity growth.

2 Methods

The aim of this paper is to assess development of labour productivity in relation to sources of financing in companies. Article analyse if small and medium-sized enterprises in food industry finance raising of labour productivity from foreign sources or rather from its own capital. The first part of analysis was focused first on all food industry to determine the development of gross value added or labour productivity (gross value added / compensation of employees). The idea was to compare the development of these economic indicators of development indicators in the corporate concept.

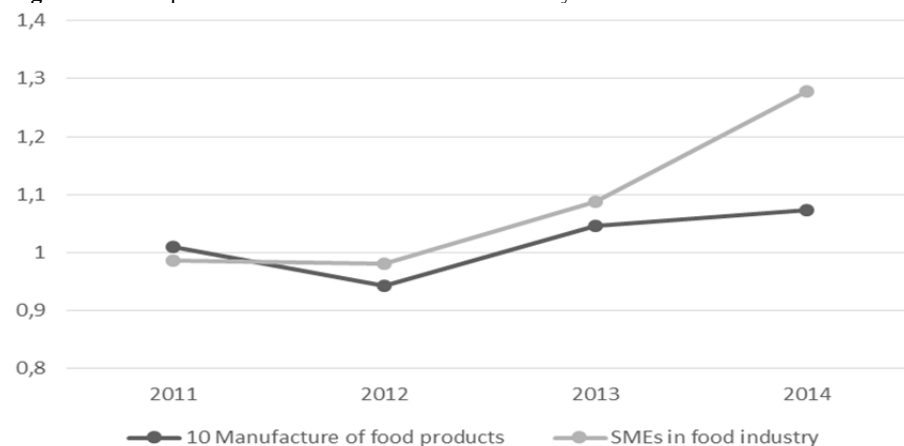
The source of data for the conducted analysis of the enterprises was a database ALBERTINA containing accounting data of companies with at least one employee. The observed data were from the period 2010-2014). Data of enterprises are surveyed at 350 companies in the Czech Republic, whose principal activity is the food industry (Section 10 - Manufacture of food products - CZ NACE).

The number of companies in the individual years differed slightly depending on classification as an SME. For comparison the equivalent data from company reports and macroeconomic indices were measured in current prices. The chosen company was characterized by following financial indicators: labour productivity (value added / personnel costs), debt (liabilities / total capital), the share of short-term foreign capital (current liabilities + short-term bank loans and overdrafts / foreign sources), the share of credit burden (bank loans and borrowings / foreign sources), the share of personnel costs (personnel costs / total costs), gross value added index and index of fixed assets.

3 Research results

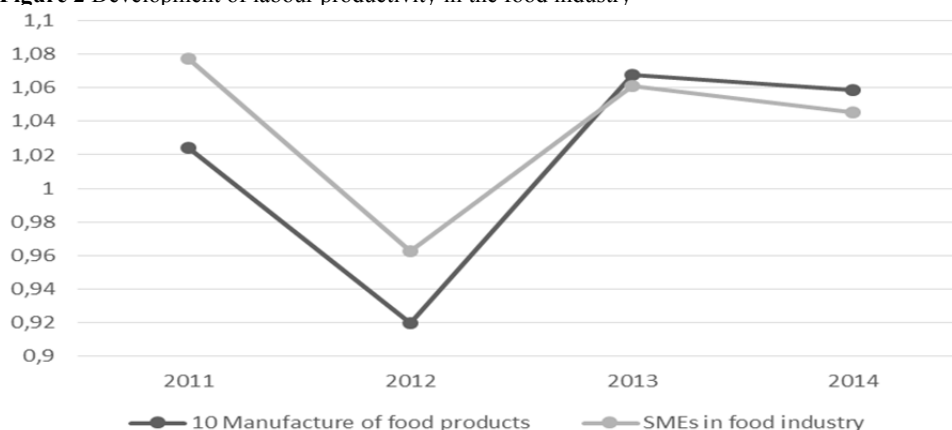
The first step of the analysis was to compare development of economic indicators of small and medium-sized enterprises and all food industry. Graph 1 shows that the trend of development in the added values are similar. It is important to realize that both indicators compared are not entirely factually identical, but to assess the development of these variance are not significant. Value added in SMEs in 2010-2012, declined year on year (the index is less than 1) and consequently an increase in 2014 is recorded annual growth of almost 28%. Compared with the development for the entire section was in 2014, this increase was higher by about 20 percentage points.

Figure 1 Development of value added in the food industry



Source: Own processing

From the comparison of labour productivity at the national economy and corporate level are already apparent different conclusions, even though the trend of this indicator are the same. In 2012 there is a significant decline in labour productivity (in Section 10 of almost 8% in SMEs by about 4%). This decrease is due to a decline in value added while personal expenses or compensation of employees increased slightly. Closer analysis shows that this development was not the drop in sales but growth in power consumption which indicates that there was an increase in prices of input factors of production. In the following years, labour productivity is growing, however in 2014, lower annual growth in the SMEs (by about 1.3 percentage points) although there was a significant increase in the value added tax (Figure2).

Figure 2 Development of labour productivity in the food industry

Source: Own processing

Further analysis had been only corporate data. For SMEs in the food industry have identified selected indicators (see Methods) and its development in the years 2010 - 2014. Table 1 shows that in those years there was a rise in value added per 1 CZK personnel costs except 2012 when the value of this indicator decreased slightly. We also recorded a decline in the indicator of the share of personnel costs again, especially in 2012 and 2013, which is likely due to the increase in prices of other factors of production, the share of personnel costs decreased. Indebtedness for enterprises in the food industry in the period decreases. The share of short-term liabilities to foreign sources is around 80% and in the period is largely unchanged. Share of loan exposure in food businesses dropped from 31.5% in 2010 to 24% in 2014.

Table 1 Development of selected indicators for SMEs in the food industry

	2010	2011	2012	2013	2014
labour productivity in CZK	1.89	2.04	1.96	2.08	2.18
share of labour costs in %	9.40	8.08	7.28	7.01	7.88
indebtedness in %	54.32	49.37	50.24	44.80	43.16
short-term external capital %	80.74	81.32	83.39	79.98	81.78
share of the credit load in %	31.54	31.29	34.30	27.84	24.18

Source: Own processing

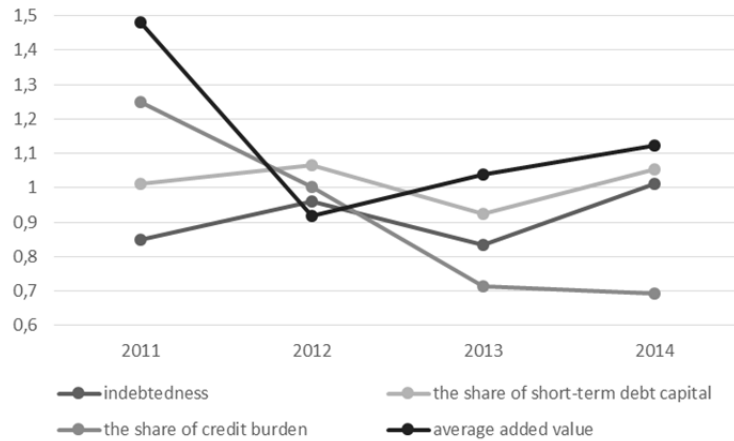
Each reference year were selected from SMEs in the food industry only enterprises that reached above-average labour productivity to analyse whether SMEs are used to finance foreign sources of productivity growth. The share of enterprises reaching above-average levels of labour productivity in different years (Table 2). While most of these enterprises were in 2010 (21.6%) and less than in 2012 (15.1%). Table 2 also illustrates the values of selected indicators.

Table 2 Development of selected indicators for SMEs with above-average labour productivity

	2010	2011	2012	2013	2014
labour productivity in CZK	3.36	4.00	3.97	4.20	4.26
share of labour costs in %	5.83	4.74	3.72	3.62	4.15
indebtedness in %	53.04	44.96	43.24	36.08	36.52
short-term external capital %	81.07	81.90	87.39	80.79	85.11
share of the credit load in %	28.21	35.25	35.39	25.24	17.46
relative number of enterprises in%	21.61	15.41	15.14	15.95	18.13

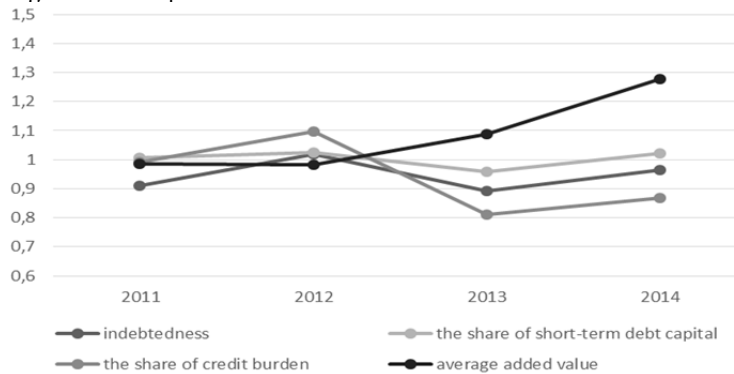
Source: Own processing

The share of personnel costs for this group in years, not only declining, but at almost half the value found for all businesses. In debt, it is possible to state that the default value for both groups of companies almost the same, but for a group of companies with above-average labour productivity decreases significantly, so in 2016 is at 36.5%. Conversely, the share of short-term foreign capital for this group, slightly higher. Companies with above-average labour productivity, however, have a significantly lower proportion of the loan burden. This can be explained either by financing assets from its own resources or reduced investment activity. It will be examined further. Figure 3 and 4 illustrate indices - annual growth rates of selected indicators.

Figure 3 Development of selected indicators for SMEs with above-average labour productivity

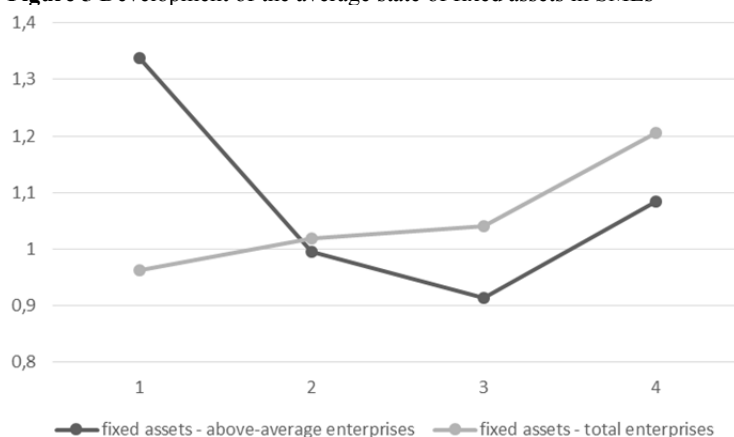
Source: Own processing

Annual increases credit burden for enterprises above average decrease (in 2013 the index is even lower than 1). Added value grows slowly in comparison to all enterprises, however, it is more effectively achieved. 1 CZK personnel costs account for about twice the value added. A more detailed analysis should lead to discrepancies were observed using other production factors and other aspects of management or specification or size of business. its location.

Figure 4 Development of selected indicators of SMEs - total

Source: Own processing

Figure 5 shows the development of the average balance of fixed assets. But it also confirmed by the research question enterprises with above-average labour productivity invest less. Their investments were significant base-year monitoring and in 2011 (annual growth of fixed assets in 2011 of about 34%). In the following years, the value of fixed assets of these enterprises even reduced. Above-average labour productivity of these investments thus showed up with a time delay. For enterprises total value of fixed assets annually since 2012, is gradually growing and it is expected that in the next period will increase the productivity of labour. It can be stated that the values of monitored indicators converge to a stable value. Enterprises that want to survive and be competitive must respond to market changes and the development of competition.

Figure 5 Development of the average state of fixed assets in SMEs

Source: Own processing

The analysis allows to answer the question if enterprises financed increasing of labour productivity from external financial sources or rather from internal financial resources. If we compare the growth rate of fixed assets and the growth rate of debt in the context of the development of labour productivity and the size of the total debt we will find that small and medium enterprises in food industry used to finance investments leading to the growth of labour productivity foreign sources, but their importance is steadily decreasing. The analysis on the contrary, we can conclude that the importance of its own resources to finance investments of small and medium enterprises increases. The analysis showed that enterprises above average productivity achieved only by investing in assets that are reflected with a lag, but are also influenced by many other factors such as the location of the company, sales opportunities, company size etc.

4 Conclusions

The article has focused on the development of labour productivity in SMEs in relation to funding in food industry. Paper has analysed whether firms financing increasing of labour productivity from external financial resources or rather from internal financial resources. If we comparing trends in value-added and labour productivity in SMEs and for the entire industry, it was found a similar trend until 2014. This year has been obvious revival of economic growth especially for small and medium-sized enterprises. Business analysis on a set of 350 small and medium enterprises in the food industry have shown that in the period monitored enterprises a slight growth in labour productivity, to reduce the share of labour costs in total costs, a decrease in total debt including credit burden and to reduce long-term resources on total debt businesses. The share of short-term resources in the total debt is in the period of almost constant. If we compare companies with above-average productivity of labour with other SMEs we found that these enterprises are characterized by lower compared to the average share of labour costs, and lower overall indebtedness, but rather a slightly higher proportion of short-term debt. The last part of the analysis focused on assessing the dynamics of monitored indicators in the context of the growth of fixed assets showed that in the time horizon of enterprises with above-average labour productivity had lower dynamics of investments due to a time lag effects of past investments. In the longer term it was possible to see a return to the same trend as in other businesses. In conclusion we can say that small and medium-sized enterprises use external financial resources to finance investment activities leading to the growth of labour productivity but during the time the importance of these resources declined.

Acknowledgement

This paper was supported by the Grant Agency of the University of South Bohemia GAJU 053/2016/S

References

- Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to Efficiency and Productivity Analysis*. Springer US. ISBN 978-0-387-25895-9.
- Čechura, L. (2012). Technical efficiency and total factor productivity in Czech agriculture. *Agricultural Economics-Zemledelska Ekonomika*, 58(4), 147-156.
- Fotr, J., & Souček, I. (2011). *Investiční rozhodování a řízení projektů*. Praha: Grada Publishing, a. s. ISBN 978-80-247-3293-0
- Homolka, J., & Švecová, M. (2012). Analysis of financial support influences on management of agricultural enterprises. *Agris On-Line Papers in Economics and Informatics*, 4(1), 13-20.
- Rolcikova, M., Kremarska, L., Otte, L., Cerny, I., & Sgem. (2013). Possible ways of calculating labour productivity in selected mining companies of the Czech republic. In *13th International Multidisciplinary Scientific Geoconference, SGEM 2013*, Albena, Bulgaria.
- Mura, L., Buleca, J., Hajduova, Z., & Andrejkovic, M. (2014). Quantitative Financial Analysis of Small and Medium Food Enterprises in a Developing Country country. *Transformations in Business & Economics*, 14(1), 212-224.
- Mura, L., & Rozsa, Z. (2013). The impact of networking on the innovation performance of smes. In *7th International Days of Statistics and Economics* (pp. 1036-1042). Prague.
- Leitmanova, I. F., & Krutina, V. (2009). Monitoring the Efficiency of Regions - Value Added Utilization (with a View to South Bohemia Region). *Ekonomický časopis*, 57(10), 1018-1037.
- Pavelka, T., & Loester, T. (2013). Flexibility of the Czech labour market from a perspective of the employment protection index. In *7th International Days of Statistics and Economics* (pp. 1090-1099). Prague.
- Petráček, F., & Leitmanová, I. F. (2013). Economic municipal undertakings. In *Aktualne Problemy Podnikovej Sfery 2013* (pp. 440-444).
- Synek, M. (2011). *Manažerská ekonomika*. Praha: Grada Publishing, a. s. ISBN 978-80-247-3494-1.
- Vrchota, J., & Marikova, M. (2015). Relationship between the growth-rate of turnover of sme's in relation to the age of the directors of these companies. In *Finance and Performance of Firms in Science, Education, and Practice* (pp.1629-1637).

National Security at a Crossroad

Marek Šusta, Stanislav Simbartl

Abstract: *In this short paper the authors describe their evaluation of a national security strategy published by the government of a small Central European country, in terms of its viability, using computer based policy simulation. The computer model was built in a form of management flight simulation to be used for testing various strategic scenarios across all security system components under various funding schemes. Respective strategy scenario success is measured primarily by the so-called Social Distress dynamics that should remain at acceptable levels to maintain in-country order and citizen's safety, keeping the risk of insurgency low. The secondary purpose of the model is to test the country's international counterinsurgency commitments fulfillment.*

Key words: National Security Strategy · Computer Modeling · Systems Thinking · System Dynamics

JEL Classification: C60

1 Introduction

The Czech Republic has gone through more than two decades of transformation from an authoritarian communist state to a democratic country fully integrated into the European Union and NATO. Not only did it have to adapt its security policy to the changes in the security environment after the end of the Cold War, it also had to set up the entire legislative, conceptual, and policy framework for its own security, build new institutions and radically reform the existing ones, create its own security culture, and develop its own approach – political, diplomatic, legal, organizational, and technical – to both international and internal security issues.

Political disputes (as everywhere) complicate the management of national security, and strategic documents reflect the security environment instead of anticipating it. All available documents do not address policy, and provide no guidelines for decision-making (Government of the Czech Republic, 2011, 2015). A related hypothesis is that some good results might still be achieved, even without a clear and stable policy framework. What is needed is a culture of debate and consensus at the professional expert level within the country's security sector, in order to bypass the ideological rivalries and short-term interests of party politics facing today's European security situation influenced by massive immigration from culturally different countries, increase in Russian activity and possible changes in the US approach to NATO. There is also a discussion on European joint foreign and security policy.

The viability of any strategy depends on adequate economic backing. However, during the 1990s, defence and security sectors were increasingly marginalized and budget transfers often served to expand funding for other priorities. Decisions about earmarking funds for security were not governed by the content of strategic documents. Instead, things were done the other way around with documents formulated based on funds the government was willing to provide. This practice of budgetary “activism” together with gradual reductions in the defence budget, plus a series of scandals over large acquisitions for the army, proved a poisonous cocktail for Czech security. (Institute of Health Information and Statistics of the Czech Republic, 2000-2015; Ministry of Defence, 1993-2012; Ministry of Interior, 2001-2012).

None of the Czech Republic strategies have ever been modeled or simulated. No dynamic scenarios were ever published. The reason why, is rather simple; simulation outcome might look depressive. Due to the global economic crisis, current trends in the public finances remain unfavorable for the security sector budget. Honoring international commitments to participation in expeditionary missions remains a priority, therefore spending cuts affects modernization and personnel costs. The modernization of the security forces has slowed down and in some areas has actually stopped.

On the other hand, there is a strategy that generally says “Czechs are going to cooperate with all allies and every single part of the security system will be supported to deliver the required outcome” (Government of the Czech Republic, 2011).

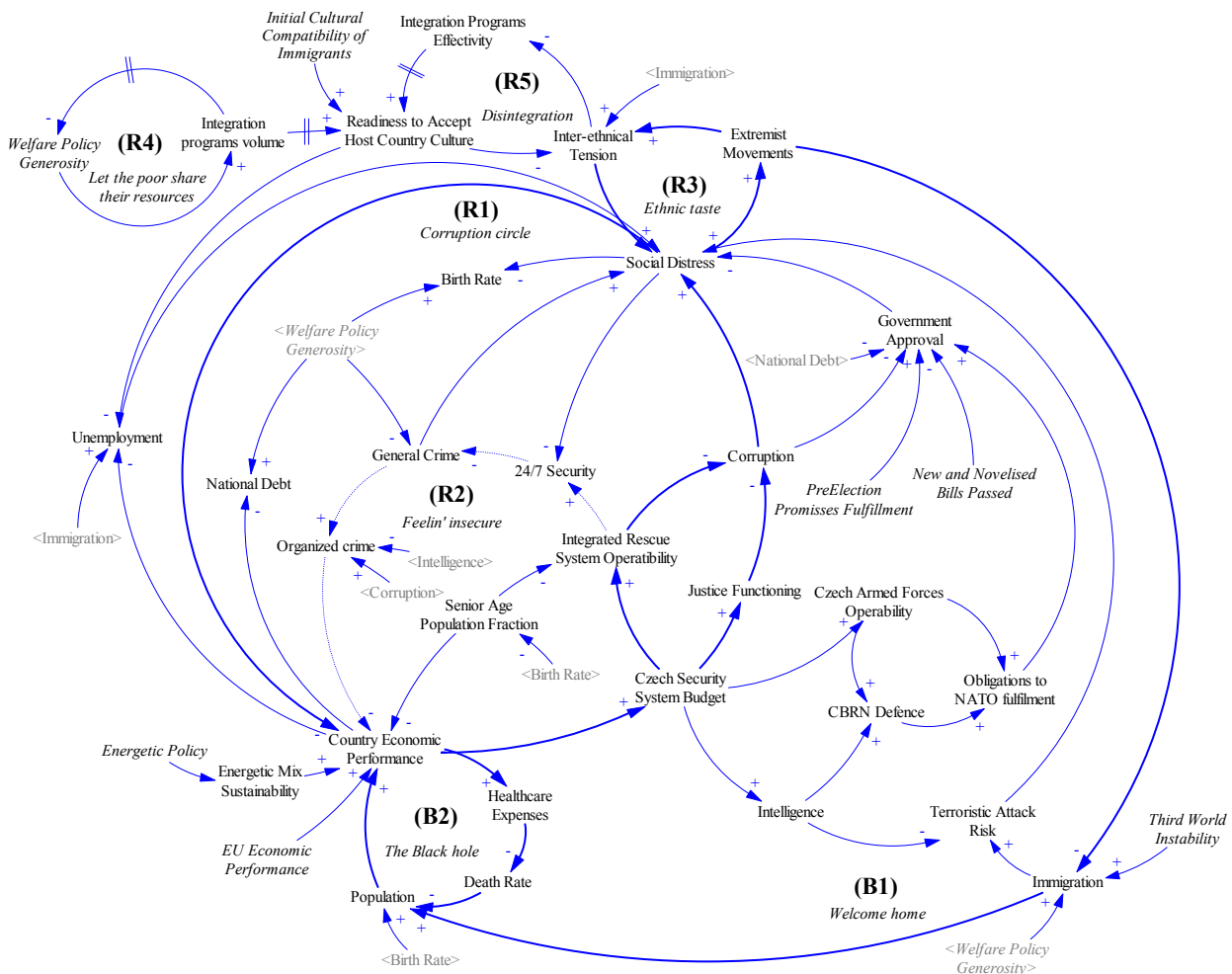
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plk. v. v. Ing. Stanislav Simbartl, Ministry of Defence of the Czech Republic, nam. Svobody 471/4, Prague /The Faculty of Business Administration at the University of Economics, Prague, Czech Republic; e-mail: stanislav.simbartl@army.cz

2 Methods

Due to lack of systems based evaluation of the national security strategy and policies, the System dynamics approach had been chosen. The security environment and fundamental parameter relations are depicted in Figure 1. The figure takes form of systems thinking causal loop diagram (Susta, 2015) and covers even the last factors with high importance to national security like immigration.

Figure 1 Causal Loop Diagram of the national security



Source: authors

The Causal Loop Diagram (Figure 1) covers areas related directly or indirectly to national and personal security. Due to the closed loops nature of the diagram, the term cornerstone might not be appropriate, but as the analysis showed, both the armed forces and the integrated rescue system (police force, fire and medical emergency squads) are strongly budget dependent and Czech security budget value is crucial for security system component development or decay (Balaban M. & Stejskal L., 2010). The Security Budget derived from the Country Economic Performance (gross domestic product) in such a small and open economy as the Czech Republic is related to the European Union's economic performance. In this study, modeled system boundaries copy Czech Republic borders; EU economic performance is therefore treated as exogenous. The country's economic performance absolute value is also related to the political party in power. Conservative parties tend to push decreases, while liberals seem to increase government spending. The idea of state assured welfare is historically strong in Europe, most government spending goes to pensions and support of all kinds, including generous support for so called maladjusted citizens. Therefore, governmental social support (Welfare Policy Generosity) causes a decrease of General Crime. Practically no one is left unsupported and crime is a chosen path, not a way necessary for survival. Even citizens that never worked are generously supported, and this policy increases Inter-Ethnic Tension because this lifestyle is typical for certain minorities. A change in welfare directly affects the Birth Rate and because current levels of social support go well beyond the country's economic performance, the National Debt also is increasing (Czech Statistical Office, 2000-2012). But having a security budget high enough is certainly not an ultimate goal of any security strategy.

The most important parameter of Social Distress must remain reasonable in order to maintain acceptable in-country order and safety of all citizens. With the exception of The Black hole (B2) all loops meet in Social Distress and its value therefore strongly affects overall behavior of the model. Social Distress is connected to the Political System Stability. A frequent change in political representation often means 180 degrees public policy reversal, causing immediate uncertainty for businesses and employed citizens. Inter-Ethnic Tension has a long history in Central Europe. Especially after the Velvet revolution (1989) the Czech government welfare policy evoked massive immigration and population explosion in certain ethnic groups that are now totally social-transfer dependent. These groups also contribute greatly to the crime rate (Ministry of Interior, 2008). Extremist counter-movements ensued in reaction to higher crime rate, elevates inter-ethnic tension even more, forming a positive feedback loop Ethnic taste (R3). Social Distress together with the welfare policy correlates with the birth rate (Czech Statistical Office, 2011), affects parliamentary Election Frequency (Masters change-R4 loop) and extremist activities (Ethnic taste-R3 loop). Extremist movements hinder Immigration and boost Inter-ethnic Tension (Ministry of Interior, 2008). The welfare policy range is a function of the political party in power as well as the Third World Instability. Immigration, which is affected by Third World Instability, and Terrorist Attack Risk are treated exogenously in Welcome home (B1) loop. Terrorist Attack Risk is another factor that affects Social Distress. Increase in Immigration combined with possible religious disputes between newcomers and traditional culture might substantially change Social Distress level.

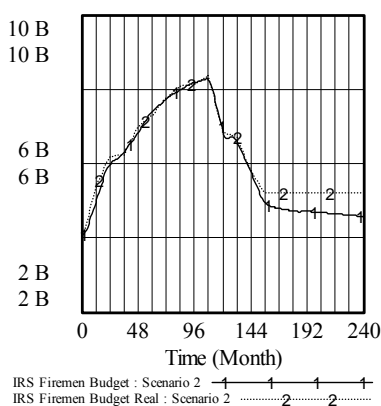
3 Research results

World The model uses real data from respective sources. Some parts of the model involving the armed forces and intelligence covers areas where real data values are classified. To make the simulation possible required sub-models that helped to track relationships between budget and capabilities in the armed forces (Susta M., 2011). Budget resources are divided into three areas, covering army human resources, operations and materiel. Performance in these three areas forms overall parameter called Czech Armed Forces Operability. Scale between 0-100 was chosen as a referential for all security system components in terms of operability. The simulation starting date was set at 2001 and past data was gathered for the whole period of 2001-2016. The simulation runs for 240 months and the obtained patterns allows running a reality check on the model behavior.

One of the scenarios modeled and simulated is based on following description of possible future development. In some cases the figure is a result of comparison with so called base scenario, where no special policy takes action and the system is left to itself to exhibit its natural behavior.

The security system of the Czech Republic started developing in the late 1990s, mainly in response to the country's accession to NATO (1999) and the subsequent accession to the European Union (2004). Another important impulse for the building of a fully operational security system was provided by two devastating natural disasters – the floods of 1997 and 2002. Even in 2012 it could still be said, in line with the Security Strategy of 2011, that “the security system serves not only as an instrument for the effective management of both military and non-military crises, but also ensures prevention of, and preparation for, potential crisis situations, as well as their timely identification and warning”.

Figure 2 Fire Rescue System Budget (bil. CZK)



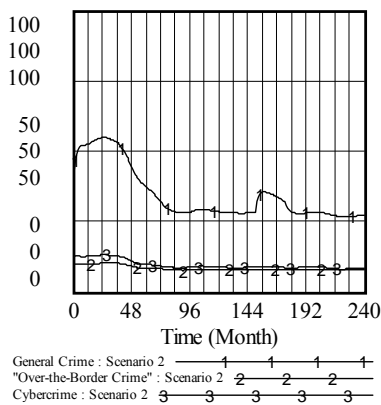
Source: authors

However, during the rest of the second decade, the security system gradually sank deep into financial problems, which was due partly to the economic crisis and also to some extent incompetent management by the government or the key ministries (especially Interior, but also Defense) that were forced to compete for resources. The crisis hit all the key

components of the system: the Fire Rescue Service (FRS), the Police Force of the Czech Republic and the Army of the Czech Republic (ACR). Figure 2 shows Fire Rescue System budget with the increased budget policy applied.

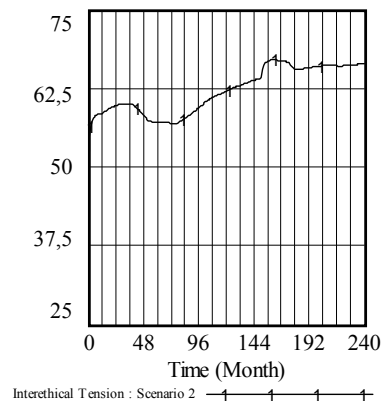
Uncontrolled, disorganized implementation of budgetary austerity was under way in all parts of the security system. In 2017 the FRS (with a budget “trimmed” by CZK 306 million) found itself on a budgetary trajectory that resulted in layoffs of firemen, a lowering of fire protection standards, and a decline of the Integrated Rescue System which resulted in a crisis management in the whole of the Czech Republic. Under pressure of the austerity measures, the Police Force of the Czech Republic had to lower its standards of security provision (the number and operational readiness of police stations fell, response time to crime calls increased). In 2019, the Police Force found itself in a state of a staffing collapse, with only 30,000 policemen doing work that, according to expert estimates, required at least 40,000. The drastic reduction of police numbers was one of the key factors contributing to the sharp rise in crime and the fact that the police effectively lost control over certain parts of the country, especially those communities with a high concentration suffering from social exclusion (Figures 3, 4).

Figure 3 Crime (Dimensionless)



Source: authors

Figure 4 Inter-ethical tension (Dimensionless)



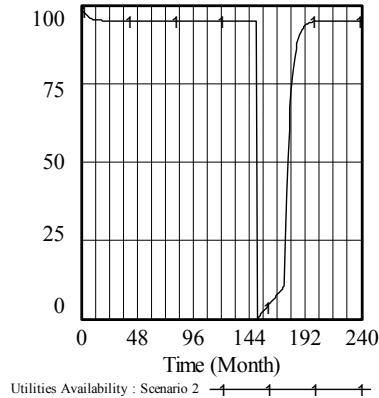
Source: authors

The Army of the Czech Republic also found itself in a budgetary impasse which led to a blanket salary reduction, a reduction or abolition of certain benefits and also further layoffs of both military and civilian personnel. Moreover, throughout the first half of the 2010s the internal debt of the army kept increasing, reaching CZK 100 billion.

From 2017 to 2020, the security system already showed signs of strain, fulfilling its primary functions only to a limited extent. After 2020, however, the deficiencies in its operation became painfully evident. In the exceptionally hot July of 2023, an extreme grid overload caused a full three-day blackout followed by 20 months of more or less unavailable electricity, not only in the Czech Republic, but also in neighboring Germany. The blackout event (Figure 5) is described in detail in the guidelines published by the government (Government of the Czech Republic, 2010). It was necessary to ensure emergency distribution of water, food and drugs to maintain public order, but the Fire Rescue Service, the Police Force of the Czech Republic and the Army of the Czech Republic, troubled by both personnel and

technology deficits, proved inadequate for the task. Moreover, in areas with high unemployment, crime rate and ethnic tensions (northern Bohemia, northern Moravia) the blackout led to organized looting and destruction of private property. The security system failed to bring these issues under control, although it was the first time in post-1989 history that the army was used to quell internal unrest. The strong frustration caused by the great loss of lives and damage to property led to the fall of the government and boosted the popularity of extremist groups.

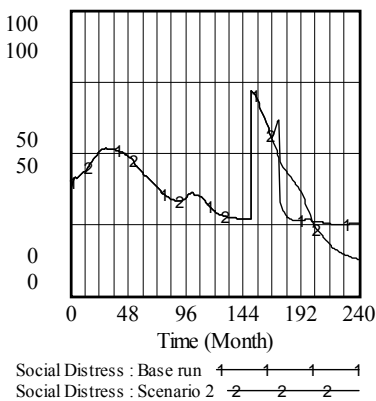
Figure 5 Utilities availability (Dimensionless)



Source: authors

After the early parliamentary elections in spring 2022, the new government was forced to adopt radical measures to stabilize and further develop the security system. Apart from increasing the budget of its key components (this increase, however, only averted their full-scale collapse), it began to prepare a draft Concept of Security System Development. The aim was to knit the security system more closely together economically, technologically, and structurally. It would operate with maximum efficiency and draw part of its funding from private-sector sources (e.g. through an “insurance tax” paid by the insurance companies of the Fire Rescue Service). The drafting and implementation process was so complex, however, that the Concept could only be fully implemented in the late 2010s. This dynamics follows “worse before better” pattern, described by Sterman (Sterman J., 2000). When the budget increase, accompanied with security system components optimization, it causes social distress to last longer (Figure 6), but ending up in lower values than base run.

Figure 6 Social Distress - Base run and Scenario comparison (Dimensionless)



Source: authors

Similar dynamics is observed in all simulated areas. Two policies are available for model users in the Optimization scenario – Real Optimization and Cuts only. The second one creates better before worse patterns, as expected. Table 1 shows KPI’s for the simulated scenario. Simulation outcomes show the best results, but this scenario requires large intra and intersystem changes. The question of cybercrime existence when there is not enough electricity available is left unsolved. Lack of electricity might result in inadequacy of anti-cybercrime measures. Parameters that met requirements are typed in bold.

Table 1 Strategic KPI's, base scenario

	Required	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
General Crime	16	17	17	18	18	19	19	19	19	20	20	20
Over-the-border Crime	12	12	12	12	13	13	13	14	14	14	14	14
Cybercrime	8	13	13	14	15	15	16	16	16	17	17	17
Corruption	23	49	41	38	37	39	41	42	42	42	43	44
Terrorist Attack Risk	10	4	4	4	4	4	4	4	4	4	4	4
Extremist Movements	15	39	40	40	40	41	41	42	42	43	43	43
24/7 security	76	75	77	78	78	77	76	76	75	75	74	73
Obligations to NATO Fulfillment	100	45	45	44	43	42	42	42	42	41	41	41
Social Distress	24	33	29	28	28	29	31	31	31	31	32	32
Armed Forces Operability	37	34	33	33	32	31	31	31	31	30	30	30
Police Operability	65	66	66	65	64	63	63	62	62	62	62	62
IRS - Firemen Operability	100	100	100	100	100	100	100	100	96	92	89	86
IRS - Emergency Medicine Operability	100	100	100	100	100	100	100	100	100	100	100	100

Source: authors

Almost all parameters dropping, the immigration is kept at very low numbers, the only well-functioning services is the Integrated Rescue System. The only parameter in this scenario that actually meets requirements is the Terrorist Attack Risk.

4 Conclusions

The scenario does not explicitly model impact of immigration, the number of immigrants is kept low but simulation results clearly show that without significant changes in approach to national security the level of sustainability and security will continue to drop. The model building and scenario simulation effort fills blind spots and comes with clear results, quantified parameters and a set of KIP's that can measure success or failure of strategic initiatives and government policies applied to the close future. Simulation outcomes indicate that the Czech Republic security system left untouched by insightful policy or policies will deteriorate, ending up in an unfavorable state as Table 1 shows. Having a security strategy is surely nice, but every strategy must be translated into a concrete set of coherent actions in order to succeed. The model was built in a form of management flight simulator using Sable environment and now is being used to test various strategies. As with every project that borders science and real life work, it is never perfect but in this case the answers were found.

Acknowledgement

This research has been supported by the Proverbs 2016-1/1/02 grant.

References

- Balaban M., & Stejskal L. (2010). *Chapters on Security*. Prague: Karolinum.
- Czech Statistical Office. (2000-2012). *GDP, National Accounts* [online]. Prague: Retrieved from http://www.czso.cz/eng/redakce.nsf/i/gdp_national_accounts_ekon.
- Czech Statistical Office. (2011). *Czech Republic Annual Report 2011* [online]. Prague: Retrieved from http://www.czso.cz/csu/redakce.nsf/i/statisticke_rocenky_ceske_republiky.
- Government of the Czech Republic. (2010). *The Report on State of Czech Republic Security Ensuring in field of crisis situation protection*. Prague.
- Government of the Czech Republic. (2011). *Security Strategy of the Czech Republic 2011* [online]. Prague: Retrieved from http://www.mzv.cz/file/705316/Bezpecnostni_strategie_2011_EN.pdf
- Government of the Czech Republic. (2015). *Security Strategy of the Czech Republic 2015* [online]. Prague: Retrieved from http://www.army.cz/images/id_8001_9000/8503/15_02_Security_Strategy_2015.pdf.
- Institute of Health Information and Statistics of the Czech Republic. (2000-2015). *Health Department Statistics* [online]. Prague: Retrieved from <http://www.uzis.cz/vykazy>.
- Ministry of Defence. (1993-2012). *Budget of Ministry of Defence 1993 -2012*. Prague.
- Ministry of Interior. (2001-2012). *Statistical Yearbook* [online]. Lazne Bohdaneč: Retrieved from <http://www.hzscr.cz/hasicien/article/statistical-yearbooks.aspx>.
- Ministry of Interior. (2008). *The Report on the Issue of Extremism in the Czech Republic in 2008* [online]. Prague: Ministry of Interior Retrieved from <http://aplikace.mvcr.cz/archiv2008/extremis>.
- Sterman J. (2000). *Business dynamics: systems thinking and modeling for a complex world*. Boston. London: Irwin/McGraw-Hill.
- Susta, M. (2015). *Systems thinking guide*. 1st ed. Prague: Proverbs Corp.
- Susta M. (2011). *Czech Armed and Security Forces Budget Change Simulation (2.0 ed.)*. Prague: Proverbs Corp.

Economic Aspects of the Concept of Active Service for the Public Sector

Jaroslav Šetek, Filip Petrách, Ivana Faltová Leitmanová, Jiří Alina

Abstract: *The article deals with current issues of economy human resources, which are currently struggling European region, while ensuring their defense, security and addressing the social ills of the current type of society. The main part is focused on the economic analysis of possible solutions, staffing the public sector to reduce current security and social risks.*

Key words: The army · Security forces · Security risks · Social ills · The public sector · Service relationships

JEL Classification: B41

1 Introduction

For every type of modern society still valid conclusion spiritual father of the economic theories of Adam Smith. He already in 1776 in his famous work *The Wealth of Nations* wrote: „The first duty of the ruler is to protect society from the violence and invasion of other independent states, and this protection can be accomplished only through military force. But the cost of preparing military forces in peacetime and their use in time of war are very different in different stages of society and in different periods of its development.” (Smith 2001)

Ensuring the security and defense of the state rests on many economic issues.. Basic questions should essentially be: "How much is enough? What is the cost-effectiveness?" This fully applies to other spheres of the public sector, which ranks all-round care for human resources of the company as social security, education, health, etc .. (Stiglitz, 1997) In its essence, in terms of how to prepare for future threats armed and social nature which may implement various specific situations, as is true that like any probable phenomenon almost everything is possible and and nothing is certain. Setting requirements for defense and other services for the public sector is generally based on the forecast, but the problem lies in the fact that the financial, human and material resources can be forecast fairly accurately even in the long term, while predicting future threats in the form of security risks and social risks it is very uncertain. (Wawrosz & Valenčík 2014) The reason is the possibility of unpredictable twists in the evolution of the security environment. But the problem lies not in the fluctuation of the value of security risks in time, but their likely nature whatsoever. On the example of defense is not enough to consider the average risk, but it is necessary to evaluate the possible dispersion of its implementation. (Šefčík 1998) Additionally, some safety and social risks are unlikely, but with fatal consequences, while others are much more likely, but with less severe consequences. It is axiomatic that the services of the public sector will not decide the size of resources mobilized in the event of speech risks, but the quantitative and qualitative dimension spent much sooner. Excessive reduction in public sector spending (to defense and security) can lead to immense difficulties in the near future. (Stiglitz, 1997)

2 Methods

The paper is processed interdisciplinary approach social sciences economics, public economics, financial theory, law and sociology. Within approach prevails application of analytical, comparative, historical and analogical thought processing methods. The choice of these methods aims at defining the possibilities for introducing active service on a voluntary basis for the public sector on the example of the Czech Republic. Analysis of the concept of active service is determined by the demand for services from the public sector and its economic constraints. Therefore,

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the partial substitution of public sector employment by active service aimed at economic efficiency of the use of human resources to this sector.

Economic differences compulsory and voluntary military service

To ensure its national defense often gets human resources for military service in a way completely different from employee relations, thus forcing the young population (predominantly male) for compulsory service to the army. The fact that the citizens need to be forced to join the army (thus forced into the role) is for them many negative economic aspects. These can be seen in the three factors.

The first is in respect of the economic dimension theory of value of human life, which in connection with armed conflicts defined the leading French liberal economist Jean-Baptiste Say. By tracking the Napoleonic Wars provided the theory that the loss of human life in an armed conflict means the loss of the country's wealth, as in human life is invested. Say's theory has its justification that can be demonstrated records of the impacts of war. (Say 2003) In the spirit of this intellectual concept human progress (economic, social, scientific, technical) and policy from the Middle Ages to the present day, was and is mainly focused on improving the ways and means to destroy more and more people in ever shorter intervals. This also evidenced in the statistics Swiss scientist in the field of polemologie J. J. Babel. According to his statistics, the number of wars in the 60s of the 20th century is estimated at 14500, which killed more than three billion people. (Šefčík 1998)

The second consists in comparing income individuals during performance of compulsory service when receiving wages (from the perspective of economic theory is a transfer), which is substantially lower than the wage obtained in the labor market. On compulsory military service can thus be viewed as a collection of taxes from certain population groups. This tax can be characterized as uneven as it is imposed on selected individuals (especially the male population) at a certain age (around 18-28 years) due to health status, compliant training in contemporary combat deployment. (Šubrt 2006) Mandatory service is then the cause of two inefficiencies:

- Firstly, it is a reality that for some individuals the opportunity costs (expressed in lost wages in the labor market) compulsory service in the army much lower than others.
- Secondly, compulsory service has the effect that the Army does not consider the full costs of alternative program. The price of labor in this service is much lower than it would have been if desired wages paid hired workers. (Becker 1971)

Third is the issue of depreciation of human capital (physical and moral), which occurs in the course of compulsory service. Here you can include loss of opportunities conscripts to serve in the army for expanding training or education that could potentially utilized in their civilian jobs, but also the obsolescence of its existing qualification before entering the service. Amortization of human capital is difficult to quantify, but comparing the value received training and education can be inferred conclusion. Its results clearly confirm the superiority of amortization of acquired value of training and education during the service.

Proponents of compulsory military conscription are voluntary service against several arguments. Primarily of interest to inequalities associated with the voluntary service. For poorer individuals (with limited alternatives other jobs) will be attractive to military service, but in case of war bear the onus is theirs. Anyone who shares this view, takes the view that certain rights and responsibilities should be divided according to position in the market. In this context applies rhetoric: "To fight for national interests and the risk and danger to life belongs to basic civic duties." Opponents of the voluntary service they are interested in the effectiveness of the army. If individuals with lower opportunity costs (the lower the value of human capital) serve in the army, then it is likely low quality of its performance. Then there is a simple solution to this problem: any employer is exposed to a similar situation and responding to it by increasing the salaries up to the point where you can choose from the quality of candidates it wishes. On this typical example, can make recommendations to the political representation of the state. It is allocated to military budgets sufficient funds for proper appreciation of human resources in the army, for only then will the defense of the state suffer from a lack of qualified staff. These concerns about the quality of the army were particularly strong in the period of voluntary service in the United States since the early 70s of the 20th century. Sociological research has confirmed a significant increase in the quality of volunteers in the eighties. This was mainly conditioned by high levels of unemployment among youth consequence of the remaining impact of the global economic crisis in the first half of the 70s of the 20th century. (Šetek 2006)

Economic, security and ethical aspects of political decision-making

The current security situation (terrorism, migration, penetration of organized crime) and the subsequent fear among the population tends to increase state power. It should be noted that the number of inhabitants in the position of taxpayers is dominated by economic aspects of fear. In this situation, aside fundamental questions of economic mechanism of functioning of the public economy, such as: "What are the dimensions achieved growth of government. There is an arbiter for the assessment? (Becker 1997)

Sense of threat raises a number of political representation of the state in the economy, security and social measures. That in its decisions while taking the wealth and freedoms of its population (mainly through taxes) .. As a result of the reign of fear mongering and political representation gaining favor. But political representation will always have their own reasons for doing anything or not. Democratic political system seems to be a ploy to political representation to convince people that they are not forced to comply or do something against their will. (Higgs 2006)

An important arbiter of the international surroundings - it is mainly States and international organizations. In the current situation, when transformed or generate new economic, political and security structures, the adjacent ongoing integration and differentiation processes when krystallizují new relationships in order to exploit the positive qualitative změnyve world to shift the concept of security into another dimension, it is particularly important . Just as it was harmful and practically unrealistic izolacismus, ignoring the surroundings and overestimating his own importance and status of the state and its economic and security bodies, so we can not accept fully all, moreover, often contradictory, opinions and views of the surrounding area. Greater benefits for devising long-term stable efficient and reasonably flexible strategy, long-term positive image and attitude brings mentioned artificial look in the mirror informed, objectified, information furnished observers - states, having importance for ensuring the smooth economic growth in kotextu social and safety aspects of migration, not only the state but also the region. This is thinking in particular countries in close geographic surroundings. (Šetek 2015)

3 Research results*Economy of human resources for the public sector*

Problems of economic rationality of the public sector is currently gaining great theoretical and practical significance. Their genesis is primarily of interest to normative economics. Dates from the mid-70s of the 20th century in developed market economies in parallel with the failure of Keynesian economics therapeutics during the deepest global economic crisis since the Second World War. You can not rely on the fact that people "somehow agree" on the need to create "public works". For their work is always needed no power of authority - the state, which results from the nature of public sector financing. The possible absence of a public sector could theoretically resulted in the decline of the state over the economic, political and social. The State would then tossed in social storms and eventually was absorbed by the state more mature and stable.

One of the basic functions of the public sector is to ensure its security and defense. This earmarked component of the army and security forces. Human resources for ensuring the operation of the state bodies in the Czech Republic acquired in the labor market through business and labor relations, or voluntary participation in active backups. By 2005, among others. Army was gaining human resources also mandatory performance of compulsory military service for male population. An alternative to compulsory military service in the civilian public - nonprofit sector (governmental and nongovernmental). Approximately in this period as was the case in most European countries. In Germany (the most advanced economies of Europe) compulsory military and alternative civilian service is canceled in 2011, especially for the "economically cheap" labor civilian security services for ancillary services in health, social sphere and non-profit sector. (Rektořík 2010) In some states the obligation of service was left (Austria, Denmark, Norway) or reintroduced (Lithuania). At the same time in these states is the possibility of an alternative civilian service, as was the case earlier in the Czech Republic until 2005.

In the Czech Republic due to an increase in the current security risks considered the introduction of mandatory payments for men and women at 18 years, in case the call to military or civilian service for emergencies. This is mainly because of economic reasons can not be fully to utilize professionals in the military. If you are considering a reform possible service for conscripts called up for service to the public sector, it is necessary to consider not only the demand within the security of the national security system, but also its surroundings. In it is a potential economic power accompanied by economic and social risks like. After the initial indicative analysis can be concluded that the proposed variation is not yet economically poor perspective. You can not just focus on the needs of the army, but the entire public sector, and even non-profit sector, substitute some functions of the state. (Rektořík 2010) The present concept seems

more like a sociological survey quantified the cost of about 230 million Czech crowns annually. This can be in terms of human capital theory be considered ineffective because the control of modern defense technology is the result of scientific and technological development of increasingly complex and need adequately trained skilled individuals. For the above reasons for this purpose appear to be appropriate to propose to the active service of the public sector on a voluntary basis in the form of military or civilian. Its completion would be from the perspective of the theory of human capital and ethical dimensions of one of the main conditions for the entry into service relationship to the state, which guarantee higher standards of economic and social security. (Rektořik 2010)

Securing growth in demand for human resources of the public sector on a voluntary basis

So far, the proposed issue applies only to public sector demand for human resources within the security of national defense on the basis of the obligation. However, it does not take into account the internal security and overall security system around the state. These economic and social aspects that accompany our society (especially its social ills - requested an increase in demand for social services, etc.). Incorporating these aspects could in turn contribute to increased quality of social system, rising living standards and consequently also for the growth of so-called. Imaginary function of the general welfare. Additionally stimulation thus raised the demand for human resources of the public sector should be implemented on a voluntary basis.

For the above reasons, it is necessary on a detailed analysis of defense policy, economic and social policy from 1990 to the present suggest a fundamental systemic changes that would ensure the efficient functioning of public sector demand regardless of the macroeconomic development of the economy (the state in the cyclical development). As a possible solution would be to create so-called. Active service in the public sector. Voluntary participation in active service should be the prestige and national pride with a view of state spending on this activity would not be expensive. It would encompass service to the state militarily organized (especially in the military, or the selected security forces) and civilian (non-profit public sector - state administration, self-government).

With the concept of active service, the question arises about the motives for voluntary. From the perspective of human capital theory this service can be evaluated as an investment in human resources before entering into business relationships (for the armed forces, security forces and the civil service). The fulfillment of this service on the basis of economic, ethical and pedagogical aspects should be one of the basic conditions for admission to the aforementioned business relationships. The service would be attractive to young people with the culmination of 18 years, especially for ending high school students, trainees, vocational schools and university students. It would also be an effective motivation for this service, young people long-term unemployed, or even create special programs for persons on maternity and parental leave.

During such a service would be able to get a free license, welding and other tests on various industrial equipment, arms license, certificate for the profession of social work and social services, preparation for attestation of physicians like. These are investments in human resources acquired during active services. They would subsequently be reflected in increased competitiveness on the job market after leaving the service in all sectors of the economy. From the perspective of human capital theory would thus causing its appreciation.

The merits of the introduction of active service in the public sector

Overall, the merits based on economic analysis and legislative functions of the public sector raised from the beginning of the transformation of the company and all related accompanying events from 1990 to the present, ie. Historico-economic, international, security and social aspects. It is also important to note the Czech Republic's integration in NATO and the European Union. The public sector represents part of the aggregate demand for human resources. From the perspective of this sub demand represents two groups of interests of the national economy and its environment.

The first is a group of interests stemming from the security aspects of the economy, which is determined by:

- Changing security environment (global, European, Czech Republic) at the end of the Cold War; with it new potential hazards of armed nature - irregular foreign wars, international terrorism, mass migration, the growth of organized crime and the like.
- Specific forms of crime in the context of structural changes in the economy - corruption in the procurement of state and local governments (cleaning, maintenance, security and logistics of these institutions ...).
- Natural disasters (floods, floods, environmental disasters ...)

Secondly, it is a group of interests for solving social problems of the economy:

- Growth of social exclusion (resulting in long-term unemployment, heavy indebtedness of the population, drug or alcohol addiction, etc.).
- Ageing population consequence of lengthening the average duration of human life.
- Growth in demand for social and health services.
- A possible influx of refugees from abroad consequence refugee crisis.

Both of the above interests - sources of demand for human resources of the public sector are always determined by legislative standards (representing the implementation of reforms and development of the public sector) on the one hand and economic development (guided by cyclical fluctuations in macroeconomic indicators). In relation to aspects of internal and external security of the state and proper social welfare are mutually interdependent "communicating vessels". Under the monitoring of macroeconomic developments on the Czech Republic's example can point to the impact of restrictive economic policy measures result from a speech the financial crisis of 2008. It is very touching and human resources in the public sector, freezing salaries and reducing the number of inmates.

Initial marketing strategy of active duty personnel in the public sector

As already mentioned the fulfillment of this service would be one of the basic conditions for admission into official relations to the army, security forces and civil service. In terms of career rules would mean active service as the first basic step to that would follow already established a hierarchy of degrees career by business conditions. Unlike a labor relations legislation falls on service relationships governed by public law, because the priority is the interest of the state. According to legislation on service contracts for members of the armed forces and security forces; We can talk about military service relationship, as the army, police and other state security forces with a military corps. According to the Civil Service Act can talk about civil service relationship (clerk).

The service relationship represents a contractual relationship between the state and individuals. That also guarantees a higher standard of economic and social security, taking into account the interests needs to ensure the activities of the State. The possibility of obtaining employment relationship based on service to the state would be one of the main priorities of human resources marketing strategy of active service. Marketing strategy should also be linked together (on the principle of "communicating vessels") with the policy of public relations and the subsequent creation of the image of the service.

Possible alternatives active public sector services

Some of the state's role to ensure public welfare provided by nongovernmental organizations. Therefore, the direct dependence of these organizations on public funds through financial subsidies from the public purse. The state would also have on the other also "subsidize" these organizations appropriate services, ie. Sending attachés active service. On the other hand, the non-state non-profit sector operates service volunteers. In the event that the service in these organizations for a longer period of time, at least at 20 hours per week, or implemented abroad, it can be recognized as a possible alternative to active service. Among the economic aspects are several reasons for this. Volunteers would have substituted the activity attaches active duty nongovernmental organizations. By their actions contributed to saving public resources for active duty, or even employees of these organizations. In this case, on the basis of positive externalities contribute to active service personnel marketing strategy support volunteering in non-profit sector. (Rektořík 2010)

For other possible alternative for the recognition of the fulfillment of active duty can be considered caring for a relative. To care this care if they were individuals who provide assistance of another person because of long-term adverse health condition in coping with the basic necessities of life to the extent specified degree of dependency. The activities of these individuals and largely substitute the provision of certain residential and field social services, whose founders are mainly local authorities and non-governmental organizations. This contributes to saving public resources. Held among others. Activity which could also take place during active service in these facilities. For this reason, based on ethical principles should belong alternative recognition active service. Moreover, these people would be in the labor market should not be discriminated against in any way for entry into one of the service relationship, because there is a presumption that such persons would be because of the social role or were not interested in a business relationship. On the other hand, must, in the case of spouses who care for a disabled person (child, elderly person), they may also rotate during this care by the other spouse to carry out the service relationship to the state.

The concept of active services based on tax theory

The role of the state is changing over time, however, raises two basic roles - the legislative, consisting of the creation of rules and redistribution, remedy "injustice market division and failure" in terms of social consensus. Redistribution is implemented in particular applications of tax policy. Taxes are a modern type of company usually paid in cash, the traditional type of society were usually paid in kind, in acts or in the form of robots. With the advent of modern society it has also been a common form of acts obligation of military service. This gradual cuts in the European region remained until the turn of the 20th and 21st centuries. In developed democratic political systems in the second half of the 20th century, given the possibility of alternative civilian service performance, which again had the nature of the tax liability in acts.

Tax on operations through military service is levied on the principle of taxpayer's ability to pay tax. Thus, the taxpayer has the proper value of human capital, which is primarily determined by his health condition. In this context, we are always excluded people with disabilities and proper rule for his physique excluded mostly women (currently not always the case - eg. The army of Israel). In terms of sociological theories obligation of military service, as well as tax, described as imposed social role (part of the concept Parson structural functionalism). Therefore, evading military service is considered a criminal offense as intentional tax evasion. (Šubrt 2006)

State budget expenditures understand government purchases of goods and services, while also transfers. In its essence in terms of income and expenditure of the state transfers represent a negative tax, and conversely negative tax transfers. How, then, in this context be viewed on active duty for the public sector. In its essence would be a transfer of a voluntary act performed for the state. The size of the transfer in macroeconomic terms would match the value of the transaction vykonaného volunteers for the public sector size minus transfers paid for entry into the social role of the volunteer. Whereas in the immeasurable economic rationality of public sector must always value tasks performed by volunteers active service outweigh the size of transfers paid to these volunteers who therefore are not paid for their performances fully rewarded - only granted transfers. This leads to cheaper labor factor in the public sector so that it may reach the fulfillment of a higher level of social welfare, without the need to increase public spending.

However, volunteers would not perform a service for the public sector only awarded for transfers. Additionally, during the period of economic growth based on the theory of opportunity cost would be able to participate in the labor market and get several times higher compared to those receiving transfers. The main problem can be seen in the fact that the volunteer would be in a position to sponsor the state, not financially or in kind, but through the services provided to the public sector. Every sponsor (unlike patron, donor) sees its activities proper feedback from its counterpart, which in this case happen. The performance in the event sponsorship would guarantee his benefactor appropriate rights (privileges), primarily meet the basic conditions for entry into service ratios, secondarily increase its competitiveness in the labor market. (Hlaváček 1999)

For the above reasons it can be stated that in terms of tax theory, voluntary service to the public sector meant the position of the automatic stabilizers to operate in the long term and automatically as stabilizing elements in regulating the economy, regardless of cyclical phases. At a time of economic growth is shaping a favorable labor market conditions for employment growth. This would consequently increase the tax revenues of the state. It can assume that the favorable labor market conditions would have decreased only offer volunteers for active service in the public sector, but also interested in employment in service relationships to the state. That would be in this situation had adequate tax revenues to cover the demand for public sector services based on employee relations and grants to nongovernmental organizations. In a period of stagnation, recession or depression would be a completely opposite situation. On the labor market, causing unemployment to rise, which would state tax revenues fell. Consequence of the interest of the service relationship to the state would grow offer active service for the public sector. The consequence of the increased supply would become filled the demand requirements of public sector human resources active service (a discount factor of the work). This would reduce state spending.

Active service in terms of the measurement of economic rationality use of human resources

Interdependent criteria of economic rationality use of human resources is the economy and efficiency. Despite the interconnectedness differ in their basic orientation. The relationship of economy and efficiency, the efficiency acts as a condition for ensuring efficiency, effectiveness while working as a page criteria of economic rationality acts as indicative guidelines economy. (Hlaváček 1999)

The basic indicator for measuring and evaluating the economy of use of human resources are personnel costs. In essence it is a summary quantified monetarily measurable values rationally spent for the creation of a performance in the public sector. Performance takes place at a certain time and place, with the proper responsibilities of the individuals achieve planned performance with minimum cost, respectively. as the maximum power from the source. There are many factors that can affect the level of efficiency. Enforced during all elementary operations, all cost inputs. For this reason, the criterion of economy of use of human resources to be distributed to the level of these activities, and thereby assign as expected, but also the actual amount of costs. However, for measuring efficiency of human resources for the needs of the public sector are not in their proper bodies of state and local government basic conditions. According to the appropriate legislative norms double-entry accounting, while ensuring monitoring of costs in those bodies, but only generic form of output quantities. "Following the breakdown of costs by type can determine what, what tool or work were spent, but does not provide information on how, for what purpose, operation of the program was cost incurred." How do we talk about efficiency in the public sector, are basic prerequisites for long-term human resource planning (based on calculations) with the proper glide and evaluation of the use of human resources as it is based on internal accounting. Even personnel costs incurred for specific purposes are not comprehensive and are recognized by various public authorities and their organizational units without additional context that these costs should be bound to a specific purpose.(Šetek 2015)

The problem of economic efficiency of the use of human resources in the public sector compared to more complex business and there is not enough space for a detailed specification. Even if there were precise measurability purposefully spent input quantity of human resources, appears another problem. This measurement is good – the performance of the public sector. Assuming that public sector performance was notionally at its maximum, the problem arises at what cost public expenditure on human resources. Then it is absolutely certain that without the participation of active service in the public sector is quite pointless to talk about issues of efficiency.

Basic strategy vision of human resources management in active service

The basic starting tool for management and organization and human resources in public sector services should be based on the introduction of the application of methods of planning and budgeting in terms of government. Seamlessly interconnected system of planning and budgeting must act as a set of documents, procedures, relations, information, control measures and the technological means used by senior management level of government to the transparent rational allocation of resources, initial planning documents in the field of development and security activities of government and processing requirements in the design of individual chapters of the state budget authority (authorities) government. The basic characteristics for the establishment of a coherent interconnected system to the government include:

- allocation of resources by government institutions must be tied to an over-arching their needs (the coverage requirements,
- resources are primarily allocated for the program structure, purpose-assembled as a display of bodies implementing the actions necessary to meet the demand for human resources in active service,
- determination of the three time horizons (long, medium, short), with annual rolling shift at these time horizons must match seamlessly interconnected system of planning and budgeting,
- the main criterion for the selection of optimal variant for allocating resources on the active security services must become the ratio of benefits to meet the needs of the total financial expenditure of government,
- within a coherent interconnected phases of planning and budgeting must develop long-term and medium-term plans, enabling long-term balanced development of the state administration,
- balance the budget proposal to the government each year must transparently justify the validity of the financial costs and the subsequent efficient allocation of resources, management and control of the source streams within the organizational structure of government.

The main objective that can be expected from the application of the system of planning and budgeting in an environment of active service is creating the conditions for long-term effective transparent use of resources to meet the needs while respecting the given resource constraints. A comprehensive system of planning and budgeting must be divided between two phases:

1) The planning phase must be based on the application of methods of comparison and analysis evaluated:

- system around active service - ie. The macroeconomic data (growth rate of gross domestic product, employment in the economy, the price level, demographic data (age structure of the population, public health, etc.), International requirements (priority of integration in EU, NATO ...),
- the need for active duty and subsequent costing,
- available resources and potential of the real state of active service,
- legislation (laws, decrees) and government resolutions.

The above factors act as an input document to provide active services on a time horizon of 5 years. The result of the planning phase must be to establish resource-specific programs covered by the public sector, which is updated after each year.

2) The stage of budgeting is implemented financial evaluation of resources, allocation of expenses for the organizational structure of government, the drafting of the budget for the time horizon of one year.

Surroundings of planning and budgeting active public sector services would be formed in dimensions:

1) strategic part:

- state policies and legislation,
- international standards,
- state budget chapter of government institutions in the Czech Republic
- International aspects - the Czech Republic's integration into the European Union, NATO, etc.

2) the source of:

- available resources of the state administration,
- acquisition process for the acquisition of materials and information technology,
- the application of scientific knowledge,
- Application of financial sponsorship for educational programs.

3) The executive management of resources:

- breakdown of expenditures for each time period,
- real source streams,
- real state and development of the state administration.

4 Conclusions

Functioning of active service would undoubtedly contribute to the growth of welfare function of society (regardless of its theoretical dimension in terms of normative economics), and therefore its members in a position of taxpayers due to a reduction in public expenditure on providing human resources for the running of the state. The function of this service would be the following levels:

- Security - strengthening internal and external security of the state and so-called. Social security for the population,
- Economical - reducing public expenditure to ensure that public sector services, reducing unemployment, non-profit sector (government, non-government) to meet growing demand for social services, education, ecology ...),
- Preventive - in particular the reduction of the risk of corruption within the state and local governments to ensure its operation (especially when cleaning, maintenance, logistics ...) and in the selection procedures when entering into business relationships,
- Ethical and pedagogical - testing the quality of human resources (moral qualities, mental and physical endurance, etc.) For service in the armed forces and security bodies, public service.

References

- Becker, G. S. (1997). *Teorie preferencí*. Grada Publishing. ISBN 80-7169-463.
- Becker, G. S. (1971.) *The economics of discrimination*. Chicago: University of Chicago Press. ISBN 9780226041155.
- Higgs, R. (2006). *Politická ekonomie strachu*. Alfa Publishing. ISBN 80-86851-33-8.
- Hlaváček, J. (1999). *Mikroekonomie sounáležitosti se společenstvím*. Praha: Karolinum. ISBN 80-7184-856-5.
- Rektořík, J. (2010). *Organizace neziskového sektoru: Základy ekonomiky, teorie a řízení*. Praha: Ekopress. ISBN: 9788086929255.
- Say, J. B. (2003). *Traite d'économie politique*, Paříž, Patrick Guillaumont.
- Smith, A. (2001). *Pojednání o podstatě a původu bohatství národů*. Praha. Liberální institut. ISBN 80-86389-15-4.

- Stiglitz, J. E (1997). *Ekonomie veřejného sektoru*. Praha: Grada. ISBN 80-7169-454-1.
- Šefčík, V. (1998). *Základy teorie ekonomiky obrany státu*. Vyškov. Vysoká vojenská škola Pozemního vojska. ISBN80-7231-029-1.
- Šetek, J. (2006). *Zabezpečení příslušníků silových resortů ve vybraných členských státech NATO a EU*. Výzkumný ústav práce a sociálních věcí, Praha, 2005, ISBN 80-87007-19-0.
- Šetek, J. (2015). Kompenzace amortizace lidského kapitálu ve služebních poměrech vojenských systémů sociálního zabezpečení. *Marathon*, 3(130), 18-22, ISSN 1211-8591.
- Šubrt, J. (2006). *Talcott Parsons a jeho přínos soudobé sociologické teorii*. 1. ed. 2006, Praha: Karolinum. ISBN 80-246-1239-9.
- Wawrosz, P. & Valenčík, R. (2014). How to Describe Affinities in Redistribution Systems. In *18th International Conference CURRENT Trends in Public Sector Research* (pp. 212-220).

Session 5

Mathematical-statistic Modelling and Optimization in Practise

Click Stream Data Analysis for Online Fraud Detection in E-Commerce

Ladislav Beránek, Václav Nýdl, Radim Remeš

Abstract: *Web services became the integration part of our life at the present time including advertisement on various web pages. Many e-commerce companies generate advertisement revenue by selling clicks (it is known as Pay-Per-Click model). In this model, e-commerce company is paid for each time an advertisement link on its website is clicked leading to the sponsoring company's content. However, some of these companies inflate the number of clicks their sites generate. Generation of such invalid clicks either by humans or software with the intention to get fraudulently money is known as click fraud. In this article we show how the click fraud can be unmasked using various time features (e.g., period of the day and the day of the week when a user's (that is identified by his IP address) clicking occur). We combine several different time features into a timeprint. We use machine learning methods in a number of experiments to get an understanding of to what extent time prints can be used for identifying click fraud. The obtained results show that timeprints indeed can be a useful tool for the improvement of the quality of click fraud analysis.*

Key words: E-commerce · Click stream analysis · Data integration · Fraud detection

JEL Classification: C63 · M31

1 Introduction

The development of web technologies introduced various ways of online advertising. Pay-per-click model belong to the most common way of online advertising. In the pay-per-click (PPC) model, partner's e-commerce companies (partners) are paid by the amount of internet traffic that they are able to drive to a sponsoring company's web site. This in turn is measured by the number of clicks received by banners and links associated with their partner accounts. This model gives an incentive for dishonest partners to generate clicks on advertisements on their websites. These clicks may be generated either manually or through the use of software installed on a mobile phone or a PC. This behavior is known as click fraud (CF). The diversity of CF attack types makes it hard for a single counter measure to prevent click fraud. We first characterize clickbots and human clickers, the two main actors leveraged to commit click fraud. Clickbot behaves like a browser but usually has relatively limited functionality compared to the latter. A typical clickbot performs some common functions including initiating HTTP requests to a web server, following redirections, and retrieving contents from a web server. Human clickers are the people who are hired to click on the designated ads and get paid in return. Human clickers have financial incentives to click on ads as quickly as possible, which distinguishes them from real users who are truly interested in the advertised products. For instance, a real user tends to read, consider, think, and surf the website in order to learn more about a product before purchase. A paid clicker has few such interests, and hence tends to get bored quickly and spends little time on the site (Daswani, 2008). To complete click fraud, all fraudulent HTTP requests must be finally redirected to the advertised website, no matter how many intermediate redirections and parties are involved along the way (see Figure 1). This fact indicates that both clickbots and human clickers must finally communicate with the victim sponsoring company (advertiser). Hence, advertisers are able to detect and counteract click fraud in the course of communication. Their aim is obvious - to protect their revenue source.

The diversity of click fraud attack types makes it hard to detect and to prevent click fraud. In this paper, we try to show that click fraud can be unmasked using various time features (e.g., period of the day and the day of the week when a user's clicks have been occurred). We combine several different time features into a timeprint, which can be seen as a type of fingerprint for click fraud detection. We use machine learning methods in a number of different

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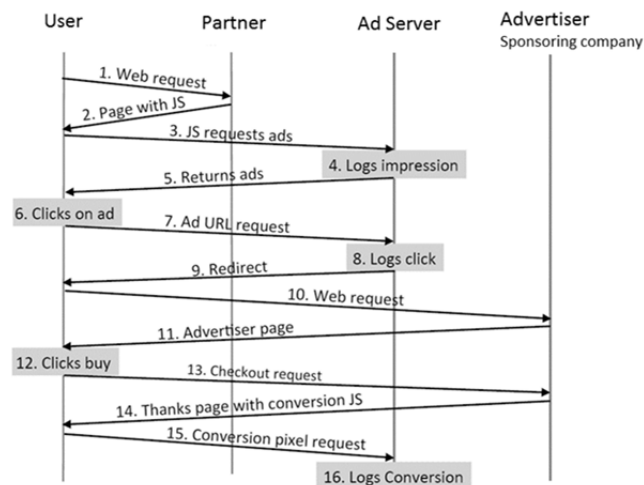
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experiments to get an understanding of to what extent timeprints can be used for identifying click fraud. In this article, we explored various time features in more depth in order to increase the quality of timeprints and in order to find out how successfully they could be used for author identification and alias matching. We investigated to what extent timeprints could be used to identify a partner was due to the fact that in some cases the clicking time is the only thing that is present.

This paper is organized as follows. In section Methods related background, used methods and datasets are briefly introduced. Experimental results and discussion are given in section Results. Conclusions and future works are given in section Discussion.

Figure 1 Anatomy of a typical ad click, showing the various HTTP requests associated with a user clicking on an advertisement, leading them to an advertiser's landing page, and from there possibly to additional interactions.



Source: Own processing

2 Methods

The detection of click fraud is not easy. Click fraud procedures have been evolving during recent years (Dave et al., 2008; Miller et al., 2011; Alrwais et al., 2012). Existing detection solutions attempt to identify click fraud activities from different perspectives, but each has its own limitations. The solutions proposed in (Metwally, 2007; Metwally et al., 2008;) perform traffic analysis on an ad network's traffic logs to detect publisher inflation fraud. However, an advanced clickbot can conduct a low-noise attack, which makes those abnormal-behavior-based detection mechanisms less effective. Haddadi (2010) proposed exploiting bait ads to blacklist malicious publishers based on a predefined threshold. Motivated by (Haddadi, 2010). Authors (Oentaryo, 2014) use data mining-based approaches to click fraud detection. Their principal findings are that features derived from fine-grained time series analysis are crucial for accurate fraud detection, and that ensemble methods offer promising solutions to highly-imbalanced nonlinear classification tasks with mixed variable types and noisy/missing patterns. The use of Dempster-Shafer theory for evidence fusion is presented in (Walgampayal et al., 2010) or (Beranek, Nydl, 2013; Beranek, 2014). Authors describe the use of Dempster-Shafer evidence theory and its data fusion technology in their intrusion detection model. This model merges alerts from different intrusion detection systems, makes intelligent inference by applying D-S evidence theory, and estimates the current security situation according to the fusion result. The idea of proactively testing if visiting clients are full-fledged modern browsers and following passively scrutinizing of user engagement is presented in (Xu et al., 2014). Authors implement a prototype of their detection module and deployed it on a large production website. A Novel ensemble learning-based approach for click fraud detection in mobile advertising environment is described in the paper (Perera et al., 2013).

Understanding user behavior is important to the design and operation of online services. Earlier research used clickstream data for web usage mining (Lu et al., 2005). Researchers applied simple methods such as Markov chains to capture users' navigation paths within a website (Balviny, 2008). However, these models focus on the simple aspects of user behavior (e.g., user's favorite webpage), and are incapable of modeling more sophisticated user behavior (Beranek et al., 2015). Other approaches use clustering techniques to identify user groups that share similar clickstream activities (Schulte, 2013). The resulting clusters can be used to infer user interests (Kima, 2011) or predict future user behaviors [8]. However, existing clustering based models are largely supervised (or semi-supervised), requiring large samples of ground-truth data to train or fine-tune the model parameters (Liu, 2016). Wang in (Wang, 2016) seeks to build unsupervised clickstream behavioral models and produce intuitive explanations on how users behave and why.

Timeprints and activity profiles

Fraudulent users often mask their activities using various tricks such as generating very sparse click sequences, changes in IP addresses, issuing clicks from different computers in different countries using Tor project, and so on. Others use conservative approach of generating the maximum number of clicks in a given interval. It is important for any fraud detection system to recognize both kinds of this described strategies. Accordingly, we derived several statistical features from the click time attribute in the click database, with the number of clicks for each publisher observed over different time intervals. The goal is to capture both the short and long term behavior of the publishers, based on the observation that publishers often try to act rationally and have constant clicks in very sparse time intervals. Specifically, for each time interval, we counted the number of clicks each publisher receives and aggregated these counts using several features: maximum clicks, average click, click skewness, and click variance. Click variance measures the deviation of number of clicks from the average clicks (norm) of a publisher, while click skewness is a measure of the asymmetry of the click distribution (Perera, 2013).

A chronotype or a circadian typology is an individual difference in personality, which is believed to be the cause of why some individuals prefer to work and exercise in the morning hours while others prefer evening hours. In 1976, Horne and Östberg published a 19-item morningness-eveningness questionnaire (Horne & Östberg, 1976) that was used to measure if a person was a morning or evening person. The questionnaire has been validated in many countries with regards to local cultures and ages. Apart from the morningness-eveningness questionnaire, circadian typology has been described and measured using different questionnaires in many studies and several countries (Urbán et al., 2011).

In our work, we have focused on finding the difference between fraudulent user and ordinary user based on knowledge of the normal course of activities during the day, i.e., on circadian preferences of ordinary user. The circadian typology classifies individuals according to three different types: morning-type, evening-type, and neither-type. Most people are neither-types and are positioned somewhere between evening or morning types while half of the population are either morning-types or evening-types (Urbán et al., 2011). It has been noted that people who have the same chronotype have similar activity pattern timing: they prefer to sleep, eat and exercise during more or less the same hours. The circadian typology seems to have an impact on the behavior of an individual and various studies have for example suggested that evening types spend more time in front of the screen (Urbán et al., 2011).

When a common user is doing something on Internet (for example performing her purchases on e-commerce web sites) then her activity may also be correlated to the user's chronotype. It is possible that a morning-type performs most of her purchases during the morning hours, while an evening-type prefers doing purchases during the evening. We suppose that these activities also are reflected on users' clicking on banners or on the web sites of advertisers. Thus, we suppose that users' clicking have some distributions of clicks within day with regards to the user's chronotype. In addition to chronotypes, there are other aspects that affects when a user is active on web sites (and also clicking). These factors are related to the living situation of a person, for example factors such as during what hours a person is at work, what time zone the person lives in, when a person has vacation and what kind of occupation the person has all matter when it comes to usage of, for example e-shops.

We analyzed users' clicking during various time intervals. Some of the features that we considered in our analysis were:

- Activity during each month,
- Activity during each hour of the day,
- Activity during each day of week,
- Activity during weekdays and weekends,
- Activity during 4-h intervals (early morning, morning, midday, evening, night, midnight).

Dataset

In our experiments, we used the dataset often used in click fraud analysis papers (palanteer.sis.smu.edu.sg/fdma2012/). The raw data consist of click database provided in comma-separated values (CSV) format. The click database captures the click traffic associated with various publishers. Table 1 lists the fields in the click database.

Table 1 Fields in the click database

Field	Description
id	Unique identifier of a particular click
numericip	Public IP address of a clicker/visitor

deviceua	Phone model/agent used by a clicker/visitor
publisherid	Unique identifier of a publisher
campaignid	Unique identifier of a given advertisement campaign
usercountry	Country from which the clicker/visitor is
clicktime	Time stamp of a given click
referredurl	URL where ad banners are clicked (anonymized; may be missing/unknown)
channel	<p>Publisher's channel type, which consists of:</p> <ul style="list-style-type: none"> • ad: Adult sites • co: Community • es: Entertainment and lifestyle • gd: Glamour and dating • in: Information • mc: Mobile content • pp: Premium portal • se: Search, portal, services

Source: palanteer.sis.smu.edu.sg/fdma2012/

The experiment was performed using three distinct sets of data: training, validation, and testing. Click data set includes 8 different attributes and has 3,173,834 instances. Each instance represents a click record for a partner. The validation set also contains similar data with 2,689,005 instances. Various prediction models were built, trained and validated using the training and validation datasets, and one which performs the best on the validation set is selected as the final model. The final model was then evaluated on the test dataset (which remains invisible during the modeling stage). The test dataset also contains 2,598,815 instances (www.dnagroup.org/PDF/FDMADataDescription.pdf).

Table 2 Overview of the dataset

Data set	Time period	No. of clicks	Fraud
Train	9-11 Feb 2012	3,173,834	72 (2.34%)
Validation	23-25 Feb 2012	2,689,005	85 (2.77%)
Test	8-10 Mar 2012	2,598,815	82 (2.73%)

Source: www.dnagroup.org/PDF/FDMADataDescription.pdf

Used Methods

Fraud detection is another type of classification which has its own special characteristics. There were many approaches proposed for fraud detection which claim to have higher accuracy. Our approach is to use traditional classification models over data derived from click data. We can tune the parameters in these models to suit with the behavior of our data. It was important that any model used could be generalized to work with the training, validation and test datasets and subsequently with any other dataset containing the same features. In order to achieve a stable model, we tried a few different models and over a range of different model parameters.

As a first step, we visualized the given data, which include the attributes like *iplong*, *agent*, *partner id*, *campaign ID*, *country*, *time*, *category*, and other. We have chosen and analyzed *Time* attribute in this dataset in terms of its effect towards modeling behavior of a user. In our experiments we have made use of the following sets of features when constructing our timeprints:

- *Hour of Day* Hour1, Hour2, ..., Hour24,
- *Period of Day* MidNight, EarlyMorning, Morning, MidDay, Evening, Night,
- *Month* Jan, Feb, ..., Dec,
- *Day* Sunday, Monday, ..., Saturday,
- *Type of Day* WeekDay, WeekEnd.

A number of different methods were tried including decision trees, Naive Bayes classifier and support vector machines. For each method we also used different learning algorithms, thus each evaluation model is in fact a unique combination of a given classification technique and learning algorithm. For experiments, we have made use of the Waikato Environment for Knowledge Analysis (WEKA). For the SVM classifier, we have used the SVC classifier from the libsvm package in WEKA. We have used a linear kernel with default parameter settings. In each step we have performed tenfold cross validation and the results from the ten folds have been averaged into a single accuracy value.

After analyzing the results on training and validation data, we found that the decision tree technique was particularly promising and provided very good accuracy.

3 Research results

At the beginning we supposed that the activity pattern or time profile of a user can be quite specific for each of the selected users. Our research confirmed that the activity of a proper user seemed to be quite consistent over time. This might have to do with the fact most people are creature of habit and unconsciously prefer to do the same things during the same hours and periods. These facts indicate that timeprints are useful for fraudulent users' identification.

Table 3 Results - precision on the validation and test sets

Method	Validation set	Test set
MARS	32.21%	30.25%
Decision tree	30.18%	29.24%
SVM	28.12%	26.05%
Naive Bayes	25.62%	20.04%

Source: Own processing

After analyzing the results on training and validation data, we found that the decision tree technique was particularly promising and provided very good accuracy (see Table 3).

We evaluated the prediction performance of more different algorithms. Few algorithms which gave best result alone are mentioned above. There were many algorithms with very low true positive and false negative rates, and which thus were able to obtain very high precision scores. These algorithms were able to obtain high precision because of their low false positive value. We were only interested on algorithms which have high true positive rates and precision (see Table 3). We also tested which of the time-based features are the most important for classification. The results show that attributes related to Period of Day (such as Night and Morning) receive highest average ranks, followed by the Type of Day. Attribute Hour of Day seems the least significant.

4 Conclusions

We have analyzed the assumption that it is possible to use user's timeprints for click fraud detection. We supposed that there are differences in personality preferences related to time and the fact that people have different working hours and sleeping hours. We have made machine learning experiments if our assumption is true and can be used for click fraud detection.

Fraud detection in the pay-per-click advertisement model is not easy also due to the fact that access to user click information is limited. In this research we perform an experiment to detect fraudulent partners based on click data associated with time. We have generated new features based on the time of performing of clicks - timeprints, and use these features to model the behavior of users. The final results showed that our model, that uses of only time attributes (timeprints), has a lower accuracy in comparison with some datamining approach using more attributes. The results on the same data with the use of all attributes available are: precision on the validation 59.38% and test sets 51.55% (Oentaryo, 2014). However, we are convinced that our method showed that it can be used for the preprocessing or for example when online processing is required.

As future work, we have a plan to perform more experiments on data mining techniques including combination of this methods. We also plan to perform experiments on different datasets obtained from actual operating data of chosen web servers.

References

- Alrwais, S.A., Dun, C.W., Gupta, M., Gerber, A., Spatscheck, O., & Osterweil, E. (2012). Dissecting ghost clicks: Ad fraud via misdirected human clicks. In R. H. Zákou (Ed.), *Proceedings of the Annual Computer Security Applications Conference* (pp. 21-30). New York: ACM.
- Baldini, P., & Giudici, P. (2008). Improving Web Clickstream Analysis: Markov Chains Models and Genmax Algorithms. In G. Felici, C. Vercellis (Eds.) *Mathematical Methods for Knowledge Discovery and Data Mining* (pp. 233-243), Hershey, PA: IGI Global.
- Beranek, L., & Nydl, V. (2013). The Use of Belief Functions for the Detection of Internet Auction Fraud, In H. Vojackova (Ed.) *Proceedings 31st International Conference on Mathematical Methods in Economics* (pp. 31-36). Jihlava: Coll. Polytechnics Jihlava.
- Beranek, L. (2014). A Belief Theoretic Approach to Finding a True Value from Recommendations in E-business. The Use of Belief Functions for the Detection of Internet Auction Fraud, In J. Talasova, J. Stoklasa, T. Talasek (Eds.) *Proceedings 32nd International Conference on Mathematical Methods in Economics* (pp. 43-48). Olomouc: Palacky University.
- Beranek, L., Nydl, V., Remes, R. (2015). Factors Influencing Customer Repeated Purchase Behavior in the E-commerce Context. In M. Pech (Ed.) *Proceedings 9th International Scientific Conference INPROFORUM 2015* (pp. 123-128). Ceske Budejovice: Univ. South Bohemia Ceske Budejovice.
- Daswani, N., Mysen, C., Rao, V., Weis, S., Gharachorloo, K., & Ghosemajumder, S. (2008). Online advertising fraud. In M. Jakobsson and Z. Ramzan (Eds.), *Crimeware: Understanding New Attacks and Defenses* (pp. 325-354). Boston: Addison-Wesley Professional.
- Dave, V., Guha, S., & Zhang, Y. (2012). Measuring and fingerprinting click-spam in ad networks. *ACM SIGCOMM Computer Communication Review - Special October issue SIGCOMM '12*, 42(4), 175-186.
- Haddadi, H. (2010). Fighting online click-fraud using bluff ads. *ACM SIGCOMM Computer Communication Review*, 40(2), 21-25.
- Horne, J.A., & Östberg, O. (1976) A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *Chronobiology International*, 4(2), 97-110.
- Kima, Y.S., & Yum, B.Y. (2011). Recommender system based on click stream data using association rule mining. *Expert Systems with Applications* 38(10), 13320-13327.
- Liu, Z et al. (2016). Patterns and Sequences: Interactive Exploration of Clickstreamsto Understand Common Visitor Paths. In *IEEE Transactions on Visualization and Computer Graphics* PP(99), 1.
- Lu, L., Dunham, M., & Men, Y. (2006). Mining Significant Usage Patterns from Clickstream Data. In Nasraoui et al. (Eds.) *Proceedings 7th International Workshop on Knowledge Discovery on the Web 2006* (pp. 1-17), Lecture Notes in Computer Science 4198. Heidelberg: Springer.
- Miller, B., Pearce, P., Grier, C., Kreibich, C., & Paxson, V. (2011). What's clicking what? techniques and innovations of today's clickbots. In: Holz, T., Bos, H. (Eds.) *DIMVA 2011*. LNCS, 6739, (pp. 164-183). Heidelberg: Springer.
- Metwally, A., Emekci, F., Agrawal, D., & Abbadi, A.E. (2008). SLEUTH: Single-publisher attack detection using correlation hunting. *Proceedings of the VLDB Endowment*, 1(2), 1217-1228.
- Metwally, A. (2007). Detectives: Detecting coalition hit inflation attacks in advertising networks streams. In C. Williamson, M.E. Zurko (Eds.) *Proceedings of the International Conference on World Wide Web 2007* (pp. 241-250). New York: ACM.
- Oentaryo, R. et al. (2014). Detecting click fraud in online advertising: a data mining approach. *The Journal of Machine Learning Research*, 15(1), 99-140.
- Perera, K.S., Neupane, B., Faisal, M.A., Aung, Z., & Woon, W.L. (2013). A Novel Ensemble Learning-Based Approach for Click Fraud Detection in Mobile Advertising. In R. Prasath, T. Kathirvalavakumar (Eds.), *Proceedings First International Conference, MIKE 2013* (pp. 370-382), Mining Intelligence and Knowledge Exploration, Lecture Notes in Computer Science 8284. Heidelberg: Springer.
- Rieger, F., Ditzl, P., Weiserova, H. et al. (1989) Circulation effects in operation of sugar vacuum pans. *Zuckerindustrie* 114(1), 45-48.
- Schulte, B., Andrianakis, H., Sun, K., & Stavrou, A. (2013). Netgator: Malware detection using program interactive challenges. In Flegel, U., Markatos, E., Robertson, W. (eds.) *Proceedings Conference on Detection of Intrusions and Malware & Vulnerability Assessment. Lecture Notes in Computer Science* (pp. 164-183), 7591. Heidelberg: Springer.
- Urbán, R., Magyarodi, & T., Rigo, A. (2011) Morningness-eveningness, chronotypes and health-impairing behaviors in adolescents. *Chronobiology International* 28(3), 238-247.
- Walgampayal, Ch., Kantardzic, M., & Yampolskiy, R. (2010). Click fraud prevention in pay-per-click model: Learning through multi-model evidence fusion. In H. Drias et al. (Eds.) *International Conference on Machine and Web Intelligence (ICMWI)* (pp. 20-27). Algiers, Algeria: IEEE.
- Wang, G., Zhang, X., Tang, S., Zheng, H., & Zhao, B.Y. (2016). Unsupervised Clickstream Clustering for User Behavior Analysis. In J. Kaye, A. Druin (Eds.) *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 225-236). New York: ACM.
- Xu, H., Liu, D., Koehl, A., Wang, H., & Stavrou, A. (2014). Click Fraud Detection on the Advertiser Side. In M. Kutylowski, J. Vaidya (Eds.) *19th European Symposium on Research in Computer Security ESORICS 2014* (pp. 419-438), Lecture Notes in Computer Science 8713. Heidelberg: Springer.

Accounting Data of ERP Systems and Spatial Autocorrelation Analysis

Petr Hanzal

Abstract: *This paper is seen as a contribution to the field of enterprise resource planning systems (ERP) and their application in spatial autocorrelation. The main objective is to demonstrate the possibility of using accounting data of enterprise information systems for regional statistics, identifying spatial autocorrelation of economic activities, through a set of accounting data obtained from enterprises. The theoretical framework provides a theoretical basis for the definition spatial statistics evaluation and indicators of economic activity. Interpretation of statistical methods are then used in the practical part, derived from accounting data of enterprise resource planning systems, 30 randomly selected enterprises with nationwide coverage in ČR, regardless of the branch structure.*

Key words: ERP – Enterprise Resource Planning Systems · Regional economic activities · Accounting data · Spatial autocorrelation

JEL Classification: C02 · E03 · C88

1 Introduction

Accounting data represents an inevitable element of any enterprise information system. Accounting data is the bearer of the recorded facts relating to the enterprise activities and is also able to be transferred, interpreted and processed. It includes complete knowledge of micro- and macro-environment of the organisation, such as the recorded data on economic facts and other factors influencing the corporate value production chain (Sodomka, 2010).

The basic function of bookkeeping is to provide all its users reliable information about the financial standing of the respective enterprise. Bookkeeping is required to particularly provide information about the property and financial situation in the form of the balance sheet, and performance information in the form of the profit and loss account, for the respective period of time. In doing this, not only the evaluation how the corporate management increased the value of the entrusted assets for the expired period is made, but we witness ever higher interest in prognosticating the financial situation, i.e. whether the enterprise is able to achieve good financial results in the future and in what amount. The accounting information is intended both for managers and various external users interested in the enterprise for various reasons. (Kovanicová, 2005).

Based on the aforementioned, we can distinguish two basic groups of accounting information users (Kovanicová, 2005):

- Entities directly participating in financing the enterprise (enterprise owners and creditors – for example debenture holders, banks, contractors);
- Entities interested to a certain extent in the financial result of the respective enterprise (tax authorities, state administration authorities, employees, competing enterprises, potential investors, the public).

In addition to its information function, bookkeeping have many other functions (Kovanicová, 2007):

- Maintaining records on the corporate events, i.e. the registration function;
- Bookkeeping is used as an evidence in disputes, particularly in protection and acknowledgement of rights resulting from creditor–debtor relationships;
- Bookkeeping is a basis for assessing the tax liabilities;
- Bookkeeping is a mean, based on which managers are responsible to the enterprise owners;
- Bookkeeping provides information for the business decision-making processes and internal decision making processes of various types and time horizons.

When financial accounting is kept, the general accounting principles should always be observed. The basic legal framework of the Czech accounting system consists of the Act on Accounting, regulations to implement it and the Czech accounting standards. The financial and tax accounting systems are mutually interconnected in Europe and in our country. Moreover, tax rules and laws have a considerable impact on the accounting rules of financial bookkeeping, which may be considerably misrepresented by them in certain cases (Šteker, 2010).

Financial accounting data is formed by facts in the field of proprietary relationships, receivables from customers, payables to suppliers, and it also monitors the revenues and expenses from the accounting unit's standpoint in its entirety. This data records all business transactions in the area of purchase and sales of goods, materials, enterprise's own products and services, including master data of suppliers and customers (Hanzal, 2009).

2 Methods

Spatial autocorrelation

The statistical quantities that allow measuring spatial dependence of regions may include the autocorrelation degree, which takes into account the spatial arrangement of regions and their mutual locations. In general, the spatial autocorrelation principal may be understood as an existence of certain dependence between probability of occurrence of a certain phenomenon in the spatial unit and probability of occurrence of the phenomenon in units *j*, which are in spatial proximity. Therefore the spatial autocorrelation equation can be presented as follows (Spurná, 2008):

$$p_i(y) = f(\sum_i w_{ij} p_j(y)) \tag{1}$$

where $p_i(y)$ is the probability of occurrence of the phenomenon in the unit *i*, w_{ij} for $i \neq j$ is the weight selected.

The idea of spatial autocorrelation may be therefore verbally defined as a similarity of regions, which are researched in regards to their mutual location and spatial continuity of a certain phenomenon. If high values of the monitored variable tend to create clusters in certain monitored locations, while the low values do so in other monitored locations, it is apparent that the monitored phenomenon shows a positive spatial autocorrelation.

If the analysed data shows a positive spatial autocorrelation, such data simultaneously creates clusters of units with similar values of the monitored phenomenon. If high values tend to be very close to low values and vice versa, it is a negative spatial autocorrelation. If the data is spread so that no relationship between close values exists, we speak of zero spatial autocorrelation. However almost every spatial data shows a certain type of positive spatial autocorrelation. The question is whether the respective degree is significant or not, this means if it expresses a real spatial dependence of the respective quantity in the monitored locations – see Table 1.

Table 1 Moran's diagram and example of Moran's I display

Weighed variable value in proximity units	Low – High	High – High
	Negative	Positive
	Spatial	Spatial
	Correlation	Correlation
Low – Low	High – Low	
Positive	Negative	
Spatial	Spatial	
Correlation	Correlation	
	Variable value in a spatial unit	

Source: Author

Spatial autocorrelation can be measured by several spatial autocorrelation statistics describing similarity of proximity observations depending on the fact, if it is a discrete or a coherent variable. In general, any statistics of spatial autocorrelation create a dependence between attribute similarity c_{ij} and distance proximity w_{ij} of spatial units *i* and *j* in the simplest expression:

$$\sum_i \sum_j c_{ij} w_{ij} \tag{2}$$

This means that all autocorrelation statistics depend on a certain definition of spatial weighing, which attempts to quantify the proximity concepts (which are often subjective) and differ from one another by expressing the attribute similarity c_{ij} .

The following methods are applied to evaluate the autocorrelation degree (Anselin, 2008):

- Moran's I criterion;
- Geary's C criterion;
- LISA analysis;
- General G statistics;
- Local G statistics.

The most frequently applied indicator to measure spatial autocorrelation of quantitative data is Moran's I criterion. Moran's I criterion can be presented in a generalised form as follows (Spurná, 2008):

$$I_k = \frac{n * \sum_{i=1}^n \sum_{j=1}^n w_{ij}^{(k)} * (z_i - \bar{z}) * (z_j - \bar{z})}{\left(\sum_{i=1}^n (z_i - \bar{z})^2 \right) * \left(\sum_{i \neq j} w_{ij}^{(k)} \right)} \quad (3)$$

$w_{ij}(k)$ is indication of mutual distance between regions i and j for step k ;

z_i is the researched quantity in location i , \bar{z} represents arithmetic average;

n is the number of the analysed units.

If the spatial autocorrelation is positive, then the Moran's criterion is positive; if the spatial autocorrelation is negative, then the Moran's criterion is negative. If the variable shows no statistical spatial dependence, the Moran's criterion is close to zero. As weights w_{ij} are not standardised for interval $<0,1>$, standardisation must be performed by aggregating them in the denominator.

Before the spatial autocorrelation analysis itself is made, the spatial weighing schemes must be created, which considerably affect the resulting values of the autocorrelation statistics from the methodological standpoint.

There are many variants of this method, which differ from one another in the neighbourhood definition methods and setup of w_{ij} weights. It is recommended to describe the neighbourhood and the weight values by weight matrix W with dimensions $n \times n$, where n is the number of regions. Weight w_{ij} between two regions can be expressed according to Table 2.

Table 2 Weight between two regions

Variant	Weight definition	Weight definition description
1	$w_{ij}=1$	If the region's centroid j is one of the closest centroids to region i
	$w_{ij}=0$	In other cases
2	$w_{ij}=1$	If the region's centroid j is within a certain distance δ from region i
	$w_{ij}=0$	In other cases
3	$w_{ij}=d_{ij}^{\gamma}$	If the distance d_{ij} between the regional centroids i and j is lower than certain distance δ from region i ($\gamma < 0$ expresses steepness of the distance impact)
	$w_{ij}=0$	In other cases
4	$w_{ij}=1$	If region j shares a common border with region i
	$w_{ij}=0$	In other cases
5	$w_{ij}=l_{ij}/l_i$	Where l_{ij} is the length of the shared border between regions i and j ; respectively, l_i is the region's circumference
6	$w_{ij}=d_{ij}$	Where d_{ij} is Euclidean distance of centroids of the neighbouring regions

Resource: (Spurná, 2008)

The methods allowing local autocorrelation analysis include so-called LISA – Local Spatial Autocorrelation Analysis, which is based on the local Moran's statistics and allows measuring spatial dependence for each individual location (Anselin, 2005). It exists in univariate or multivariate version. It is based on the same principles as Moran's I, nevertheless it is localised, and the inputs necessary for LISA statistics are the same as those for the global autocorrelation statistics.

Indicator of intensity of economic relationships

The administrative unit LAU1 – districts was the smallest monitored location during the spatial autocorrelation research. The intensity of economic relationships was calculated for each unit based on business transactions of enterprises, and then these units have been subject to a research by statistical methods, whose aim was to identify the spatial dependences.

In order to define economic agglomerations in the Czech Republic, a set of indicators has been chosen to characterise the situation in the individual regions from the point of view of sales of merchandise, own products and services in the monitored regions of the respective territory, from a sample of 30 randomly selected enterprises with nationwide coverage.

Indicators of intensity of economic relationships on the basis of business transactions of enterprises

The definition itself, calculation and definition of data of the individual partial intensities are shown in Table 3 with the following meaning of the respective variables:

Y_i – the number of employees of the enterprise i , where $i=1 \dots n$.

Z_r – population of the region r where sales are performed, or from which purchases are performed, where $r = 1 \dots$ the number of regions (in our case the number of LAU1 – districts).

n – the number of enterprises (in our case 30).

Table 3 Definition, calculation and sources of data of the individual components

Partial intensity	Mathematic definition	Description of variables	Data filter criterion	Data source
I_{hpsz_r} Partial intensity of values of sales of merchandise and own products	$\frac{\sum_{i=1}^n \frac{B_{ri}}{Y_i}}{Z_r}$	B_{ri} – Total amount of all sales of merchandise and own products to the target region r by the enterprise i	Synthetic account 604 for merchandise 601 for own products	Author's calculation
I_{ppsz_r} Partial intensity of the number of sales of merchandise and own products	$\frac{\sum_{i=1}^n \frac{C_{ri}}{Y_i}}{Z_r}$	C_{ri} - Total number of all sales of merchandise and own products to the target region r by the enterprise i	Synthetic account 604 for merchandise 601 for own products	Author's calculation
I_{hpsz_r} Partial intensity of values of sales of services	$\frac{\sum_{i=1}^n \frac{D_{ri}}{Y_i}}{Z_r}$	D_{ri} - Total amount of all sales of services to the target region r by the enterprise i	Synthetic account 602 for services	Author's calculation
I_{ppsz_r} Partial intensity of the number of sales of services	$\frac{\sum_{i=1}^n \frac{E_{ri}}{Y_i}}{Z_r}$	E_{ri} – Total number of all sales of services to the target region r by the enterprise i	Synthetic account 602 for services	Author's calculation
I_{hnz_r} Partial intensity of the values of purchases of goods and material	$\frac{\sum_{i=1}^n \frac{F_{ri}}{Y_i}}{Z_r}$	F_{ri} - Total amount of all purchases of goods and material from the source region r by the enterprise i	Synthetic account 131 for goods 111 for material	Author's calculation
I_{pnz_r} Partial intensity of the number of purchases of goods and material	$\frac{\sum_{i=1}^n \frac{G_{ri}}{Y_i}}{Z_r}$	G_{ri} - Total number of all purchases of goods and material from the source region r by the enterprise i	Synthetic account 131 for goods 111 for material	Author's calculation

I_{hns_r} Partial intensity of values of purchases of services	$\frac{\sum_{i=1}^n \frac{H_{ri}}{Y_i}}{Z_r}$	H_{ri} - Total amount of all purchases of services from the source region r by the enterprise i	Synthetic account 518 for services	Author's calculation
I_{pns_r} Partial intensity of number of purchases of services	$\frac{\sum_{i=1}^n \frac{I_{ri}}{Y_i}}{Z_r}$	I_{ri} - Total number of all purchases of services from the source region r by the enterprise i	Synthetic account 518 for services	Author's calculation

Source: author's own

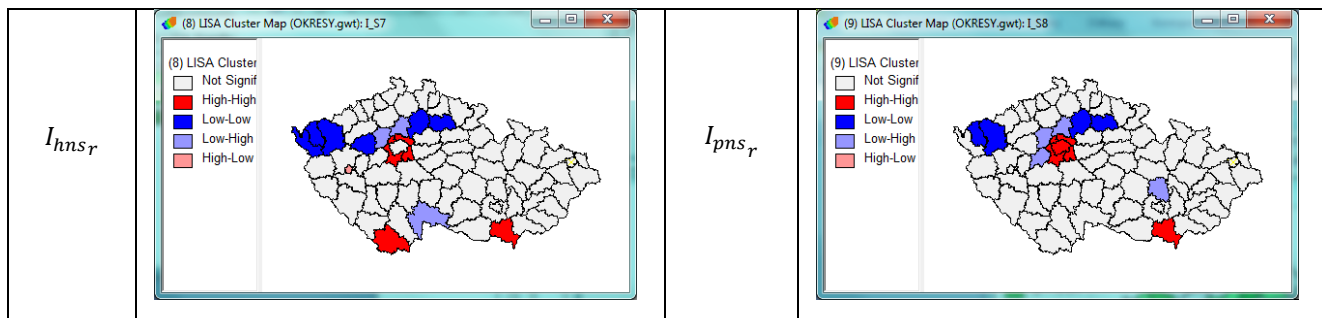
3 Research results

LISA method was used for analysis of spatial autocorrelation; all calculations were made using OpenGeoDa software. Partial constituents of the indicator of intensity of economic relationships were analysed based on business transactions of the enterprises defined in Chapter 2. The weight matrix calculation method was defined according to variant 6, Table 2, Chapter 2. Table 4 shows the values of spatial dependence between LAU1 regions for various types of business transactions.

When defining agglomerations were used partial indicators intensity of economic relations on the basis of business cases for 30 business entities, as defined by Chapter 2. The method of calculating weights matrix defined by variations 6 Table no. 2, chapter 2. Deep red parts in the map represent the regions in which is identified high intensity of economic relations based on business cases, business entities and are bordering with the regions in which the intensity is similar. The deep blue parts of the map represent those regions in which is identified low intensity of economic relations based on business cases business entities, while the neighboring regions, in which the intensity is similar.

Table 4 LISA analysis, according to various type if intensity of economic relations

Indicator	Map of LISA analysis	Indicator	Map of LISA analysis
I_{hpz_r}		I_{ppz_r}	
I_{hps_r}		I_{pps_r}	
I_{hnz_r}		I_{pnz_r}	



Source: author's own

Conclusions

The performed analysis of spatial autocorrelation of the selected variables based on calculation LISA criterion confirmed the hypothesis, that spatial data is characteristic by its spatial dependence, because positive spatial autocorrelation has been confirmed. We may deduce from the aforementioned that the cluster interconnection from the point of view of business operations of 30 randomly selected enterprises is demonstrable, however not very high.

The increasing mutual dependence is a characteristic feature of the global economy development. These phenomena may be described both by economic & statistic indicators acquired on the basis of statistical research, and on the basis of data from business information systems, which are providers of a large volume of information important for regional economy and development. The business information systems provide many instruments for effective procurement of information.

References

- Anselin, L. (2008). *GeoDa - An Introduction to Spatial Data Analysis* [online]. Spatial Analysis Laboratory. [Cited: 9 30, 2008.] Available from: <http://geodacenter.asu.edu/pdf/geodaGA.pdf>.
- Anselin, L., Ibnu Syabri, Youngihn Kho. (2005). *GeoDa: An Introduction to Spatial Data Analysis*. [online] Spatial Analysis Laboratory. [Cited: 12 18, 2009.]. Available from: www.geoda.uiuc.edu/pdf/geodaGA.pdf.
- Hanzal, P. (2009). Výpočet HDP regionů a ČR produktovou metodou pomocí účetních dat podnikatelských subjektů. In *Proceedings of the International Scientific Conference INPROFORUM 2009* (pp. 97-103).
- Hanzal, P. (2015). Accounting Data of ERP Systems and Spatial Dependence of Economic Activity. In *Proceedings of the International Scientific Conference INPROFORUM 2015* (pp. 97-103).
- Kovanicová, D. (2007). *Abeceda účetních znalostí pro každého*. Praha: Polygon. ISBN 978-80-7273-143-5.
- Kovanicová, D. (2005). *Finanční účetnictví: světový koncept*. Praha: Polygon. ISBN 80-7273-129-7.
- Sodomka, P., Klčová, H. (2010). *Informační systémy v podnikové praxi*. Brno: Computer Press, 2010. ISBN 978-80-251-2878-7.
- Spurná, P. (2008). Prostorová autokorelace – všudypřítomný jev při analýze prostorových dat? *Sociologický časopis*, 4, 767-787. ISSN 0038-0288.
- Šteker, K. (2010). *Informační systémy podniků a jejich praktická aplikace pro řízení ekonomického procesu* [Dissertation]. Zlín: Univerzita Tomáše Bati.

A Note on Optimization under Uncertainty: Comparing Probabilistically Constrained and Robust Optimization Methodology

Michal Houda

Abstract: *Dealing with optimization problems, data entering the optimization process are usually of uncertain nature. There are several approaches to deal with data uncertainty, starting with classical sensitivity analysis and/or parametric programming. In this paper, we concentrate on two specific approaches, namely on chance constrained (stochastic) and robust optimization. Chance (probabilistically) constrained optimization is based on the assumption that underlying uncertainty is driven by a probability distribution, that is, considered as a random vector. On the other hand, robust optimization deals with the situation in which uncertainty is given only by a membership of the uncertain factor to an explicitly defined set. We compare these two approaches with respect to the behavior of optimal values and optimal solution sets and discuss the drawbacks of each of two approaches on an illustrative example.*

Key words: Stochastic Optimization · Chance Constrained Optimization · Robust Optimization

JEL Classification: C44 · C61

1 Introduction

In many applied economic and econometric studies, optimization models appear. These are characterized (among other things) by a need for *data*. For example, in the classical production analysis, we have to determine properties of the production technology, that is how much sources we consume in order to perform a selected number of activities, how is the level of available amount to consume, or how the unit revenue from the activities in question looks like. The data enter in the optimization process in form of numeric coefficients of technology matrix, right hand sides of technology inequalities and coefficients of objective functions, and are usually considered known, *deterministic*, and fixed. Traditional methodology (let us mention the well-known linear, quadratic, or convex optimization) are then used to solve the problem and to obtain the optimal distribution of the activities.

However, data are seldom known and fixed. Instead, we nearly always use a kind of approximation: a classical approach is to replace an unknown data element of the optimization problem by some appropriately selected value—by a historical observation, their mean value, or by an expert advice, for example. Then the problem is solved by deterministic optimization and checked for its accuracy by sensitivity analysis. But this is not always a good way to proceed. Kall (1976) in his book on stochastic optimization provides a (nowadays classical) example of a simple linear optimization problem in which the random parameters are replaced by their mean values. Solving the problem, we obtain a solution which is for 75% of possible instances of random parameters infeasible. This is the motivation to use more elaborated methods to solve such problems.

In several last decades, several methodologies were appeared to overcome the issue of the unknown data. First to mention is the traditional *sensitivity analysis* of the solution of the deterministic optimization problem. It corresponds to the case in which the uncertainty is totally ignored at the building and solution stage of the problem and the sensitivity of the optimal value and the optimal solutions with respect to perturbations of the data is examined ex-post, after the solution is obtained. Sensitivity analysis is more or less important part of every basic textbook on operations research, see e. g. Hillier, Lieberman (2014). A natural extension to the sensitivity analysis is *parametric programming*, in which the data element is considered as a parameter, and the optimization problem is solved with respect to this parameter. The optimal value and optimal solution sets are seen as functions of the parameter and we can investigate the properties of these functions.

2 Mathematical Optimization Models with Uncertain Data

In this section we present two representations for the problems with uncertain data. First, let us consider a general optimization problem

$$\text{minimize } c(x; \xi) \text{ subject to } g(x; \xi) \leq 0, x \in X, \quad (1)$$

where $x \in X \subset \mathbb{R}^n$ is a decision vector belonging to a fixed deterministic set X , $\xi \in \Xi \subset \mathbb{R}^s$ is a data element of the problem, $c: X \times \Xi \rightarrow \mathbb{R}$ is an objective function, and $g: X \times \Xi \rightarrow \mathbb{R}^K$ is the constraint mapping. If the data element ξ of the problem is known and fixed in advance (before the decision is to be taken), we face the deterministic optimization problem which can be solved, under appropriate assumptions, by means of mathematical optimization methodology. For example, if c is linear function, g affine vector function, and X a polyhedron, we end up with a deterministic linear optimization problem solvable by the traditional simplex method or modern interior point approaches. From the methodological point of view, we qualify such problems as belonging to the *wait-and-see* optimization approach.

If the data element is not known in advance (that is, before a solution has to be obtained), we describe the problem (1) as the problem with uncertainty, or briefly as *uncertain problems*. In fact, problem (1) can be even simplified from the theoretical and methodological point of view. First, any nonlinear and/or uncertain objective function c can be moved to the constraint part of the problem without losing the generality; let us just consider the following problem

$$\text{minimize } t \text{ subject to } g(x; \xi) \leq 0, c(x; \xi) \leq t, x \in X, t \in \mathbb{R}. \quad (2)$$

Second, it is also possible to consider one constraint only (that is, $K = 1$): it is in fact possible to replace K constraints $g_j(x; \xi), j = 1, \dots, K$ by one-dimensional constraint $g(x; \xi) := \max_j g_j(x; \xi)$. On the other hand, calculating probabilities for such max-type constraints is as hard as the original problem (1); this is why we do not pursue this direction. Hence, let us consider the following simplified uncertain problem

$$\text{minimize } c^T x \text{ subject to } g(x; \xi) \leq 0, x \in X \quad (3)$$

for the sequel.

2.1 Robust Optimization Approach

Having to solve (3) before the data element ξ is known, it is advisable to hedge the results against a set of possible values of ξ . One possible approach is to satisfy the constraints of (3) for *all* possible values of the data ξ . Mathematically, we require that $g(x; \xi) \leq 0$ for all $\xi \in \Xi$ where Ξ is a so-called *uncertainty set*. Such approach is known under the name of *worst-case approach* and leads to a *robust optimization problem* of the form

$$\text{minimize } c^T x \text{ subject to } g(x; \xi) \leq 0, x \in X \forall \xi \in \Xi. \quad (4)$$

The uncertainty set can in fact differ from the set Ξ introduced in (1) where it represents the set which the uncertainty element is known to belong to. In (4), it is rather the set of actual instances of ξ for which the constraints are required to be fulfilled. This distinction is not too important from the practical point of view and we will consider that both the set coincide in this paper.

The robust optimization problem (4) is a deterministic optimization problem with a potentially infinite number of constraints and so numerically hard to solve with traditional approaches. We refer the reader to the book of Ben-Tal, El-Ghaoui & Nemirovski (2009) for further study of the theory and methodology of robust optimization.

2.2 Probabilistically Constrained Optimization Approach

Instead of considering all possible instances of data ξ as in (3), we prefer to solve the uncertain problem only for such instances which are most probable to happen. In formal view, we now assume that ξ is a random vector following a known probabilistic distribution, and we require the constraints in (3) to be fulfilled with a sufficiently high probability $1 - \varepsilon$ (with ε being small positive number). The resulting problem is known as *probabilistically* or *chance constrained optimization problem* and has the form

$$\text{minimize } c^T x \text{ subject to } \mathbb{P}_\xi(g(x; \xi) \leq 0) \geq 1 - \varepsilon, x \in X \quad (5)$$

where \mathbb{P}_ξ is the probability distribution of the random vector ξ . These problems fall into broader class of optimization problems, namely stochastic optimization problems. For the methodology and solving algorithm for stochastic optimization see e. g. books of Prékopa (1996), Ruszczyński & Shapiro (2003), or Dentcheva, Ruszczyński & Shapiro (2014).

3 Research results

3.1 Example: Single-Item Uncapacitated Lot Sizing Optimization Problem

Consider a simple problem of inventory management consisting in minimization of setup, production (ordering) and holding costs for a selected product which is to be stored in an inventory (for example due to some technical reasons). The setup cost is a fixed cost spent when an order for the product is placed (e. g., administrative costs). The production cost is the variable cost proportional to the actual quantity of the ordered product (e. g. factoring or transportation costs). The holding costs are the costs for storing items of the product (e. g. warehouse space, taxes, opportunity cost, etc.) which are not immediately consumed by an outer demand. The problem is considered repeatedly in several consecutive time intervals (e. g. monthly) up to a final time horizon T . We consider the demand as an uncertain data element of the problem. The uncertain optimization lot sizing problem can be then formulated as to

$$\text{minimize } \sum_{t=1}^T (s_t y_t + p_t x_t + h_t s_t) \quad (6)$$

subject to

$$\begin{aligned} s_{t-1} + x_t &= d_t + s_t \\ 0 &\leq x_t \leq M_t y_t \\ s_t &\geq 0, s_0 = 0 \\ y_t &\in \{0; 1\} \text{ for every } t = 1, \dots, T, \end{aligned} \quad (7)$$

where

s_t is the setup cost for the time interval t ,

p_t is the production cost for the time interval t ,

h_t is the holding cost for the time interval t ,

y_t is the binary variable equal to 1 if the order is placed in the time interval t ,

x_t is the production level for the time interval t ,

s_t is the inventory level (remaining quantity) at the end of the time interval t ,

d_t is the (uncertain) demand level for the product at the time interval t ,

M_t is the upper bound for the production (order level) of the item at the time interval t .

The first equality of (7) represent the inventory balance—the uncertain demand is satisfied by the items from the inventory and by the actual production. Remaining items are stored in the inventory for the next time interval. Second row of (7) involves a (sufficiently high) parameter M_t bounding the actual production from above if needed (that is, if the order is placed in the time interval t). In the uncapacitated problem, this upper bound is chosen so that any demand can be satisfied by the production. For an extended reading about these models and solutions approaches see e. g. the book of Pochet & Wolsey (2006).

In order to exclude the uncertainty from the objective function (6), introduced by the state variable s_t , we formulate an equivalent optimization model eliminating this state variable,

$$\text{minimize } \sum_{t=1}^T \left(s_t y_t + \left(p_t + \sum_{\tau=t}^T h_t \right) x_t - z_t \right) \quad (8)$$

subject to

$$\begin{aligned}
 \sum_{\tau=1}^t x_{\tau} &\geq \sum_{\tau=1}^t d_{\tau}, \\
 z_t &\leq \left(\sum_{\tau=t}^T h_{\tau} \right) d_t \\
 0 &\leq x_t \leq M_t y_t \\
 y_t &\in \{0; 1\} \text{ for every } t = 1, \dots, T,
 \end{aligned} \tag{9}$$

where z_t are auxiliary variables representing potential holding prices for the consumed production (future at t) which have to be of course subtracted from the objective.

Consider now the demands d_t to be uncertain parameters; problem (8)–(9) is then considered as an uncertain optimization problem. We can formulate the robust optimization counterpart as in (4) setting up the uncertainty set Ξ for the demand: let $\Xi := [d_1^L; d_1^U] \times \dots \times [d_T^L; d_T^U]$, that is, we expect the demand d_t at each time t to belong to a fixed closed interval $[d_t^L; d_t^U]$. To formulate robust lot sizing optimization problem, it is enough to add the condition $\forall (d_1, \dots, d_T) \in \Xi$ to the constraint part (9) of the uncertain problem. It is easy to see, in this case, that the first condition is then equivalent to the condition

$$\sum_{\tau=1}^t x_{\tau} \geq \sum_{\tau=1}^t d_{\tau}^U, \tag{10}$$

that is, we have to produce such amount of the item so that the worse demand can be even satisfied. Replacing further d_t by d_t^U in the second condition of (9) we obtain the final robust formulation for the lot sizing problem.

To formulate the probabilistically constrained counterpart we just have to suppose d_t to follow a known probability distribution. Then we reformulate the first condition of (9) as

$$\sum_{\tau=1}^t x_{\tau} \geq F_t^{(-1)}(1 - \varepsilon_t), \tag{11}$$

where $F_t^{(-1)}$ is the quantile function for the cumulative demand $\sum_{\tau=1}^t d_{\tau}$. This function is not always easy to calculate as we deal with the distribution of the sum of random variables. This set of constraints is known under the name of individual probabilistic constraints as we deal with the constraints for each time t individually (with their own level parameters ε_t). Much difficult is the case of joint probabilistic constraints (dealing with the probability of the whole time paths for demand); we will not treat this case in our current paper.

3.2 Numerical Illustration

Let $T = 6$ time periods, $s_t \equiv 100$, $p_t \equiv 6$, $h_t \equiv 4$ (all these cost constant through the time for simplicity). Let further consider the demands d_1, \dots, d_T belong to intervals $[5; 15]$, $[10; 20]$, $[15; 25]$, $[20; 30]$, $[5; 15]$, $[5; 15]$ respectively, and so is defined the uncertainty set Ξ . For the stochastic optimization problem, suppose that the probability distribution of d_t is uniform over these intervals, that these demands are independent, and set up the probability levels with $\varepsilon_t \equiv 0.05$. The quantile functions $F_t^{(-1)}$ for the cumulative demand can be obtained integrating the density for the sum of independent random variables as given by Sadooghi-Alvandi, Nematollahi & Habibi (2009).

Let first consider a deterministic (wait-and-see) case considering the demands to be the centers of the intervals mentioned above. The optimal value of the problem (the total cost) is 1020 with setups in time periods 1, 3, and 4 and the production (ordering) levels of 25, 20, and 45 items at these time periods, respectively. This particular demand setting is improbable to happen in reality, let thus consider the robust and stochastic optimization case.

The robust optimization problem leads to the optimal solution in which an additional setup in time period 5 is performed, and the production levels are adjusted to 35, 25, 30 and 30 items. The optimal value of the problem varies from 1260 (for the highest possible demand, that is, lowest holding costs) to 2100 (lowest possible demand, that is, highest holding costs), provided that the holding costs applies only to the actual inventory level (that is, the variable z_t is to be determined *after* the demand d_t is observed).

The optimal solution for the probabilistically constrained optimization problem leads to the same setup time periods as the optimal robust solution, but the production levels are adjusted to 34.83, 25.122, 30.036, and 30.006 items. The

optimal value of the problem varies from 1258,316 (for the highest possible demand) to 2098,316 (for the lowest possible demand). It is also worth to note that the case of the highest possible demand falls into the set of solutions that was not covered by the production (as improbable to happen). The slight decrease of the total costs is due to this fact, that we do not hedge against the demands with smallest probabilities—not for all realizations the demand is satisfied. It may seem that the difference between the optimal values is negligible considering robust and stochastic results. But this is due to the particular selection of the uncertainty set and the probability distribution. (In fact, the 95% quantile for the cumulative demand at time $T = 6$ is calculated to 119,994.) We refer to Houda (2006) for an opposite example where the robust and stochastic solutions differ significantly.

Although the wait-and-see result provides apparently the best cost-saving solution, it is worth to say that it may not be so if uncertainty of the demand has to be considered. If the highest possible demand takes place (120 items in total), such demand is not covered by 30 items! We did not include penalties for unsatisfied demand to the model, but use of robust or probabilistically constrained methods is justified if these penalties are higher than the costs to be paid by an eventually redundant production provided by the robust or probabilistically constrained method.

4 Conclusion

In this paper we have discussed the robust and probabilistically constrained approach to solve an optimization problem under data uncertainty. We have formulated a general robust and probabilistically constrained optimization problems as the methods to deal with data uncertainty, and showed this formulation on an example of single-item uncapacitated lot sizing optimization problem, that is, an instance of optimization problem solved in classical inventory theory. We have also provided a simple numerical example of this problem on which we can investigate the differences of an ad-hoc deterministic optimization and the robustified versions presented. Even that the actual numerical setting of the example does not provide a high distinction between stochastic and robust programs, it is known from the literature that the solutions can differ considerably when moving to different probabilistic distributions (for example normal ones).

References

- Ben-Tal, A., El-Ghaoui, L. & Nemirovski, A. (2009). *Robust optimization*. New Jersey: Princeton University Press. ISBN 978-0-691-14368-2.
- Hillier, F. & Lieberman G. (2014). *Introduction to Operations Research*. 10th edition. New York: McGraw-Hill. ISBN 978-1-25-916298-5.
- Houda, M. (2006). Comparison of approximation in stochastic and robust programming. In M. Hušková & M. Janžura (Eds.) *Proceedings of the 7th Prague Symposium on Asymptotic Statistics and 15th Prague Conference on Information Theory, Statistical Decision Functions and Random Processes Prague Stochastics 2006* (pp. 418-425). Prague: MatfyzPress.
- Kall, P. (1976). *Stochastic Linear Programming*. Berlin: Springer-Verlag. ISBN 978-3-642-66252-2.
- Prékopa, A. (1995). *Stochastic Programming*. Budapest: Akadémiai Kiadó. ISBN 978-90-481-4552-2.
- Pochet, Y. & Wolsey, L. A. (2006). *Production Planning by Mixed Integer Programming*. New York: Springer. ISBN 978-0387-29959-4.
- Ruszczynski, A. & Shapiro, A., eds. (2003). *Stochastic Programming*, volume 10 of Handbooks in Operations Research and Management Science. Amsterdam: Elsevier. ISBN 978-0-444-50854-6.
- Sadooghi-Alvandi, S. M., Nematollahi, A. R. & Habibi, R. (2009). On the distribution of the sum of independent uniform random variables. *Statistical Papers* 50(1), 171-175.

Approximation of a Planar B-Spline Curve by Polygonal Trail with Special Characteristics

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Abstract: When using the output data from CAD systems, the curve is often described in a so-called "spline" format. The regulation of a cutting, respectively other machine requires, that the input data are given in a form of a sequence of linear segments with prescribed maximal difference to the real curve, expressed in the "spline" format. Specifically, we are talking about replacing the given planar B-spline curve by polygonal trail with tops on this curve. We are doing this by a way when the distance between the individual linear segments of the trail and to those linear segments corresponding parallel tangent of the curve is less than or equal to the given positive ε . The requirement of a construction like this is motivated by the fact that during the cutting process by a laser, respectively a water beam, the polygonal trail is easier to track than the whole curve.

A company MIR in Eskede, Sweden, which was the ordering party of this task, had chosen from a set of different types of planar B-spline curves the following three mostly used ones, the so-called clamped, opened and closed ones. The positive result of solving this task become used in a regulation system AMOS, which is a component of one laser-cutting machine in a company Skanpak, Czech Republic.

Key words: Planar B-spline curves · The types of planar B-spline curves · Approximation of B-spline curves by a polygonal trail · Cox – de Boor's formula

JEL Classification: G10 · G63 · C65

1 Introduction

In R^2 provided with a rectangular Cartesian system of coordinates $o; x_1, x_2$, let us consider the chosen integer $p \geq 1$ configuration of $n+1$ so-called control points P_0, P_1, \dots, P_n (excluding the case that all of them form just one single point), and for $m = n + p + 1$ of so-called nodal vector $U = (U_0, U_1, \dots, U_m)$ of dimension $m + 1$, whose components (nodes) create a non-decreasing sequence of real numbers (excluding the stationary sequence); while the j^{th} node U_{j-1} , where $j = 1, 2, \dots, m + 1$, has a so-called multiplicity $k (\geq 1, \text{integer})$, if it happens to be in this sequence k -times. For example, the first node of the vector $(1, 1, 1, 2, 4, 5, 6, 6)$ has a multiplicity 3, the fifth has a multiplicity 1 and the last node has a multiplicity 2. So-called (planar) B-spline curve of the p^{th} degree, determined by the control points $P_r = x_i^{(r)} = (x_1^{(r)}, x_2^{(r)})$, $r = 0, 1, \dots, n$ (the index i is representing the numbers 1 and 2), nodal vector $U = (U_0, U_1, \dots, U_m)$ and to this vector corresponding B-spline base functions of the p^{th} degree $N_{p,r}$, is defined by parametric equations:

$$x_i(u) = \sum_{r=0}^n P_r \cdot N_{p,r}(u) = \sum_{r=0}^n x_i^{(r)} \cdot N_{p,r}(u) \quad (1)$$

for $u \in \langle U_0, U_m \rangle$ where $\langle U_0, U_m \rangle$ is not empty (respectively U_m included).

The calculation of B-spline basis functions can be realised based on Cox – de Boor's recursive formula:

$$N_{0,j} = \begin{cases} 1 & \text{for } U_j \leq u < U_{j+1}, \\ 0 & \text{elsewhere} \end{cases} \quad (2)$$

$$N_{p,j} = \frac{u - U_j}{U_{p+j} - U_j} N_{p-1,j} + \frac{U_{p+j+1} - u}{U_{p+j+1} - U_{j+1}} N_{p-1,j+1};$$

during the calculations, the expressions that lack sense are put equal to zero.

We assign an increasing sequence of nodal points $V_0, V_1, V_2, \dots, V_{sk}$ to the nodal vector U .

If, for instance, the dimension of vector $U = (U_0, U_1, U_2, U_3, U_4, U_5, U_6, U_7, U_8) = (1, 1, 1, 3, 5, 8, 8, 10, 10)$, then $V_0 = 1, V_1 = 3, V_2 = 5, V_3 = 8, V_4 = 10$. The dimension of vector $V = (V_0, V_1, V_2, V_3, V_4) = (1, 3, 5, 8, 10)$ is $sk + 1 = 4 + 1 = 5$. So, in our example, $sk = 4$.

In applications are mostly used so-called "clamped", respectively "opened", respectively "closed" B-spline curves of degree p defined on the interval $\langle U_p, U_{m-p} \rangle$. For the clamped curve, it is requested that the initial and final nodal points of vector U have a multiplicity $p+1$, for opened curve, it is requested that the initial and final nodal points of vector U have a multiplicity at maximum equal to p , and for closed curve, it is required that the control points for $j = 0, 1, \dots, p-1$: $P_j = P_{n-p+j+1}$, were true and also the coordinates of vector U form an arithmetical sequence.

In all three given cases, the constructed B-spline curve is "copying" the course of the polygonal trail with vertices $P_0, P_1, P_2, \dots, P_n$, which we call control polygonal trail. At the same time, the opened, respectively closed curve, reflects the actual state by its name, while clamped curve marks out by the fact that it has its beginning at the point P_0 , and its end at the point P_n , and at these points, it touches the control polygonal trail.

For $X = U_p$, let us denote the integer from sequence $j = 0, 1, 2, \dots, sk$ by the symbol t , where $X = V_t$. Analogically for $Y = U_{m-p}$ we denote by the symbol tt an integer from sequence $j = 0, 1, 2, 3, \dots, sk$ such that $Y = V_{tt}$.

The number $ss = tt - t (\geq 0)$ gives the whole number (closed segments) of constructed B-spline curve. On the q^{th} segment, where $q = 1, \dots, ss$, the parameter of u is changing on the interval $\langle V_{t+q-1}, V_{t+q} \rangle$.

Let $p = 3, n + 1 = 4 + 1 = 5$ control points $P_0, P_1, \dots, P_4, m + 1 = (n + p + 1) + 1 = 8 + 1 = 9^{\text{th}}$ dimensional vector $U = (1, 1, 1, 3, 5, 8, 8, 10, 10)$. The construction of opened B-spline curve of the third degree. To the vector U we assign a vector $V = (V_0, V_1, V_2, V_3, V_4) = (1, 3, 5, 8, 10)$. We have $X = U_p = U_3 = 3 = V_1 \Rightarrow t = 1$, then we have $Y = U_{m-p} = U_{8-3} = U_5 = 8 = V_3 \Rightarrow tt = 3$. The whole number of (closed) segments of constructed curve is $ss = tt - t = 3 - 1 = 2$. On the 2nd segment ($q = 2$) the parameter is changing in interval $\langle V_{t+q-1}, V_{t+q} \rangle = \langle V_{1+2-1}, V_{1+2} \rangle = \langle V_2, V_3 \rangle = \langle 5, 8 \rangle$.

If for the integer q from a sequence $1, 2, \dots, ss-1$ (where $ss \geq 2$), it is valid that multiplicity $k (\geq 1)$ of node V_{t+q} (regards the vector U) is greater than or equal to $p + 1$, then (closed) segments of the curve of q^{th} and $(q+1)^{\text{th}}$ are not continuing on each other; if $k < p + 1$, then they are continuing each other. In this example the first segment of the curve continues on its second segment. (see references)

2 Methods

Those methods are used in a planar B-spline curves in R^2 . We also used the Cox – de Boor's recursive formula for calculations of B-spline base functions. The algorithms for the calculation of tasks mentioned in abstract are a part of a program, that the author has created.

3 Research results

The results of this research are being used in a Swedish company MIR in a system AMOS. The AMOS is used for laser or water cutting process.

The mathematical part of solving the problem

Let us suppose that for $i = 1, 2$ we know parametrical equations of q^{th} (closed) segment of constructed B-spline curve of the p^{th} degree in the form

$$x_i(u) = \sum_{r=1}^{p+1} a_i^{(r)} u^{p+1-r}, \quad (3)$$

where $u \in \langle V_{t+q-1}, V_{t+q} \rangle = I_q$ (see paragraph 1). It is the first derivative of function $x_i(u)$:

$$\dot{x}_i(u) = \sum_{r=1}^p (p + 1 - r) a_i^{(r)} u^{p-r}. \quad (4)$$

Let $u_1 < u_2$ are numbers from the interval I_q , the corresponding points on studied q^{th} segment, for brevity, we denote as points u_1, u_2 (the couple of different points). The slope of secant line connecting the points $u_1 < u_2$ is equal to division

$$\frac{x_2(u_2) - x_2(u_1)}{x_1(u_2) - x_1(u_1)} = k_1$$

and the slope of tangent of the curve (exactly the q^{th} segment of the curve) in the point $z \in (u_1, u_2)$ is equal

$$\frac{\dot{x}_2(z)}{\dot{x}_1(z)} = k_2.$$

In accordance with the requirement of the task, $k_1 = k_2$, the following equation has to be true

$$\frac{x_2(u_2) - x_2(u_1)}{x_1(u_2) - x_1(u_1)} = \frac{\sum_{r=1}^p (p+1-r) a_2^{(r)} z^{p-r}}{\sum_{r=1}^p (p+1-r) a_1^{(r)} z^{p-r}},$$

or the equation

$$\sum_{r=1}^p (p+1-r) z^{p-r} \cdot \begin{vmatrix} a_1^{(r)} & a_2^{(r)} \\ x_1(u_2) - x_1(u_1) & x_2(u_2) - x_2(u_1) \end{vmatrix} = 0. \tag{5}$$

A point on the studied segment, in which the slope of the curve is parallel with the secant line connecting the points $u_1 < u_2$, it applies to an algebraic equation (5) of the degree, at most $p - 1$. The solution of equation (5) can be the best realised with the use of Bairstow's iteration method.

Example 1. For $n = 5$, let us consider $n + 1 = 5 + 1 = 6$ control points $P_0 = (1, 5), P_1 = (5, 10), P_2 = (10, 8), P_3 = (6, 6), P_4 = (15, 2), P_5 = (8, -1)$, and for $p = 2$ and $m = n + p + 1 = 5 + 2 + 1 = 8$ nodal vector $U = (U_0, U_1, \dots, U_8) = (0, 0, 0, 3, 6, 9, 12, 12, 12)$. The vector $V = (V_0, V_1, V_2, V_3, V_4) = (0, 3, 6, 9, 12)$ assigned to the vector U . It will be about the construction of clamped B-spline curve of the 2nd degree. For $X = U_p = U_2 = 0 = V_0$ follows $t = 0$, for $Y = U_{m-p} = U_{8-2} = U_6 = 12 = V_4$ follows $tt = 4$, so the constructed B-spline curve of the 2nd degree, designated by the chosen control points, nodal vector U and to this vector relevant B-spline base functions $N_{2,j}$ in number $n + 1 = 6$ (the calculation of those functions according to (2))

$$N_{2,0} = \begin{cases} \frac{1}{9}(u^2 - 6u + 9) & \text{for } 0 \leq u < 3, \\ 0 & \text{elsewhere,} \end{cases}$$

$$N_{2,1} = \begin{cases} -\frac{1}{18}(3u^2 - 12u) & \text{for } 0 \leq u < 3, \\ \frac{1}{18}(u^2 - 12u + 36) & \text{for } 3 \leq u < 6, \\ 0 & \text{elsewhere,} \end{cases}$$

$$N_{2,2} = \begin{cases} \frac{1}{18}u^2 & \text{for } 0 \leq u < 3, \\ -\frac{1}{18}(2u^2 - 18u + 27) & \text{for } 3 \leq u < 6, \\ \frac{1}{18}(u^2 - 18u + 81) & \text{for } 6 \leq u < 9, \\ 0 & \text{elsewhere,} \end{cases}$$

$$N_{2,3} = \begin{cases} \frac{1}{18}(u^2 - 6u + 9) & \text{for } 3 \leq u < 6, \\ -\frac{1}{18}(2u^2 - 30u + 99) & \text{for } 6 \leq u < 9, \\ \frac{1}{18}(u^2 - 24u + 144) & \text{for } 9 \leq u < 12, \\ 0 & \text{elsewhere,} \end{cases}$$

$$N_{2,4} = \begin{cases} \frac{1}{18}(u^2 - 12u + 36) & \text{for } 6 \leq u < 9, \\ -\frac{1}{18}(3u^2 - 60u + 288) & \text{for } 9 \leq u < 12, \\ 0 & \text{elsewhere,} \end{cases}$$

$$N_{2,5} = \begin{cases} \frac{1}{9}(u^2 - 18u + 81) & \text{for } 9 \leq u \leq 12, \\ 0 & \text{elsewhere,} \end{cases}$$

is composed of $ss = tt - t = 4 - 0 = 4$ (closed) segments. The parametrical equations for example the 4th (closed) segment ($q = 4$), where the parameter u is changing in interval $\langle V_{t+q-1}, V_{t+q} \rangle = \langle V_{0+4-1}, V_{0+4} \rangle = \langle V_3, V_4 \rangle = \langle 9, 12 \rangle$, according to (1)

$$\begin{pmatrix} x_1(u) \\ x_2(u) \end{pmatrix} = \sum_{r=0}^5 \begin{pmatrix} x_1^{(r)} \\ x_2^{(r)} \end{pmatrix} \cdot N_{2,r}(u) = \binom{1}{5} \cdot 0 + \binom{5}{10} \cdot 0 + \binom{10}{8} \cdot 0 +$$

$$+ \binom{6}{6} \cdot \frac{1}{18} (u^2 - 24u + 144) + \binom{15}{2} \cdot \frac{1}{18} (-3u^2 + 60u - 288) +$$

(6)

$$+ \begin{pmatrix} 8 \\ -1 \end{pmatrix} \cdot \frac{1}{9} (u^2 - 18u + 81) = \begin{pmatrix} -\frac{1}{18}(23u^2 - 468u + 2160) \\ -\frac{1}{9}(u^2 - 6u - 63) \end{pmatrix}$$

For $u = 12$, according to (6) we get the ending point of the curve $P_5 = (8, -1)$. Are parametrical equations of the hodograph of the curve (of it's 4th segment)

$$\begin{pmatrix} \dot{x}_1(u) \\ \dot{x}_2(u) \end{pmatrix} = \begin{pmatrix} -\frac{1}{9}(23u - 234) \\ -\frac{1}{9}(2u + 6) \end{pmatrix},$$

and so we have

$$\begin{pmatrix} \dot{x}_1(12) \\ \dot{x}_2(12) \end{pmatrix} = \begin{pmatrix} -14/3 \\ -2 \end{pmatrix}, \quad \frac{\dot{x}_1(12)}{\dot{x}_2(12)} = \frac{-2}{-14/3} = \frac{3}{7},$$

And a line segment $P_4 P_5$ of control polygonal trail has a tangent

$$\frac{2 - (-1)}{15 - 8} = \frac{3}{7} \quad .$$

The curve is touching the control polygonal trail in the point P_5 .

For $q = 3$ has a node $V_{t+q} = V_{0+3} = V_3 = 9 = U_5$ of multiplicity $k = 1$ and it is true that $k = 1 < p + 1 = 2 + 1 = 3$. So the 3rd and the 4th (closed) segments of the constructed curve are linked to each other. For the considered example we will make an equation (5). According to (6) is

$$a_1^{(1)} = -23/18, \quad a_1^{(2)} = 468/18 = 26, \quad (7)$$

$$a_2^{(1)} = -1/9, \quad a_2^{(2)} = 6/9 = 2/3,$$

and then

$$x_1(u_2) = x_1(12) = 8, \quad x_1(u_1) = x_1(9) = 21/2, \quad (8)$$

$$x_2(u_2) = x_2(12) = -1, \quad x_2(u_1) = x_2(9) = 4,$$

so the equation (5) with the use of (7) and (8) will have the form

$$\begin{aligned} 0 &= 2z \begin{vmatrix} -23/18 & -1/9 \\ -5/2 & -5 \end{vmatrix} + \begin{vmatrix} 26 & 2/3 \\ -5/2 & -5 \end{vmatrix} = \\ &= 2z \cdot \frac{55}{9} - \frac{385}{3} \Rightarrow z = \frac{385/3}{110/9} = \frac{385 \cdot 9}{110 \cdot 3} = \frac{385 \cdot 3}{110} = \frac{21}{2}. \end{aligned} \quad (9)$$

A point $z \in (9, 12)$, in which the tangent of the curve is parallel with secant, connecting the points $u_1 = 9 < 12 = u_2$, is equal to a number $21/2$.

Example 2. The problem is the same as in the Example 1. The determinant in equation (5)

$$D_r = \begin{vmatrix} a_1^{(r)} & a_2^{(r)} \\ x_1(u_2) - x_1(u_1) & x_2(u_2) - x_2(u_1) \end{vmatrix}$$

it can be written in a form $\varepsilon_{ij} \cdot a_i^{(r)} (x_j(u_2) - x_j(u_1))$, where i, j are addition indexes changing independently on each other from 1 to 2 (Einstein summation convention), where ε_{ij} is Levi-Civita's tensor of the 2nd degree with coordinates

$$\varepsilon_{ij} = \begin{cases} 0, & \text{for } i = j, \\ 1, & \text{for } i < j, \\ -1, & \text{for } i > j, \end{cases}$$

as

$$x_j(u_2) - x_j(u_1) = a_j^{(1)}(u_2^2 - u_1^2) + a_j^{(2)}(u_2 - u_1),$$

we have

$$D_r = (u_2^2 - u_1^2) \cdot \varepsilon_{ij} \cdot a_i^{(r)} \cdot a_j^{(1)} + (u_2 - u_1) \cdot \varepsilon_{ij} \cdot a_i^{(r)} \cdot a_j^{(2)}.$$

For $r=1$ is

$$D_1 = (u_2^2 - u_1^2) \cdot \varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(1)} + (u_2 - u_1) \cdot \varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)},$$

and because

$$\varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(1)} = \varepsilon_{ji} \cdot a_j^{(1)} \cdot a_i^{(1)} = -\varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(1)},$$

is $\varepsilon_{ij} \cdot a_j^{(1)} \cdot a_i^{(1)} = 0$ and because

$$D_1 = (u_2 - u_1) \cdot \varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)}.$$

Further we have

$$D_2 = (u_2^2 - u_1^2) \cdot \varepsilon_{ij} \cdot a_i^{(2)} \cdot a_j^{(1)} + (u_2 - u_1)$$

and because again $\varepsilon_{ij} \cdot a_i^{(2)} \cdot a_j^{(2)} = 0$, is

$$D_2 = (u_2^2 - u_1^2) \cdot \varepsilon_{ij} \cdot a_i^{(2)} \cdot a_j^{(1)}.$$

The equation (5) is then

$$0 = 2z \cdot D_1 + D_2 = 2z \cdot (u_2 - u_1) \cdot \varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)} + (u_2 - u_1) \cdot (u_1 + u_2) \cdot \varepsilon_{ij} \cdot a_i^{(2)} \cdot a_j^{(1)},$$

that is

$$0 = 2z \cdot \varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)} + (u_1 + u_2) \cdot \varepsilon_{ij} \cdot a_i^{(2)} \cdot a_j^{(1)} \quad (10)$$

and because

$$\varepsilon_{ij} \cdot a_i^{(2)} \cdot a_j^{(1)} = \varepsilon_{ji} \cdot a_j^{(1)} \cdot a_i^{(2)} = -\varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)},$$

(9) could be written in a form

$$0 = \varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)} \cdot \{2z - (u_1 + u_2)\}. \quad (11)$$

Supposing that the determinant

$$\varepsilon_{ij} \cdot a_i^{(1)} \cdot a_j^{(2)} = \begin{vmatrix} a_1^{(1)} & a_2^{(1)} \\ a_1^{(2)} & a_2^{(2)} \end{vmatrix} \neq 0, \quad (12)$$

follows (10)

$$z = \frac{u_1 + u_2}{2}. \quad (13)$$

For $u_1 = 9 < 12 = u_2$ follows from (12), that $z = (9 + 12)/2 = 21/2$, which corresponds to the result (8) from Example 1. If we choose in interval $\langle 9, 12 \rangle I_4$ for example points $u_1 = 10 < 12 = u_2$, then based on (12)

$$z = \frac{10+12}{2} = \frac{22}{2} = 11.$$

In this point is the tangent of the curve parallel to the secant connecting those two points. The determinant (11) with elements (7) is not equal to zero, how we can easily find out.

Example 3. For $n = 9$ let us study $n + 1 = 9 + 1 = 10$ control points $P_0 = (1, 11)$, $P_1 = (12, 11)$, $P_2 = (12, 2)$, $P_3 = (8, 2)$, $P_4 = (8, 8)$, $P_5 = (4, 8)$, $P_6 = (4, 3)$, $P_7 = (1, 3)$, $P_8 = (1, 11)$, $P_9 = (12, 11)$, and for $p = 2$ and $m = n + p + 1 = 9 + 2 + 1 = 12$ nodal vector $U = (U_0, U_1, U_2, \dots, U_{12}) = (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)$, the components of which create an arithmetical sequence. A vector V assigned to the vector U is equal to the vector U .

For $j = 0, 1 = 2 - 1 = p - 1$ is true. $P_j = P_{n-p+j+1}$: $P_0 = P_{9-2+0+1} = P_8$, $P_1 = P_{9-2+1+1} = P_9$. It will be a construction of a closed B-spline curve of the 2nd degree. For $X = U_p = U_2 = 2 = V_2$ follows $t = 2$, for $Y = U_{m-p} = U_{10} = 10 = V_{10}$ follows $tt = 10$, so the constructed B-spline curve of the 2nd degree, determined by the given control points, nodal vector U and to this vector relevant B-spline base functions N_{2j} for $j = 0, 1, \dots, 8$

$$N_{2,j} = \begin{cases} \frac{1}{2}(u-j)^2 & \text{for } j \leq u < j+1, \\ \frac{1}{2}(-2u^2 + 2u(2j+3) - (2j^2 + 6j + 3)) & \text{for } j+1 \leq u < j+2, \\ \frac{1}{2}(u-(j+3))^2 & \text{for } j+2 \leq u < j+3, \\ 0 & \text{elsewhere,} \end{cases}$$

and

$$N_{2,9} = \begin{cases} \frac{1}{2}(u^2 - 18u + 81) & \text{for } 9 \leq u < 10, \\ \frac{1}{2}(-2u^2 + 42u - 219) & \text{for } 10 \leq u < 11, \\ \frac{1}{2}(u^2 - 24u + 144) & \text{for } 11 \leq u < 12, \\ 0 & \text{elsewhere,} \end{cases}$$

(the calculation of these functions according to (2)), consists of $ss = tt - t = 10 - 2 = 8$ (closed) segments. Parametrical equations of the first (closed) segment ($q = 1$), on which the parameter u changes in interval

$\langle V_{t+q-1}, V_{t+q} \rangle = \langle V_{2+1-1}, V_{2+1} \rangle = \langle V_2, V_3 \rangle = \langle U_2, U_3 \rangle = \langle 2, 3 \rangle = I_1$, are equal (according to (1))

$$x_1(u) = -\frac{1}{2}(11u^2 - 66u + 75),$$

$$x_2(u) = -\frac{1}{2}(9u^2 - 36u + 14). \quad (14)$$

Parametrical equations of the 8th (closed) segment ($q = 8$), in which the parameter u changes in interval

$\langle V_{t+q-1}, V_{t+q} \rangle = \langle V_{2+8-1}, V_{2+8} \rangle = \langle V_9, V_{10} \rangle = \langle U_9, U_{10} \rangle = \langle 9, 10 \rangle = I_8$, are equal (according to (1))

$$x_1(u) = \frac{1}{2}(11u^2 - 198u + 893), \quad (15)$$

$$x_2(u) = -(4u^2 - 80u + 389).$$

According to (14) is

$$x_1(2) = 13/2, \quad x_2(2) = 11,$$

according to (15)

$$x_1(10) = 13/2, \quad x_2(10) = 11;$$

constructed B-spline curve is closed.

The tangent of the secant, connecting the side points of interval I_8 , which are points $u_1 = 9 < 10 = u_2$, is equal

$$\frac{x_2(10) - x_2(9)}{x_1(10) - x_1(9)} = \frac{11 - 7}{\frac{13}{2} - 1} = \frac{8}{11} = k_1,$$

and the tangent of secant of the curve in a point $z = (u_1 + u_2)/2 = (9 + 10)/2 = 19/2$ (see Example 2) is equal to

$$\frac{\dot{x}_2(19/2)}{\dot{x}_1(19/2)} = \frac{(-8u + 80)_{u=19/2}}{(11u - 99)_{u=19/2}} = \frac{-\frac{152}{2} + \frac{160}{2}}{\frac{209}{2} - \frac{198}{2}} = \frac{4}{\frac{11}{2}} = \frac{8}{11} = k_2,$$

so $k_1 = k_2$. In a point $z = 19/2 \in (9, 10)$ is a tangent of the curve parallel with secant, connecting the points $u_1 = 9 < 10 = u_2$.

Example 4. For $n = 4$ let us consider $n + 1 = 4 + 1 = 5$ control points: $P_0 = (1, 5)$, $P_1 = (5, 10)$, $P_2 = (10, 8)$, $P_3 = (6, 6)$, $P_4 = (15, 2)$, and for $p = 3$ and $m = n + p + 1 = 4 + 3 + 1 = 8$ nodal vector

$$U = (U_0, U_1, U_2, \dots, U_7, U_8) = (0, 5, 5, 5, 5, 10, 10, 15, 20).$$

A vector $V = (V_0, V_1, V_2, V_3, V_4) = (0, 5, 10, 15, 20)$ is associated to the vector U . This will be about a construction of opened B-spline curve of the 3rd degree. For $X = U_p = U_3 = 5 = V_1$ follows $t = 1$, for $Y = U_{m-p} = U_5 = 10 = V_2$ follows $tt = 2$, so the constructed B-spline curve of the 3rd degree, designated by given control points, nodal vector U and to this vector associated B-spline base functions $N_{3,j}$ in number $n + 1 = 5$ (the calculation of those functions according to (2))

$$N_{3,0} = \begin{cases} \frac{1}{125}u^3 & \text{for } 0 \leq u < 5, \\ 0 & \text{elsewhere,} \end{cases}$$

$$\begin{aligned}
 N_{3,1} &= \begin{cases} -\frac{1}{125}(u^3 - 30u^2 + 300u - 1000) & \text{for } 5 \leq u < 10, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{3,2} &= \begin{cases} \frac{1}{125}(3u^3 - 75u^2 + 600u - 1500) & \text{for } 5 \leq u < 10, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{3,3} &= \begin{cases} -\frac{1}{50}(u^3 - 21u^2 + 135u - 275) & \text{for } 5 \leq u < 10, \\ -\frac{1}{250}(u^3 - 45u^2 + 675u - 3375) & \text{for } 10 \leq u < 15, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{3,4} &= \begin{cases} \frac{1}{250}(u^3 - 15u^2 + 75u - 125) & \text{for } 5 \leq u < 10, \\ \frac{1}{100}(u^3 - 42u^2 + 570u - 2450) & \text{for } 10 \leq u < 15, \\ -\frac{1}{500}(u^3 - 60u^2 + 1200u - 8000) & \text{for } 15 \leq u \leq 20, \end{cases}
 \end{aligned}$$

is composed of $ss = tt - t = 2 - 1 = 1$ (closed) segment. The parametrical equations of the first (closed) segment ($q = 1$), on which, the parameter u is changing in interval $\langle V_{t+q-1}, V_{t+q} \rangle = \langle V_{1+1-1}, V_{1+1} \rangle = \langle V_1, V_2 \rangle = \langle 5, 10 \rangle = I_1$, are equal (the calculation based on (1))

$$\begin{aligned}
 x_1(u) &= \frac{7u^3 - 159u^2 + 1215u - 2725}{50}, \\
 x_2(u) &= \frac{-6u + 80}{5}.
 \end{aligned} \tag{16}$$

Based on (16) we have

$$\begin{aligned}
 a_1^{(1)} &= \frac{7}{50}, \quad a_1^{(2)} = -\frac{159}{50}, \quad a_1^{(3)} = \frac{1215}{50} = \frac{243}{10}, \\
 a_2^{(1)} &= 0, \quad a_2^{(2)} = 0, \quad a_2^{(3)} = -\frac{6}{5},
 \end{aligned} \tag{17}$$

then for $u_1 = 6 < 9 = u_2$ (a couple of different points on studied segment)

$$\begin{aligned}
 x_1(u_2) = x_1(9) &= 217/25, \quad x_1(u_1) = x_1(6) = 353/50, \\
 x_2(u_2) = x_2(9) &= 26/5, \quad x_2(u_1) = x_2(6) = 44/5,
 \end{aligned} \tag{18}$$

so the equation (5) will be with the use of (17), (18) of a shape

$$0 = 3z^2 \begin{vmatrix} \frac{7}{50} & 0 \\ \frac{81}{50} & -\frac{18}{5} \end{vmatrix} + 2z \begin{vmatrix} -\frac{159}{50} & 0 \\ \frac{81}{50} & -\frac{18}{5} \end{vmatrix} + \begin{vmatrix} \frac{243}{10} & -\frac{6}{5} \\ \frac{81}{50} & -\frac{18}{5} \end{vmatrix},$$

which can be written in a form

$$7z^2 - 106z + 396 = 0.$$

The solutions of this quadratic equation are

$$z_{1,2} = \frac{106 \pm \sqrt{106^2 - 4 \cdot 7 \cdot 396}}{14} = \frac{53 \pm \sqrt{37}}{7} = \begin{cases} 8.4404 \\ 6.7025 \end{cases},$$

and both are elements of interval $(u_1, u_2) = (6, 9)$.

The slope of the tangent, connecting the points $u_1 = 6 < 9 = u_2$, is according to (18)

$$\frac{x_2(9) - x_2(6)}{x_1(9) - x_1(6)} = \frac{26/5 - 44/5}{434/50 - 353/50} = -\frac{20}{9} = k_1,$$

The slope of a tangent to the curve in points $z_{1,2}$ is equal to

$$\frac{\dot{x}_2(z_{1,2})}{\dot{x}_1(z_{1,2})} = \frac{-6/5}{\left(\frac{21u^2 - 318u + 1215}{50}\right)_{u=z_{1,2}}} = -\frac{20}{9} = k_2.$$

So $k_1 = k_2$, as required.

Example 5. For $n = 4$ let us consider $n + 1 = 4 + 1 = 5$ control points $P_0 = (1, 5)$, $P_1 = (5, 10)$, $P_2 = (10, 8)$, $P_3 = (6, 6)$, $P_4 = (15, 2)$, and for $p = 4$ and $m = n + p + 1 = 4 + 4 + 1 = 9$ nodal vector $U = (U_0, U_1, U_2, \dots, U_8, U_9) = (0, 0, 0, 0, 1, 2, 3, 3, 3, 3)$. A vector $V = (V_0, V_1, V_2, V_3) = (0, 1, 2, 3)$ is associated to the vector U . For $X = U_p = U_4 = 1 = V_1$ follows $t = 1$, for $Y = U_{m-p} = U_5 = 2 = V_2$ follows $tt = 2$, so the constructed, opened B-spline curve of the 4th degree, designated by given control points, nodal vector U and to this vector relevant B-spline base functions $N_{4,j}$ in quantity $n+1 = 5$ (the calculation of those functions based on (2)).

$$\begin{aligned}
 N_{4,0} &= \begin{cases} -\frac{1}{8}(15u^4 - 56u^3 + 72u^2 - 32u) & \text{for } 0 \leq u < 1, \\ \frac{1}{8}(u^4 - 8u^3 + 24u^2 - 32u + 16) & \text{for } 1 \leq u < 2, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{4,1} &= \begin{cases} \frac{1}{72}(85u^4 - 264u^3 + 216u^2) & \text{for } 0 \leq u < 1, \\ -\frac{1}{72}(23u^4 - 168u^3 + 432u^2 - 432u + 108) & \text{for } 1 \leq u < 2, \\ \frac{1}{18}(u^4 - 12u^3 + 54u^2 - 108u + 81) & \text{for } 2 \leq u < 3, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{4,2} &= \begin{cases} -\frac{1}{36}(13u^4 - 24u^3) & \text{for } 0 \leq u < 1, \\ \frac{1}{36}(14u^4 - 84u^3 + 162u^2 - 108u + 27) & \text{for } 1 \leq u < 2, \\ -\frac{1}{36}(13u^4 - 132u^3 + 486u^2 - 756u + 405) & \text{for } 2 \leq u < 3, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{4,3} &= \begin{cases} \frac{1}{18}u^4 & \text{for } 0 \leq u < 1, \\ -\frac{1}{72}(23u^4 - 108u^3 + 162u^2 - 108u + 27) & \text{for } 1 \leq u < 2, \\ \frac{1}{72}(85u^4 - 756u^3 + 2430u^2 - 3348u + 1701) & \text{for } 2 \leq u < 3, \\ 0 & \text{elsewhere,} \end{cases} \\
 N_{4,4} &= \begin{cases} \frac{1}{8}(u^4 - 4u^3 + 6u^2 - 4u + 1) & \text{for } 1 \leq u < 2, \\ -\frac{1}{8}(8u^4 - 61u^3 + 168u^2 - 200u + 87) & \text{for } 2 \leq u \leq 3, \\ 0 & \text{elsewhere,} \end{cases}
 \end{aligned}$$

consists of $ss = tt - t = 2 - 1 = 1$ (closed) segment. The parametrical equations of this first (closed) segment ($q = 1$), on which the parameter u is changing in interval $\langle V_{t+q-1}, V_{t+q} \rangle = \langle V_{1+1-1}, V_{1+1} \rangle = \langle V_1, V_2 \rangle = \langle 1, 2 \rangle = I_1$, are equal (calculation based on (1))

$$\begin{aligned}
 \begin{pmatrix} x_1(u) \\ x_2(u) \end{pmatrix} &= \sum_{r=0}^4 P_r \cdot N_{4,r}(u) = \\
 &= \binom{1}{5} \frac{u^4 - 8u^3 + 24u^2 - 32u + 16}{8} + \binom{5}{10} \frac{-23u^4 + 168u^3 - 432u^2 + 432u - 108}{72} + \\
 &+ \binom{10}{8} \frac{14u^4 - 84u^3 + 162u^2 - 108u + 27}{36} + \binom{6}{6} \frac{-23u^4 + 108u^3 - 162u^2 + 108u - 27}{72} + \\
 &\quad + \binom{15}{2} \frac{u^4 - 4u^3 + 6u^2 - 4u + 1}{8} = \\
 &= \begin{pmatrix} \frac{57u^4 - 268u^3 + 378u^2 - 60u + 39}{24} \\ -\frac{81u^4 - 552u^3 + 1512u^2 - 1728u + 72}{24} \end{pmatrix}.
 \end{aligned} \tag{19}$$

For the points $u_1 = 1 < 3/2 = u_2$, laying in interval I_1 , is based on (19)

$$x_1(u_1) = x_1(1) = 146/24 = 73/12, \quad x_1(u_2) = x_1(3/2) = 979/128,$$

$$x_2(u_1) = x_2(1) = 615/24 = 205/8, x_2(u_2) = x_2(3/2) = 3045/128,$$

which is

$$x_1(3/2) - x_1(1) = \frac{979}{128} - \frac{73}{12} = \frac{601}{384}, \quad x_2(3/2) - x_2(1) = \frac{3045}{128} - \frac{205}{8} = -\frac{235}{128}, \quad (20)$$

so the slope of a secant, connecting the points $u_1 = 1 < 3/2 = u_2$, is equal to

$$\frac{x_2(3/2) - x_2(1)}{x_1(3/2) - x_1(1)} = -\frac{235/128}{601/384} = -\frac{705}{601} = -1.173 = k_1.$$

For the considered case, we will construct an equation (5). Based on (19) is

$$a_1^{(1)} = \frac{57}{24} = \frac{19}{8}, \quad a_1^{(2)} = -\frac{268}{24} = -\frac{67}{6}, \quad a_1^{(3)} = \frac{378}{24} = \frac{63}{4}, \quad a_1^{(4)} = -\frac{60}{24} = -\frac{5}{2}, \quad (21)$$

$$a_2^{(1)} = -\frac{81}{24} = -\frac{27}{8}, \quad a_2^{(2)} = \frac{552}{24} = 23, \quad a_2^{(3)} = -\frac{1512}{24} = -63, \quad a_2^{(4)} = \frac{1728}{24} = 72,$$

so based on (20), (21) (considering the appropriate modifications of the determinants)

$$\begin{aligned} 0 &= 4z^3 \begin{vmatrix} 19 & -27 \\ 8 & 8 \\ 601 & -235 \end{vmatrix} + 3z^2 \begin{vmatrix} -67 & 23 \\ 6 & 23 \\ 601 & -235 \end{vmatrix} + 2z \begin{vmatrix} 63 & -63 \\ 4 & -63 \\ 601 & -235 \end{vmatrix} + \begin{vmatrix} -5 & 72 \\ 2 & 72 \\ 601 & -235 \end{vmatrix} = \\ &= 4z^3 \frac{1}{128} \frac{1}{3} \frac{1}{8} \begin{vmatrix} 19 & -27 \\ 601 & -705 \end{vmatrix} + 3z^2 \frac{1}{128} \frac{1}{3} \frac{1}{6} \begin{vmatrix} -67 & 138 \\ 601 & -705 \end{vmatrix} + 2z \frac{1}{128} \frac{1}{3} \frac{1}{4} \begin{vmatrix} 63 & -252 \\ 601 & -705 \end{vmatrix} + \\ &+ \frac{1}{128} \frac{1}{2} \frac{1}{3} \begin{vmatrix} -5 & 144 \\ 601 & -705 \end{vmatrix}, \end{aligned}$$

So after multiplying by the product $128 \cdot 6$

$$\begin{aligned} 0 &= z^3 \begin{vmatrix} 19 & -27 \\ 601 & -705 \end{vmatrix} + z^2 \begin{vmatrix} -67 & 138 \\ 601 & -705 \end{vmatrix} + z \begin{vmatrix} 63 & -252 \\ 601 & -705 \end{vmatrix} + \begin{vmatrix} -5 & 144 \\ 601 & -705 \end{vmatrix} = \\ &= 2832 z^3 - 35703 z^2 - 107037 z - 83019, \end{aligned}$$

and after dividing by the number 3, we have

$$0 = 944 z^3 - 11901 z^2 - 35679 z - 27673. \quad (22)$$

Using Bairstow's iterative method, a cubic equation (22) has three real roots (with an accuracy of 4 decimal places)

2.7591, 1.2334, 8.6146,

From which, only the second one, that is 1.2334, is laying in interval $(u_1, u_2) = (1, 3/2)$. By derivation of the equation (19), we get

$$\dot{x}_1(u) = \frac{228u^3 - 804u^2 + 756u - 60}{24} = \frac{57u^3 - 201u + 189u - 15}{6},$$

$$\dot{x}_2(u) = \frac{-324u^3 + 1656u^2 - 3024u + 1728}{24} = \frac{-81u^3 + 414u^2 - 756u + 432}{6},$$

so the slope of tangent of the curve in point $z = 1.2334$ is equal to

$$\frac{\dot{x}_2(1.2334)}{\dot{x}_1(1.2334)} = \frac{\frac{1}{6}(-81u^3 + 414u^2 - 756u + 432)_{u=1.2334}}{\frac{1}{6}(57u^3 - 201u^2 + 189u - 15)_{u=1.2334}} = -1.173 = k_2.$$

So $k_1 = k_2$, which means, that tangent of the curve in point $z = 1.2334 \in (u_1, u_2) = (1, 3/2)$ is parallel to a secant connecting the points $u_1 = 1 < 3/2 = u_2$.

The construction of required polygonal trail

Primarily, let us choose a positive number ε and an integer $H \geq 5$. The interval $I_1 = \langle u_1 = V_t, V_{t+1} = u_2 \rangle$, where the parameter u is changing on the first (closed) segment of constructed B-spline curve of the p^{th} degree ($q = 1$), we will divide (for example equally) to H partial intervals using the dividing points

$$u_1 = d_0 < d_1 < d_2 < \dots < d_H = u_2.$$

We will try to look for touching points of tangent curves $z_1^{(j)}, z_2^{(j)}, \dots, z_k^{(j)}$, for integer $j = 1, 2, \dots, H$, which are parallel with secant connecting the point u_1, d_j (because the degree of algebraic equation (5) is less than or equal to $p-1$). For the total number of points k , it is true, that inequality $k \leq p-1$ is valid for all numbers k . We will continue in this process of searching, until the maximum of numbers $\varepsilon_1^{(j)}, \varepsilon_2^{(j)}, \dots, \varepsilon_k^{(j)}$, giving the distance between the relevant tangent of the curve and the secant of the curve, will be less than or equal to the chosen number ε ; for the last number $j = \bar{j}$ we will choose a point d instead of the end point of a line segment, which has the beginning in the point u_1 . In the next step, we will move the point d_j to the place of the point u_1 (as it is common in creating computer programs), and in interval $\langle d_j, u_2 \rangle$ we will continue analogically as in the first case. We will stop when the inequality $d_j \geq u_2$ is true. The result of this type of processing of the first segment of the curve will be a certain sequence of parameters

$$u_1 = d_0 < d_{j_1} < d_{j_2} < \dots < d_{j_w} < u_2, \quad (23)$$

to which the corresponding points on the first segment of the curve will form tops of polygonal trail, meeting formulated task (see abstract).

A situation, where the original choice of the numbers ε and H is unsuitable, could happen (from the point of view of given assignment), and it is therefore necessary to change it.

After processing the first segment of B-spline curve of the p^{th} degree, we will continue in an analogous way when processing the second (closed) segment of the curve (if it exists), realised in a process of choosing two numbers $\varepsilon > 0$ and integer $H \geq 5$, which does not have to be the same as in the first segment, etc. The polygonal trail, constructed of individual polygonal trails of particular segments of the curve, then meets the specified task for the number ε , which is the maximal out of numbers ε for each segments.

It is obvious that the described algorithm of the solution of given assignment requires converting the assignment into computer program. The author of this article created this program.

Example 6. For $n = 5$, let us consider $n + 1 = 5 + 1 = 6$ control points as in Example 1, and for $p = 3$ and $m = n + p + 1 = 5 + 3 + 1 = 9$, nodal vector $U = (U_0, U_1, U_2, \dots, U_8, U_9) = (0, 0, 0, 1, 4, 6, 7, 8, 8, 8)$. A vector $V = (V_0, V_1, V_2, V_3, V_4, V_5) = (0, 1, 4, 6, 7, 8)$ is associated to the vector U . This will be about a construction of opened B-spline curve of the 3rd degree. For $X = U_p = U_3 = 1 = V_1$ follows $t = 1$, for $Y = U_{m-p} = U_6 = 7 = V_4$ follows $tt = 4$, so the constructed B-spline curve of the 3rd degree, designated by given control points, nodal vector U and to this vector relevant B-spline base functions $N_{3,j}$ is composed of $ss = tt - t = 4 - 1 = 3$ (closed) segments. Segments meet each other. The parametrical equations of the first (closed) segment ($q = 1$) are

$$x_1(u) = \frac{-31u^3 + 48u^2 + 1032u + 16}{360}, \quad (24)$$

$$x_2(u) = \frac{95u^3 - 1140u^2 + 3840u - 2320}{720}, \quad (25)$$

where $u \in \langle V_{t+q-1}, V_{t+q} \rangle = \langle V_1, V_2 \rangle = \langle 1, 4 \rangle = I_1$. For example, a computer generated sequence (23) for $\varepsilon = 0.05$ and $H = 8$ is following:

$$1 < 1.375 < 1.703 < 1.99 < 2.493 < 3.058 < 3.529 < 4.$$

The points on the first segment of a curve, corresponding to the tops of the polygonal trail we are looking for are based on (24) and (25). To be sure, for instance we can choose a couple of points $u_1 = 3.058 < 3.529 = u_2$, from this sequence of parameters, and construct an equation of type (5), we will obtain a quadratic equation

$$1.676z^2 + 2 \cdot (1.103)z - 25.461 = 0.$$

Its root, laying between 3.058 and 3.529, is equal to 3.296. The distance of this point, on the first segment of curve with this parameter, that is a touching point of tangent of the curve (which is parallel with a secant containing these two points), is 0.038, that is less than or equal to $\varepsilon = 0.05$.

The parametrical equations of the second (closed) segment of the constructed curve ($q = 2$) are

$$x_1(u) = \frac{229u^3 - 3072u^2 + 13512u - 16624}{360}, \quad (26)$$

$$x_2(u) = \frac{-u^3 + 12u^2 - 57u + 169}{9}, \quad (27)$$

where $u \in \langle V_{t+q-1}, V_{t+q} \rangle = \langle V_2, V_3 \rangle = \langle 4, 6 \rangle = I_2$. For example, a computer generated sequence (23) for $\varepsilon = 0.05$ and $H = 8$ is

$$4 < 4.75 < 5.063 < 5.414 < 5.78 < 6.$$

The points on the second segment of a curve, based on (26) and (27), are corresponding to the tops of the polygonal trail we are looking for.

To be sure, for instance we can choose a couple of points $u_1 = 4 < 4.75 = u_2$, from this sequence of parameters, and we can also construct an equation of the type (5), we will obtain a quadratic equation

$$0.264z^2 - 2 \cdot (1.171)z + 5.179 = 0.$$

Its two roots: $z_1 = 4.21$, $z_2 = 4.659$, are laying between 4 and 4.75. The distance of this point, on the second segment of the curve, with parameter z_1 , that is a touching point of tangent of the curve (which is parallel with a secant containing these two points $4 < 4.75$), is $\varepsilon_1 = 0.024$; for an analogous case, a point with parameter z_2 is $\varepsilon_2 = 0.004$. The $\max\{\varepsilon_1, \varepsilon_2\} = 0.024 \leq 0.05$.

The parametrical equations of the third (closed) segment of constructed curve ($q = 3$) are

$$x_1(u) = \frac{-277u^3 + 5196u^2 - 32160u + 66400}{72}, \quad (28)$$

$$x_2(u) = \frac{-u^3 - 6u^2 + 96u + 28}{36}, \quad (29)$$

where $u \in \langle V_{t+q-1}, V_{t+q} \rangle = \langle V_3, V_4 \rangle = \langle 6, 7 \rangle = I_3$. For example, a computer generated sequence (23) for $\varepsilon = 0.05$ and $H = 8$ is

$$6 < 6.5 < 6.638 < 6.844 < 7.$$

The points on the third segment of a curve, based on (28) and (29), are corresponding to the tops of the polygonal trail we are looking for.

To be sure, for instance we can choose a couple of points $u_1 = 6.844 < 7 = u_2$, from this sequence of parameters, and construct an equation of type (5), we will obtain a quadratic equation

$$2.011z^2 - 2 \cdot (12.592)z + 77.986 = 0.$$

Its root, laying between 6.844 and 7, is equal to 6.915. The distance of this point, on the third segment of curve with this parameter, that is a touching point of tangent of the curve (which is parallel with a secant containing these two points), is 0.046, that is less than or equal to $\varepsilon = 0.05$.

A polygonal trail, constructed out of partial polygonal trails for each segments of the curve, is fulfilling the assignment for $\varepsilon = 0.05$.

4 Conclusions

An approximation of the B-spline curves of the p^{th} degree ($p \geq 1$, integer) by a polygonal trail is described in this article. The approximation of the curve is fulfilling the assignments form abstract. Using a computer program, that the author has created, we solved a problem in Example 6.

References

- Bézier, P. (1972). *Numerical control; mathematics and applications*. London: J. Wiley.
- Boor, C. D. (1972). On calculating with B-splines. *Journal of Approximation Theory*, 6(1), 50-62. doi:10.1016/0021-9045(72)90080-9.
- Böhmer, K. (1974). *Spline-Funktionen; Theorie und Anwendungen*. Stuttgart: B.G. Teubner.
- Dehghan, M., Yousefi, S. A., & Rashedi, K. (2013). Ritz–Galerkin method for solving an inverse heat conduction problem with a nonlinear source term via Bernstein multi-scaling functions and cubic B-spline functions. *Inverse Problems in Science and Engineering*, 21(3), 500-523. doi:10.1080/17415977.2012.701627.
- Dişibüyük, Ç., Budakçı, G., Goldman, R., & Oruç, H. (2013). Generating functions for B-Splines with knots in geometric or affine progression. *Calcolo*, 51(4), 599-613. doi:10.1007/s10092-013-0102-8.
- Gálvez, A., & Iglesias, A. (2013). Firefly Algorithm for Explicit B-Spline Curve Fitting to Data Points. *Mathematical Problems in Engineering*, 2013, 1-12. doi:10.1155/2013/528215.
- Kaňka, M. (2015). Segmented Regression Based on B-Splines with solved Examples. *Statistics and Economy Journal*. 95(4), Prague, 47-66.

- Kaňka, M. (2016). *Segmented Regression Based on Cut-off polynomials*. *Statistics and Economy Journal*, 96(2), 60-72.
- Makarov, V. L., & Chlobystov, V. V. (1983). *Splajn-approximacija funkcij: Učebnoe posobie dlja studentov*. Moskva: "Vysšaja Škola".
- Meloun, M., Militký, J. (1994). *Statistické zpracování experimentálních dat*. Praha: Plus.
- Meyer, K. (2005). *Random regression analyses using B-splines to model growth of Australian Angus cattle*. *Genetics Selection Evolution Genet. Sel. Evol.*, 37(5), 473-500. doi:10.1051/gse:2005012.
- Schrutka, L. (1941). *Leitfaden der Interpolation*. Wien: Springer-Verlag.
- Vasilenko, V. A. (1983). *Splajn-funkcii: Teorija, algoritmy, programmy*. Novosibirsk: Izd. "Nauka".
- Zakharov, V. G. (2014). *Elliptic Scaling Functions As Compactly Supported Multivariate Analogs Of The B-Splines*. *Int. J. Wavelets Multiresolut Inf. Process. International Journal of Wavelets, Multiresolution and Information Processing*, 12(02), 1450018. doi:10.1142/s0219691314500180.

On Utility Function for Money

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Abstract: *It is well-known, that in decision analysis, it is worth to use utility function. It is a way how to make a better individual decision than in case without application of utility function. In this paper we present a way how to construct a utility function for money and how to use it for a solution of St. Petersburg paradox.*

Key words: St. Petersburg paradox · Utility function for money · Expected profit

JEL Classification: C44 · D80

1 Introduction

The aim of this paper is to introduce a utility function for the money. In decision theory, it is well-known that without applying utility function, we cannot obtain relevant results. In the models of decision theory, the utility function is very often omitted, because it is easier to suppose that the utility function is linear, hence it is not necessary to do computations with it.

However, if we omit a utility function, we do not obtain such good (subjective) results as in case when we take a care about a utility function. The aim of this paper is to introduce a utility function for money, introduce the construction of this function and explain on St. Petersburg paradox a usage of utility function for money.

2 Methods

2.1 Saint Petersburg Paradox

First, let us recall a St. Petersburg paradox. St. Petersburg paradox or St. Petersburg lottery was invented by Nicolas Bernoulli in 1713. As it is known, it first appeared in a letter to Pierre Raymond de Montmort. The name of the paradox comes from the name of the city, where the resolution for this paradox was given by a cousin of Nicolas Bernoulli – by Daniel Bernoulli. Daniel Bernoulli published his arguments in the Commentaries of the Imperial Academy of Science of Saint Petersburg (today it is called Russian Academy of Science) in 1738.

St. Petersburg paradox is a problem partly from decision analysis, partly from probability theory. It is supposed a following game – game for a single player. In this game, a fair coin is tossed and it is computed the number of heads before the first tail is appeared – let us call it H . Then the player wins 2^H , where, as mentioned before, H is the number of tosses before the first tail appeared.

The question is what the price of this game is. It means, what is the price which is a player able to respect for this game. More precisely, what is the highest price which is the player able to pay for the possibility to play this game? (It is clear, that a player cannot lost in this game, in the worst case she/he wins only 1, but she/he can win 2, 4, 8, ...)

Why is this problem called a paradox? The reason is that, usually, players are willing to pay maximally about \$10 for a change to play this game. However, when we decide to compute the expected payoff of this game, the result is (surprisingly!) infinity. Therefore, why nobody offers for example \$ 100 for a possibility to play this game?

Is it really an expected payoff of this game infinity? Let us compute it. As we mentioned above, there are following possible results - in case when we toss the coin and tail is first, there is no head, the payoff is $2^0 = 1$. This result is achieved with probability $1/2$. In case when we toss the coin and first we have head and then tail; the result is one head, the payoff is $2^1 = 2$ and this result is achieved with a probability of $1/2^2 = 1/4$.

Hence, we can see that the possible results and their probabilities are as follows.

Table 1 Possible results in St. Petersburg Paradox

Possible results				
Result	Number of heads	Probability	Payoff	Payoff * Probability
T	0	1/2	$2^0=1$	1/2
HT	1	1/4	$2^1=2$	1/2
HHT	2	1/8	$2^2=4$	1/2
HHHT	3	1/16	$2^3=8$	1/2
HHHHT	4	1/32	$2^4=16$	1/2
HHHHHT	5	1/64	$2^5=32$	1/2
HHHHHHT	6	1/128	$2^6=64$	1/2
...

Now let us recall the formula for expected value. The value of payoff of this game is a discrete random variable, the well-known formula for expected value of discrete random variable is:

$$E V = \sum_{i=0}^{+\infty} v_i \cdot p_i,$$

where i -s are possible results of this game, p_i is a probability of result i and v_i is a payoff in case of result i . Hence, we can see from our previous table that for each i , the multiplication $v_i \cdot p_i$ is equal to $\frac{1}{2}$, therefore the sum of $v_i \cdot p_i$ is equal to infinity.

So, why do not players offer a higher price for this game although their expected profit is equal to infinity?

Is the calculation correct? Yes, it is. However, the convergence is very slow, for more details see Feller (1945); hence the following remarks can be raised up. First – are we able to pay all possible payoffs of this game? What is the expected payoff in case when we admit that we have only finite amount of money. Let us suppose that somebody is willing to pay up to $\$2^{10} = \1024 , respectively if he collects all his money, which he has; he can pay up to pay off after 17 heads - $\$2^{17} = \131072 . The payoff of the game after 35 heads is equal to the value of US national gold reserve which is saved at Fort Knox and after 38 heads it is equal to the value of all bank deposits in US dollars in the USA. Would the expected payoff change under these new assumptions? Let us recalculate the value of the game under these conditions – let us consider the same game, but suppose the highest possible payoffs. More precisely, we consider the same game, but in case of higher supposed payoff then it is possible, we pay only the highest possible one.

New values of the game are given in the following table.

Table 2 Values of St. Petersburg Paradox in case of finite possible result

Possible results			
Case	Maximal possible payoff (US \$)	Number of heads for this payoff	Value of the game (US \$)
Friend	256	8	5
Standard	1024	10	6
Risk	131072	17	9.5
Millionaire	1048576	20	11
Bill Gates (2015) ¹	68719476736	36	19
US golden reserve	$8.79 \cdot 10^{12}$	43	22.5
US bank deposits	$35.18 \cdot 10^{12}$	45	23.5

¹ – Bill Gates', US golden reserve and US bank deposits payoffs according to Wikipedia.com

Second argument, why and how to recalculate the result is to admit that the time for the game is finite. There is supposed that the game might take theoretically indefinitely (theoretically I can still have head and head and head ..., one day, second day, and still head and head....), what is not doable. Hence, also in case, when we suppose that it is not a problem for us to pay every possible payoff, we should state that there is some finite number of possible tosses (= finite time for a game).

Next argument comes from probabilities of expected payoffs – more precisely, let us suppose that we offer \$ X for the possibility to play this game. What is the probability that our payoff would be higher than X ? For example, it is easily seen that with probability $\frac{1}{2}$, the payoff is \$2 or more, only with probability $\frac{1}{4}$, it is more than or equal to 4; only with probability $\frac{1}{8}$, it is 8 or more and so on. Therefore, the argument is, why to pay such value if only with such low probability I may have some profit?

The last argument, which we want to mention here, is that we do not consider a utility. If we calculate expected profit, expected payoff, we do not consider that our utility from money is not a linear function. So, let us consider the utility function. (By the way, it was a solution given by Daniel Bernoulli – application of utility function.)

2.2 Construction of utility function for money

Now, let us suppose, theoretically, that we can pay every possible payoff and we can play the game as long as is necessary. Does there exist some solution of this paradox also in this case? Yes, it is possible to solve this problem, too. We can apply a utility function for money.

In the previous analysis, we supposed that the utility function for money is linear (we do not use any transformation, so it was supposed to be linear). However, it is known, the utility function for money is a concave function. Even, by economists, it is considered that the utility function for money has a form

$$u(x) = a + b \cdot \exp\left(-\frac{x}{c}\right),$$

where a, b, c are constants. Everybody has his own values of these constants. So, our aim is to find a way how to estimate values of these constants. To estimate individual constants, we first need to know at least several points from individual utility function for money.

Hence, the first task is to get some points from individual utility function for money. There are two main possible ways how to do it. First one is more complicated and gives better results; the second one is very easy but not too precise.

Estimation of parameters a, b, c

Let us start with the first one. First, we need to know some points from the utility function for money; it means we need to find for some amount of money the utility from this amount of money. We can suppose (it is not necessary) that the utility of \$ 0 is equal to zero, hence we put $u(0) = 0$. (Sometime, especially in case when we want to construct a utility function for money for some concrete lottery, where we have already decided to pay the price for the ticket to this lottery, we omit this requirement and we put utility from “–price of the ticket” is equal to zero. More precisely, we put $u(-p) = 0$, where p is the price of the ticket.)

Then we need to know some other point of the utility function, usually, we want to know the highest value of the utility (usually we put it to be equal to 1, but it is not necessary, too). More precisely, in this case, we search for such amount of money that the decision maker is not able to recognize if she/he has this amount of money or if she/he has more. Mathematically, we search for x such that for all $y \geq x: u(y) \approx u(x)$. And we put $u(x) = 1$ (does not matter if it is equal to 1 or to some other constant). Then we know the value of our utility function at two points. We would like to apply regression analysis to estimate values of constants a, b, c , so it is necessary to know more points of our utility function. To get others points, we can apply following formula

$$u(x) = p \cdot u(y) + (1 - p) \cdot u(z). \quad (1)$$

What does it mean? If we know utility at points y and z , then we can use two types of questions. First, we ask the decision maker to identify the (definitely obtaining) payoff (it would be x) which is indifferent (for her/him) to payoff of y with probability p or payoff of z with probability $1 - p$. Then, we apply a formula above and receive a utility at the point x .

Second possibility, how to apply previous formula is – in case, when we would like to get utility at some point x - we choose two known points of the utility function (say y, z) and put the following question. What is the value of probability p such that the decision maker is indifferent between a definitely obtaining a payoff of x or a payoff of y with probability p and a payoff of z with probability $1 - p$.

Hence, we can see that if we know two points of our utility function, we can generate so many other points as we need. However, if we would like to do some computations with utility function, we need to know whole function. It means to estimate the parameters a, b, c . It is well known, that if we know that our utility function is in the above mentioned form, and we know several points of this function, we can apply a regression analysis to estimate parameters of the function. To finish calculations, we can use some statistical software.

Utility function with only one parameter

As was promised above, there exists a second – easier - way how to estimate a utility function. Now, a utility function is consider to be in the following form

$$u(x) = R \left(1 - \exp\left(-\frac{x}{R}\right) \right)$$

where R is an individual constant. It is easily seen, that this form of utility function is a special case of the previous one. In the previous case, it is more complicated to obtain the parameters; on the other hand the result is more precise. In this case we have only one parameter. There are two main ways how to estimate a parameter. One possibility is to apply the same method as in the previous case – to find several points of the utility function and then to use a regression analysis. However, it is quite complicated, too.

Thus, it would be better to use a special construction of utility function and search R as follows. In Hillier, Lieberman (2001), there is recommended to ask a decision maker (question (1)) to identify such R that she/he is indifferent between two following situations:

- She/he gains R dollars with probability 0.5 and lose $\frac{R}{2}$ dollars with probability 0.5,
- Neither gain nor lose anything.

When a decision maker identifies an R , we have an estimation of her/his utility function of money and we can apply it for a decision problem. The idea comes from the equation $\frac{1}{2} u(R) + \frac{1}{2} u(-R/2) \approx 0 = u(0)$. However, if we check this equation, we can see that it fails for R too big. Hence, it seems better for us to estimate R in the following way – to ask a decision maker to identify M such that she/he cannot almost recognize if she/he has M or $2M$ and then put $R = \frac{1}{10} M$.

3 Research results

3.1 Application of utility function in decision theory

When we have already estimated a utility function, or when we know it exactly, it is very easy to apply the utility function to our decision problem. It is enough to apply our utility function to all possible results of the game or experiment and to compute all expected values or decision making rules with this function. For expected values, it means that we compute an expected utility instead of expected payoff.

3.2 Calculations

In this part, let us show, how to estimate parameters of the utility function for money and then, how to apply a known (or estimated) utility function to St. Petersburg paradox.

We show how to estimate parameters of the utility function in the form (1). The estimation of parameter R was described above. To estimate parameters a, b, c , we need first to know some points of our utility function. We can put $u(0) = 0$ and we ask a decision maker what is the highest - M - amount of money which is she/he able to recognize (in the sense that she/he is indifferent between the situation to have M dollars and the situation to have more than M).

Let us suppose that the answer is \$ 1 000 000, $M = 1\,000\,000$. Thus, we can put $u(1\,000\,000) = 1$ and now, we already know two points of a constructed utility function.

To obtain next points, we need to apply formula (1); therefore, we should ask a decision maker in following ways.

- Suppose, that there is such a game in which you may gain \$ 1 000 000 with probability $\frac{1}{2}$ or to get nothing with probability $\frac{1}{2}$. What is the highest price which you offer for a possibility to play this game? (Sure, the answer depends on the finance situation of a decision maker, too. The solution is individual.)

Let us suppose that the answer is \$ 10 000.

In such case, we get, if we apply the equation (1): $u(10000) = 0.5 u(1000000) + 0.5 u(0) = 0.5$ that a utility from \$ 10 000 is equal to $\frac{1}{2}$.

- We continue in the same way and obtain:

$$\begin{aligned} u(1000) &= 0.5 u(10000) + 0.5 u(0) = 0.25, \\ u(250) &= 0.5 u(1000) + 0.5 u(0) = 0.125, \\ u(100) &= 0.5 u(250) + 0.5 u(0) = 0.25, \\ u(2000) &= 0.5 u(1000000) + 0.5 u(1000) = 0.75. \end{aligned}$$

- Now, let us look at the points of our utility function and let us decide that we need to know the utility at the point 50000. Hence, we can rise up the following question: Suppose that you pay \$ 50000 for a possibility to play a game in which you may gain \$ 1 000 000 with probability p or to get nothing with probability $1 - p$. What must be the value of p you would be willing to play this game? If the answer is p at least equal to 0.95, we get

$$u(50000) = 0.95 u(1000000) + 0.05 u(0) = 0.95$$

Using the same questions and arguments, we derive $u(5000) = 0.9 u(10000) + 0.1 u(0) = 0.45$ and $u(100000) = 1 u(1000000) + 0 u(0) = 1$.

Now, we know the values of the utility function at 11 points, let us summarize these result in the following table.

Table 3 Some points of utility function

Utility function	
Value	utility
0	0
100	0.0625
250	0.125
1000	0.25
2000	0.35
5000	0.45
10000	0.5
20000	0.75
50000	0.95
100000	1
1000000	1

Hence, we can estimate the parameters a, b, c . To do it, we can apply a regression analysis to estimate values of our constants a, b, c . It is not a trivial problem, because it is a case of nonlinear estimation with problems of local extremes. However, we can make this problem easier, if we recall that we decided to put $u(0) = 0$ and $\lim_{x \rightarrow +\infty} u(x) = 1$. Under these conditions, we get (if $c > 0$)

$$\begin{aligned} u(0) &= a + b \cdot \exp\left(-\frac{0}{c}\right) = a + b: a = -b \\ \lim_{x \rightarrow +\infty} u(x) &= a + \lim_{x \rightarrow +\infty} \exp(-x/c) = a: a = 1, \quad b = -1. \end{aligned}$$

Now, it is enough to estimate a constant c . To do it, we can use some statistical software or, to use an Excel add-in – Solver. The aim is to find c such that the estimated function best fit known points of the function in the sense of SSE (Sum of Square Errors). Hence, we run Solver to minimize the SSE with only one variable c (or with three variables a, b, c under the conditions that $a = -b = 1$).

Fix $a = 1, b = -1$ and apply Solver to estimate c ; we get $c = 10780.55$.

Therefore, we obtained the utility function in the form

$$u(x) = 1 - \exp\left(-\frac{x}{10780,55}\right).$$

Now, we can apply this utility function to St. Peterburg paradox. Let us use this function and compute an expected utility.

$$E u(x) = \sum_{i=0}^{+\infty} u(x_i) \cdot p_i = \sum_{i=0}^{+\infty} \left(1 - \exp\left(-\frac{2^i}{10780,55}\right)\right) \cdot \frac{1}{2^{i+1}} = 0.0006728$$

To identify the value of the game, we need to find x such that $u(x) = 0.0006728$. Therefore, we can derive

$$x = -10780.55 \ln(1 - 0.0006728) = 7.26$$

What does our result mean? We derived that even if we admit all payoffs as possible and we admit infinitely long game, the price of game should not exceed for a chosen decision maker 7.26 (for another decision maker, his utility function could differ, but the result probably would not be too different). Hence, we showed that it was worth to apply a utility function for money for a decision problem. Applying the utility function, we achieved a meaningful result. We can also choose the second approach to the construction of the utility function, ask the decision maker the question (1), we get his R and apply the same procedure as with more complicated utility function. If we choose $R = 10000$ (by the construction of previous utility function, we got that utility at $100\,000$ is the same as utility at $1\,000\,000$), compute the value of the game to be equal to \$ 8.86.

4 Conclusions

In the paper we show, that it is worth to apply a utility function for money on decision-making problem. We show how to construct this utility function and we demonstrate on St. Petersburg's paradox how to use this function on decision-making problem.

References

- Feller, W. (1945). Note on the law of large numbers and "fair" games. *The Annals of Mathematical Statistics*, 16(3), 301-304.
 Dehling, H. G. (1997). Daniel Bernoulli and the St. Petersburg Paradox. *Nieuw archief voor wiskunde*, 15, 223-228.
 Hillier, F. S., & Lieberman, G. J. (2001). *Introduction to Operations Research*, McGraw Hill. New York.
 Wikipedia (2016). Available from: https://en.wikipedia.org/wiki/St._Petersburg_paradox.

Comparison of Multi-Output Frontier Models: Application to Slovak Agriculture

Bohuš Kollár, Zlata Sojková

Abstract: *In this paper the multiple output distance function is used to investigate the technical efficiency of the Slovak agricultural subjects. The main aim of this paper is to compare the results of two chosen stochastic frontier models, namely ratio model and ray model. Furthermore, the effect of Common Agricultural Policy subsidies on the efficiency of farms is estimated. The technical efficiency is studied on the balanced panel data consisting of 308 agricultural subjects for the 7 periods of years 2007-2013. The data is drawn from the Information Sheets of the Ministry of Agriculture and Rural Development of Slovak Republic. The applied distance functions eliminate the main disadvantage of the stochastic frontier analysis. Hence, allowing for the multiple outputs in the analysis. In this paper, there are two outputs considered, namely animal breeding revenues and crop production revenues. The main findings of this paper are similar to the results of previous research. There is a high degree of correlation between the models' estimated efficiencies. The correlation coefficients range from 0.71 to 0.82 for the studied period. Furthermore, the pairwise comparison of the efficiency scores proves no significant difference between the models' estimations. Considering the effect of the subsidies on the efficiency of farms, both models prove the statistically significant impact of the non-investment subsidies. The considered ratio model and ray model not only give similar efficiency estimates, but also similar interpretation of the chosen variables.*

Key words: Agriculture · Efficiency · Multiple Output · Ratio Model · Ray Model · Stochastic Frontier Analysis · Subsidies

JEL Classification: C33 · C52 · H21 · Q14

1 Introduction

There are several ways in which the production technology can be represented. Describing such a technology is mostly performed applying the production, cost, profit or revenue functions. Additionally, input and output distance functions can be used in the research of a production technology (Coelli and Perelman, 1998). Motivation for empirical estimation is to calculate the efficiency of studied decision making units (DMUs).

The main advantage of distance function application is that it allows for the multiple-input, multiple-output technology. However, most of the analyses apply only one of the methods to estimate the efficiency. Studies by Coelli and Perelman (1998), Zhang and Garvey (2008) or Rashidgalam et al. (2016) compare results of various distance functions.

Traditionally, there are two main groups of methods to measure efficiency, namely:

- linear programming model – data envelopment analysis (DEA),
- econometric model – stochastic frontier analysis (SFA).

Methods mentioned above have their advantages and disadvantages. DEA can be quite easily used for the multiple-input, multiple-output technology estimation and does not require the specification of the functional form of the production frontier. On the other hand, as a deterministic method, DEA does not account for the statistical noise and all the deviations from the frontier are assigned to the inefficiency of the DMU. SFA handles the statistical noise, but requires the underlying functional form of the production frontier. In addition, the SFA cannot be directly used for the multiple-input, multiple-output frontier estimation. Certain adjustments have to be made in order for SFA to be suitable for multi-product analysis. Such adjustments result in two types of models compared in this paper:

- stochastic distance function model or ratio model (Fare et al., 1993, Lovell et al., 1994),
- stochastic ray frontier (Lothgren, 1997).

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Furthermore, there are alternative approaches to estimating the technical efficiency in the stochastic frontier models. Acquah and Onumah (2014) compared Jondrow et al. (1982) and Battese and Coelli (1988) approaches. Most of the papers apply only one of these approaches. Exception is Hoyo et al. (2014). Results of the co-existing approaches of estimation based on the simulated data show that although the actual values differ, there is strong positive correlation between results. The difference exists in the variance of the efficiency scores where Battese and Coelli (1988) approach gives results with smaller variance (Acquah and Onumah, 2014).

Efficiency in agriculture

Analysis in this paper focuses on the Slovak agricultural subjects. Agriculture is typical for the multiplicity of outputs. Most of the agricultural subjects produce crop and animal outputs. Agriculture and Common Agriculture Policy (CAP) subsidies are subject of the number of studies focusing on the efficiency of farms and the impact of the subsidies.

As mentioned earlier, the estimation of the efficiency is usually conducted with the application of the DEA or the SFA. Applying the SFA, the efficiency of Slovak and Czech milk producers was compared. Metafrontier multiple output distance function revealed regional differences, where only West Slovak regions could keep up with competitors from Czech Republic (Čechura et al., 2014). Using the same approach (i.e. SFA) the impact of subsidies from the Rural Development Programme 2007-2013 was studied for the Czech Republic by Pechrová (2015). Results for the panel data on 454 farms show statistically significant differences of efficiency between supported and unsupported farms. Furthermore, applying the contrafactual analysis, the impact of the investment support measures was researched by Medonos et al. (2012). The analysis shows, that the bigger farms were favoured as these have easier access to loans and hence, easier access to investment subsidies. In addition, the investment support had positive effect on the added value and productivity.

The SFA was further applied in the research of the technical efficiency of organic and biodynamic farms in Czech Republic. Applying the Cobb-Douglas specification with one output on the panel data of years 2005-2012 suggests that the subsidies had positive effect on the production possibilities. (Pechrová and Vlačicová, 2013). On the other hand, multiple-output distance function was used in comparison of EU countries' crop production. The estimation results proved no significant differences between efficiencies of the countries. Given the CAP goal of improving the competitiveness of the farms, this occurred in 6 old and 2 new member states, i.e. moved nearer to production frontier (Čechura et al., 2015).

For the further research on the efficiency in agriculture see Brummer et al. (2016), Pechrová (2014), Revoredo-Giha (2009), Madau (2011).

The paper is organized as follows, section 2 describes the methods of efficiency estimation and data used in this paper, section 3 describes the obtained results, section 4 concludes.

2 Methods

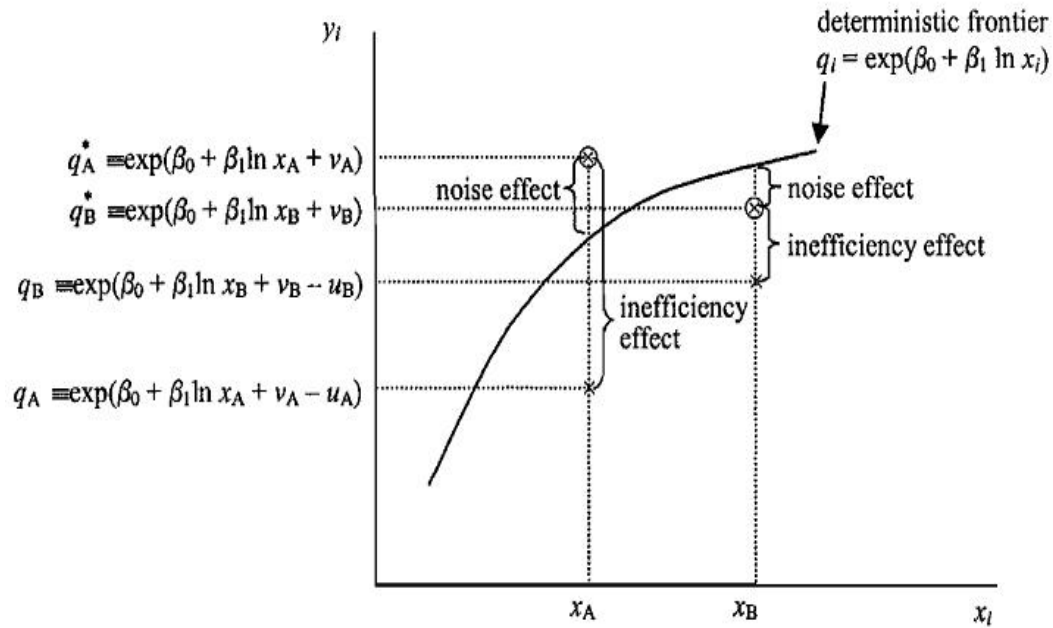
As mentioned before, the aim of this paper is two-fold. The focus is put on the comparison of the two SFA approaches of efficiency estimation, namely:

- stochastic distance function model or ratio model (Fare et al., 1993, Lovell et al., 1994),
- stochastic ray frontier (Lothgren, 1997).

Initially proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977) the SFA allows for the estimation of the production function model given by the Equation 1:

$$\ln(y) = \alpha + \beta * \ln(x_i) + v_i - u_i \quad (1)$$

The SFA accounts for the fact that the quantity of i 's firm output is influenced not only by the efficiency of a subject but also by the noise effect (v_i). Deviation from the frontier is known as the compound error term, where the noise effect (v_i) represents impact of random external factors and can be positive or negative (Greene, 2008). Therefore, SFA model (Eq. 1) consists of three parts, namely deterministic frontier, noise effect and inefficiency (Figure 1)

Figure 1 Three parts of the stochastic frontier

Source: Coelli et al., 2005

Measure of i 's farm technical efficiency (TE) is computed as:

$$TE_i = \exp(-u_i) \quad (2)$$

This measure (Eq. 2) takes values 0 - 1 and represents quantity of i 's farm output relative to the output achievable if the inputs had been used efficiently. The SFA assumptions are:

- v_i is symmetrically distributed,
- v_i and u_i are independent and identically distributed variables,
- v_i is distributed independently of u_i and both error terms are uncorrelated with the explanatory variables,
- v_i and u_i are homoskedastic (Coelli et al., 2005).

2.1 Stochastic distance function for multiple output technical efficiency

The major disadvantage of the SFA is that only one output can be included in the analysis. Fare et al. (1993) introduced the distance function in estimating the multiple product technology. The technology is specified as a translog function. However, the value of the distance function cannot be directly estimated. An approach to overcome this problem was suggested by Lovell et al. (1994, Eq. 3)

$$\ln D_i(X, Y) = \ln Y_L + \ln D_i(X, Y/Y_L) \quad (3)$$

In the Eq. 3, the Y is a vector of outputs of dimension L and Y_L is arbitrarily chosen output. However, Eq. 3 has to be further adjusted to the final form, which can be then estimated (Eq. 4, Zhang and Garvey, 2008)

$$\begin{aligned} -\ln Y_L = & \alpha_0 + \sum_{k=1}^K \alpha_k \ln X_k + \sum_{l=1}^L \beta_l \ln \left(\frac{Y_l}{Y_L} \right) + \frac{1}{2} \sum_{k=1}^K \sum_{k'=1}^K \alpha_{kk'} \ln X_k \ln X_{k'} + \sum_{k=1}^K \sum_{l=1}^{L-1} \gamma_{kl} \ln X_k \ln \left(\frac{Y_l}{Y_L} \right) + U_i \\ & + \frac{1}{2} \sum_{l=1}^L \sum_{l'=1}^L \beta_{ll'} \ln \left(\frac{Y_l}{Y_L} \right) \ln \left(\frac{Y_{l'}}{Y_L} \right) \end{aligned} \quad (4)$$

From the Eq. 4, the technical efficiency can be calculated as:

$$TE_i = \exp(-U_i) = D_i(X, Y) \quad (5)$$

2.2 Stochastic ray frontier

Lothgren (1997) generalized the multi-output ray function using a polar-coordinate angle output vector. This function can be rewritten as:

$$Y = \|Y\| \cdot m(\theta) \quad (6)$$

$$\|Y\| = (\sum_{i=1}^P Y_i^2)^{1/2} \quad (7)$$

In Eq. 7, the P represents the number of outputs.

Applying the number of adjustments, the natural log-linear stochastic ray function suitable for the empirical analysis can be written as:

$$\begin{aligned} \|Y\| = & \alpha_0 + \sum_{k=1}^K \alpha_k \ln X_k + \sum_{l=1}^L \beta_l \ln \theta_l + \frac{1}{2} \sum_{k=1}^K \sum_{k'=1}^K \alpha_{kk'} \ln X_k \ln X_{k'} + \frac{1}{2} \sum_{l=1}^L \sum_{l'=1}^L \beta_{ll'} \ln \theta_l \ln \theta_{l'} + \\ & \sum_{k=1}^K \sum_{l=1}^L \gamma_{kl} \ln X_k \ln \theta_l - U \end{aligned} \quad (8)$$

In Eq. 8, the θ stands for the polar-coordinate angle, K denotes the number of inputs and L equals $P-1$. Note that P represents the number of outputs.

For more details see Zhang and Garvey (2008).

2.3 Data and variables

In this paper, the efficiency of Slovak agricultural subjects is studied with the main aims of comparing the two SFA methods and assessing the impact of CAP subsidies on the efficiency of farms. Both methods described earlier are applied on the same balanced panel data consisting of 308 farms for the years 2007-2013. The data is drawn from the Information Sheets of the Ministry of Agriculture and Rural Development of Slovak Republic. Given the data's financial nature, the appropriate indices drawn from the Eurostat are used to adjust for inflation and to express the financial entries in the 2014 prices.

The analysis is conducted using the crop revenues and animal breeding revenues as the outputs. For the stochastic distance function the animal revenue output is chosen as the Y_L (see previous chapter). The inputs are capital, average wage, farmed land (area), long-term assets acquirement (LTAA) and total amount of subsidies. Investment subsidies, non-investment subsidies, national additional payment, LTAA and subsidies from the Rural Development Programme 2007-2013 are used for the explanation of the variance of the inefficiency.

3 Research results

The results are obtained with the use of two statistical programmes. The stochastic ray frontier is modelled in the R-software. The rest of the analysis, i.e. the stochastic distance function and comparison of results is conducted in the STATA 13.

3.1 Frontier models estimation

The stochastic distance function model is presented in Table 1, stochastic ray function in Table 2. Following the previous chapter, estimation of both models is conducted using the same dataset of 308 farms for the years 2007-2013, which is also the programming period for the Rural Development Programme (RDP).

Comparing the two models (Table 1 and Table 2), the highest coefficient in both frontier models is estimated for the variable Wage, i.e. this variable has the highest elasticity. Furthermore, both models' results signify negative impact of the long-term assets acquirement and the amount of subsidies on the production level. However, the significance of these variables differs. Given the fact that the panel data is used, one of the variables of the interest is the time variable. It can be concluded that neither of the considered models proved the time variable to be statistically significant.

Table 6 Stochastic distance function model

Variable	Coef.	Std. Err.	z	P> z	95% Conf. Interval	
Capital	1.481	0.865	1.710	0.087	-0.215	3.177
Wage	18.064	4.053	4.460	0.000	10.120	26.008
Farmed land	8.388	2.544	3.300	0.001	3.401	13.375
LTAA	-0.266	0.600	-0.440	0.657	-1.442	0.910
Subsidies	-8.568	2.015	-4.250	0.000	-12.518	-4.618
Time	0.863	0.665	1.300	0.194	-0.440	2.167
Crop / Animal	0.266	0.032	8.190	0.000	0.202	0.330
Capital*Capital	4.264	0.590	7.230	0.000	3.108	5.420
Capital*Wage	-0.998	0.164	-6.100	0.000	-1.318	-0.677
Capital*Farmed land	-1.180	0.148	-8.000	0.000	-1.470	-0.891
Capital*LTAA	-0.079	0.031	-2.540	0.011	-0.140	-0.018
Capital*Subsidies	0.633	0.124	5.120	0.000	0.391	0.876
Capital*Time	0.024	0.102	0.230	0.817	-0.176	0.224
Wage*Wage	-1.968	0.477	-4.120	0.000	-2.903	-1.033
Wage*Farmed land	-0.763	0.515	-1.480	0.139	-1.773	0.247
Wage*LTAA	0.122	0.130	0.940	0.348	-0.133	0.377
Wage*Subsidies	1.472	0.424	3.470	0.001	0.641	2.303
Wage*Time	0.326	0.140	2.320	0.020	0.051	0.601
Farmed land*Farmed land	1.371	0.262	5.240	0.000	0.858	1.884
Farmed land*LTAA	0.113	0.099	1.140	0.253	-0.081	0.308
Farmed land*Subsidies	-1.030	0.278	-3.700	0.000	-1.576	-0.484
Farmed land*Time	0.335	0.188	1.780	0.075	-0.033	0.704
LTAA*LTAA	0.022	0.005	4.130	0.000	0.012	0.033
LTAA*Subsidies	-0.053	0.066	-0.810	0.420	-0.182	0.076
LTAA*Time	0.079	0.053	1.470	0.141	-0.026	0.184
Subsidies*Subsidies	0.128	0.021	5.990	0.000	0.086	0.170
Subsidies*Time	-0.453	0.158	-2.870	0.004	-0.762	-0.143
Time*Time	-0.607	0.087	-7.000	0.000	-0.777	-0.437
(Crop/Animal)*Capital	-0.039	0.018	-2.150	0.031	-0.074	-0.004
(Crop/Animal)*Wage	-0.313	0.065	-4.780	0.000	-0.441	-0.184
(Crop/Animal)*Farmed land	-0.302	0.044	-6.890	0.000	-0.387	-0.216
(Crop/Animal)*LTAA	0.002	0.013	0.190	0.849	-0.023	0.028
(Crop/Animal)*Subsidies	0.419	0.042	9.860	0.000	0.336	0.502
(Crop/Animal)*Time	-0.072	0.026	-2.750	0.006	-0.124	-0.021
Constant	-59.002	20.154	-2.930	0.003	-98.504	-19.500
Insig2v	-2.361	0.096	-24.610	0.000	-2.549	-2.173
Inefficiency model						
Subsidies	-0.403	0.039	-10.400	0.000	-0.478	-0.327
Non-invest. Subs.	0.027	0.074	0.370	0.715	-0.118	0.173
Invest. Subs	-0.006	0.015	-0.400	0.686	-0.035	0.023
Top-up payment	-0.029	0.015	-1.850	0.064	-0.059	0.002
Non-invest RDP	0.163	0.012	14.060	0.000	0.140	0.186
Invest. RDP	0.010	0.016	0.600	0.545	-0.022	0.042
LTAA	-0.191	0.040	-4.780	0.000	-0.270	-0.113
Constat	6.693	0.853	7.850	0.000	5.021	8.365

Source: Own processing

Table 7 Stochastic ray model

Variable	Coef.	Std. Err.	z	P> z
Capital	2.180	1.207	1.805	0.071
Wage	16.925	2.569	6.589	0.000
Famed land	0.366	0.478	0.767	0.443
LTAA	-1.375	0.467	-2.942	0.003
Subsidies	-0.720	0.441	-1.634	0.102
Time	0.072	1.080	0.067	0.947
Capital*Capital	0.649	0.065	9.947	0.000
Capital*Wage	-0.273	0.127	-2.160	0.031
Capital*Famed land	-0.087	0.030	-2.882	0.004
Capital*LTAA	-0.133	0.027	-4.895	0.000
Wage*Wage	-1.848	0.252	-7.344	0.000
Capital*Subsidies	-0.035	0.022	-1.635	0.102
Wage*Famed land	-0.010	0.048	-0.215	0.830
Capital*Time	-0.887	0.061	-14.527	0.000
Wage*LTAA	0.160	0.050	3.215	0.001
Wage*Subsidies	0.070	0.051	1.355	0.175
Wage*Time	-0.812	0.117	-6.946	0.000
Famed land*Famed land	-0.033	0.016	-1.989	0.047
Farmed land*LTAA	0.001	0.009	0.072	0.942
Farmed land*Subsidies	0.015	0.012	1.282	0.200
Farmed land*Time	1.144	0.039	29.362	0.000
LTAA*LTAA	0.099	0.009	10.636	0.000
LTAA*Subsidies	-0.003	0.008	-0.417	0.677
LTAA*Time	-0.230	0.028	-8.192	0.000
Subsidies*Subsidies	0.029	0.007	3.973	0.000
Subsidies*Time	-0.059	0.027	-2.162	0.031
Time*Time	-0.237	0.153	-1.544	0.123
Constant	-66.051	13.857	-4.767	0.000
Inefficiency model				
Subsidies	-0.016	0.097	-0.167	0.868
Non-invest. Subs.	0.239	0.139	1.716	0.086
Invest. Subs	-0.065	0.042	-1.541	0.123
Top-up payment	-0.031	0.024	-1.272	0.203
Non-invest RDP	0.429	0.076	5.623	0.000
Invest. RDP	0.017	0.043	0.388	0.698
LTAA	-0.858	0.113	-7.577	0.000
sigmaSq	3.130	0.603	5.187	0.000
gamma	0.958	0.009	105.409	0.000

Source: own processing

For both models, there are variables chosen for the explanation of the inefficiency term, as described in the previous chapter. Once again, the models (Table 1 and Table 2) give similar results. The variables non-investment subsidies from the RDP 2007-2013 and long-term assets acquirement proved to be statistically significant with the same direction of the relation to the inefficiency. While the non-investment RDP subsidies appear to increase the variance of the inefficiency term, the long-term assets acquirement significantly decreases such variance. Other variables chosen for the explanation of the inefficiency term did not prove to be statistically significant.

3.2 Comparison of the efficiency scores

Estimation of the efficiency scores follows the estimation of the models. The comparison is conducted with the use of correlation coefficient and the test of equality of medians. The higher the correlation coefficient, the tighter the results of stochastic distance function and stochastic ray function. The null hypothesis for the chosen test states that the medians of models' efficiency scores are equal. If the null hypothesis stands, we consider the results of the models to be the same, i.e. neither of the models gives out significantly higher (lower) efficiency scores. (Table 3).

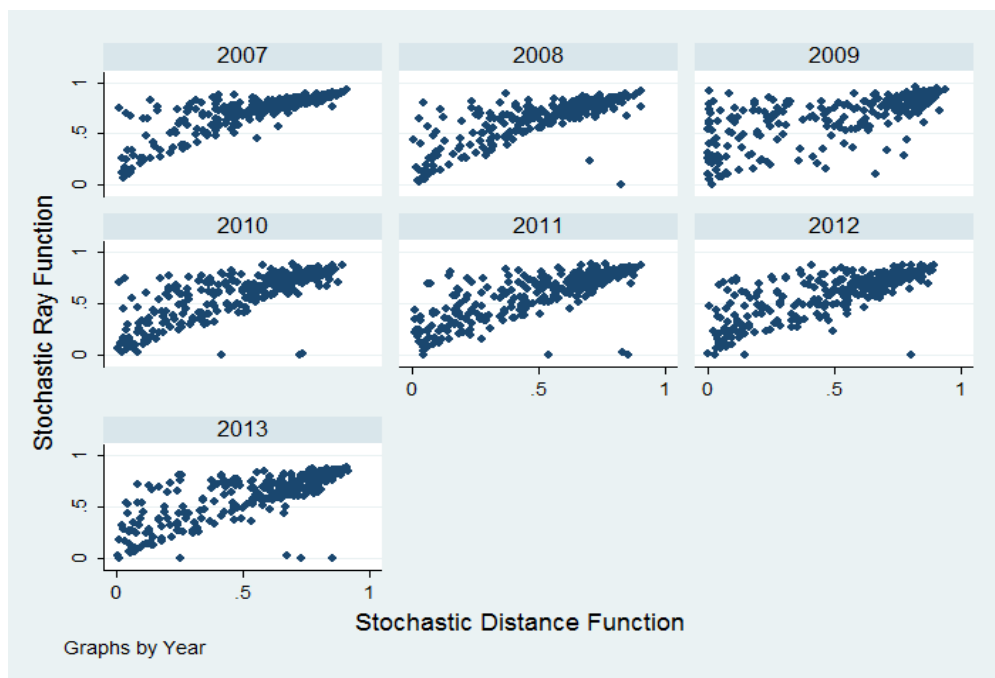
Table 8 Comparison of distance and ray function efficiencies

Year	Correlation Coefficient	Equality of medians
2007	0.8155	1.0000
2008	0.7944	1.0000
2009	0.7098	1.0000
2010	0.7707	1.0000
2011	0.7797	1.0000
2012	0.7645	1.0000
2013	0.7765	0.9974

Source: own processing

Table 3 documents the results of the comparison of the stochastic distance function and stochastic ray function. Estimated efficiency scores of the models prove to have high correlation for each year. The correlation is the highest in the year 2007 with the value 0.8155 and ranges from 0.7098 to 0.8155. Although the actual efficiency scores differ, such correlations signify the fact that the models give out similar results.

Figure 2 Efficiency scores scatterplot



Source: own processing

Furthermore, the pairwise comparison of the efficiency scores proves no significant difference between the models' estimations. The test's null hypothesis is not rejected in any of the studied years. Therefore, it can be concluded that the models' efficiency scores are not only highly correlated, but there is no significant difference between them.

The relationship between the model's efficiency scores can be further seen in the Figure 2. Scatterplots document the previously obtained results of the high positive correlation, where only small number of farms is estimated with highly different efficiency scores. Once again, the matched pairs test proved that there is not significant difference in scores. The scatterplots for the studied period depict strong linear relationship between the models' efficiencies.

4 Conclusions

The main aim of this paper was to compare the results of two stochastic frontier methods applicable to the multiple output, multiple input technology. Namely, these approaches are the stochastic distance function and stochastic ray function. The comparison of these methods is conducted on the sample of 308 Slovak farms for the period of years 2007-2013. In addition, the impact of the CAP subsidies is assessed using both mentioned approaches.

Firstly, both models give similar frontier coefficients and efficiency scores estimation. Both models estimate the statistically significant impact of the non-investment RDP 2007-2013 subsidies and long-term assets acquirement on the variance of the inefficiency term. Furthermore, both models indicate the same direction of the impact of these variables.

Secondly, given the estimated efficiency scores, there is a high degree of correlation between models' results. The correlation coefficients for the studied years do not fall under 0.70 and go as high as 0.82. In addition to this, comparison of medians of efficiency scores proves no significant difference in model's estimates and scatterplots depict linear relationship between estimates.

To sum up the results, both of methods used in this paper support the conclusion of previously conducted research, i.e. that both multiple output stochastic frontier approaches offer similar efficiency estimates.

References

- Acquah, H. D., & Onumah, E. E. (2014). Alternative Approaches to Technical Efficiency Estimation in the Stochastic Frontier Model. *Agris on-line Papers in Economics and Informatics*, 6(2), 3-10. ISSN 1804-1930.
- Battese, G. E., & Coelli, T. J. (1988). Predictions of firm-level technical efficiencies with generalized frontier production function and panel data. *Journal of Econometrics*, 38(3), 387-399. ISSN 0304-4076.
- Brummer, B., Glauben, T., & Thijssen, G. (2002). Decomposition of Productivity Growth Using Distance Functions: The Case of Dairy farms in Three European Countries. *American Journal of Agricultural Economics*, 84(3), 628-644. doi: 10.1111/1467-8276.00324.
- Čechura, L., Hockman, H., Malá, Z., & Malý, M. (2014). Productivity and Efficiency Differences between Czech and Slovak Milk Producers. *Review of Agricultural and Applied Economics*, 17(2), 17-24. ISSN 1336-9261.
- Čechura, L., Hockman, H., Malý, M., & Žáková Kroupová, Z. (2015). Comparison of Technology and Technical Efficiency in Cereal Production among EU Countries. *Agris on-line Papers in Economics and Informatics*, 7(2), 27-37. ISSN 1804-1930.
- Coelli, T., & Perelman, S. (1999). A comparison of parametric and non-parametric distance functions: With application to European railways. *European Journal of Operational Research*, 117(2), 326-339. ISSN 0377-2217.
- Fare, R., Grosskopf, S., Lovell, C.A.K., & Yaisawarng, S. (1993). Derivation of shadow prices for undesirable outputs: a distance function approach. *Rev. Econ. Stat.*, 75(2), 374- 380. doi: 10.2307/2109448.
- Hoyo, J. J. G., Espino, D. C., & Toribio, R. J. (2004). Determination of technical efficiency of fisheries by stochastic frontier models: a case on the Gulf of Cadiz (Spain). *ICES Journal of Marine Science*, 61, 416-421. E-ISSN:1095-9289.
- Jondrow, J., Lovell, C. A. K., Materov, I. S., & Schmidt, P. (1982). On the estimation of technical efficiency in the stochastic frontier production function model. *Journal of Econometrics*, 19(2-3), p. 233-238. ISSN 0304-4076.
- Lothgren, M. (1997). Generalized stochastic frontier production models. *Econ. Lett.*, 57(3), 255-259. doi: 10.1016/S0165-1765(97)00246-2.
- Lovell, C.A.K., Richardson, S., Travers, P., & Wood, L.L. (1994). Resources and Functionings: A New View of Inequality in Australia. In: Eichhorn, W. (Ed.), *Models and Measurement of Welfare and Inequality*. Springer-Verlag, Berlin, 787-807. ISBN 978-3-642-79039-3.
- Madau, F. A. (2011). Parametric Estimation of Technical and Scale efficiencies in Italian Citrus farming. *Agricultural Economics Review*, 12(1). ISSN 1109-2580.
- Medonos, T. et al., 2012. The Assessment of the Effects of Investment Support Measures of the Rural Development Programmes: The Case of the Czech Republic. *AGRIS on-Line Papers in Economics and Informatics*, 4(4), 35-48. Retrieved from: <http://search.proquest.com/docview/1314373060?accountid=32559>.
- Pechrová, M. (2014). Determinants of the Farmers' Conversion to Organic and Biodynamic Agriculture. *Agris on-line Papers in Economics and Informatics*, 6(4), 113-120. ISSN 1804-1930.
- Pechrová, M. (2015). Impact of the Rural Development Programme Subsidies on the farms' inefficiency and efficiency. *Agric. Econ. – Czech*, 61(5), 197-204. ISSN 1805-9295.
- Pechrová, M., & Vlašicová, E. (2013). Technical Efficiency of Organic and Biodynamic Farms in the Czech Republic. *Agris on-line Papers in Economics and Informatics*, 5(4), 143-152, ISSN 1804-1930.
- Rashidghalam, M., Heshmati, A., Dashti, G., & Pishbahar, E. (2016). A Comparison of Panel Data Models in Estimating Technical Efficiency. *IZA Discussion Paper No. 9807*.
- Revoredo-Giha, C., Milne, C. E., Leat P. M., & Cho, W. J. (2009) Efficiency of Scottish Farms: A Stochastic Cost Frontier Analysis. *Agricultural Economics Review*, 10(2). ISSN 1109-2580.
- Zhang, T., & Garvey, E. (2008). A comparative analysis of multi-output frontier models. *Journal of Zhejiang University SCIENCE A*, 9(10), 1426-1436. ISSN 1862-1775.

Solving Economic Problems by Using OML Modeling Language

Radim Remeš

Abstract: *The aim of this article is to introduce an algebraic modeling language called Optimization Modeling Language (OML) to solve economic optimization problems. How to use this language is demonstrated on the example using the methods of mixed linear programming in OML language. The solution is found by using the Microsoft Solver Foundation tool, which can be used for mathematical simulation, optimization, and modeling. The example solution is demonstrated by using the Microsoft Visual Studio programming tool.*

The benefits of using this tool for mathematics include easy usage and concurrently wide scope of the problems solution.

Key words: Business Analytics · Solver Foundation Services · Optimization Modeling Language · OML · Linear programming · Mixed integer linear programming

JEL Classification: C61 · C63

1 Introduction

This article introduces an algebraic modeling language called Optimization Modeling Language (OML). Optimizing methods are used to solve a whole spectrum of problems.

Optimizing methods are mainly used for covering conventional optimization (Gen, Cheng, 2000), simulation and risk analysis (Goswami, Mishra, 2016), decision analysis (Palvia, Gordon, 1992), simulation optimization (Carson, Maria, 1997), stochastic optimization (Houda, Klicnarova, 2015), robust optimization, or food processing industry (Rieger et al., 1989).

Nowadays there are many software for solving optimization problems, frequently used are XPRESS-MP (Fico, 2016), ILOG CPLEX (IBM, 2016, LINGO (Lindo, 2016), lp_solve (Eikland, Notebaert, 2016), or Gurobi (Gurobi Optimization, 2016).

How to use OML language is demonstrated on the example by using the methods of linear programming. The solution is found by using the Microsoft Solver Foundation tool (Microsoft, 2013), which can be used for mathematical simulation, optimization, and modeling. The example solution is demonstrated by using the Microsoft Visual Studio programming tool (Microsoft, 2016). These tools were also used by students in the economic course to calculate the optimization of e-commerce (Beranek, Remes, 2013).

2 Optimal solution finding

To demonstrate this, we used an example for which the inspiration from books of authors Asllani (2015) and Kreyszig, Kreyszig, Norminton (2011) was obtained.

A small company produces scooters for children. The sales forecast in units for the coming year are given in the table 1. The company has a capacity of 300 scooters per month. It is possible to augment the production by up to 25% through overtime working, but this increases the production cost for a scooter from the usual 400 CZK to 500 CZK. Currently there are 50 scooters in stock. The storage costs have been calculated as 100 CZK per unit held in stock at the end of a month. We assume that the storage capacity at the company is unlimited (the real capacity does not impose any limits in our case). We are at the first of January. Which quantities need to be produced and stored in the course of the next twelve months in order to satisfy the forecast demand and minimize the total cost?

Table 1 Sales forecasts for the coming year

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Forecast items	300	150	250	250	600	700	420	500	290	120	200	300

Source: Own processing

First, we need to define decision variables:

- s_i quantity stored in i -th month,
 p_i quantity produced in i -th month,
 p'_i quantity produced in overtime work in i -th month.

Next we define parameters:

- d_i demand forecast in i -th month (see table 1).

Now we can formulate the objective function:

$$\min C = \sum_{i=1}^{12} (s_i \cdot 100 + p_i \cdot 400 + p'_i \cdot 500) \quad (1)$$

where:

- C the total production cost,
 s_i quantity stored in i -th month,
 p_i quantity produced in i -th month,
 p'_i quantity produced in overtime work in i -th month,
 d_i demand forecast in i -th month.

For objective function we have to define the set of constraint:

$$s_i \geq 0 \text{ and } p_i \geq 0 \text{ and } p'_i \geq 0 \quad (2)$$

$$p_i \leq 300 \text{ and } p'_i \leq 375 \quad (3)$$

$$p_1 + p'_1 + 50 = d_1 + s_1 \quad (4)$$

$$p_i + p'_i + s_{i-1} = d_i + s_i \quad (5)$$

And the set of non-negativity constraints:

$$s_i \geq 0 \text{ and } p_i \geq 0 \text{ and } p'_i \geq 0 \text{ for all } i = \langle 1, 12 \rangle \quad (6)$$

Finally, overall formulation:

$$\min C = \sum_{i=1}^{12} (s_i \cdot 100 + p_i \cdot 400 + p'_i \cdot 500) \quad (7)$$

subject to:

$$p_i \leq 300 \text{ and } p'_i \leq 375 \text{ for all } i = \langle 1, 12 \rangle \quad (\text{constraint maximum amount of scooters})$$

$$p_1 + p'_1 + 50 = d_1 + s_1 \text{ for } i = 1 \quad (\text{constraint for January})$$

$$p_i + p'_i + s_{i-1} = d_i + s_i \text{ for all } i = \langle 2, 12 \rangle \quad (\text{constraint for other months than January})$$

$$s_i \geq 0 \text{ and } p_i \geq 0 \text{ and } p'_i \geq 0 \text{ for all } i = \langle 1, 12 \rangle \quad (\text{non-negativity constraint})$$

3 Results - Solving the problem in Microsoft Visual Studio

For solution of our problem we utilize the library for mathematic programming and optimization Microsoft Solver Foundation (Microsoft, 2013). We use this library alongside with Microsoft Visual Studio development environment (Microsoft, 2016).

Both Microsoft Visual Studio development environment Community edition and Microsoft Solver Foundation libraries Express edition are distributed free, it is possible to download them from Microsoft website.

3.1 Developing Models

Microsoft Solver Foundation offers three developing models in Microsoft Visual Studio environment, which leads to these possible ways to the final solution:

- Solver Foundation Services,
- Solver Foundation Solvers,
- Optimization Modeling Language.

Developing model Solver Foundation Services (SFS) is suitable for novice developers, because desired algorithm (solver) is chosen automatically.

Solver Foundation Solvers developing model accesses to specific solvers (e.g. solver for linear programming, quadratic programming, integer programming solver for quasi-Newton methods) and is more appropriate for advanced developers.

Optimization Modeling Language (OML) is an algebraic modeling language that is designed exclusively for modeling and problem solving. Source code and designed model are mutually separate, each of them is in a separated file. This leads to the transparency of the program and the designed model can thus be easily edited later and modified for resolving the given problem. We will use this developer model in our problem solving.

3.2 Optimization Modeling Language

The example solution of our chosen task will be presented on a model designing by using Optimization Modeling Language (OML). The model will be used together with developing model Solver Foundation Services.

The model design is prepared with the use of equations 1-7 consisting of these stages:

- set of parameters (months demand forecast),
- decision variables (productions),
- constraint,
- goals.

On listing 1 is shown frame of a whole programme in C# language, the commented lines will be further completed with the code of solution.

Listing 1 Frame of a programme for SFS model

```
using System;
using Microsoft.SolverFoundation.Services;

namespace ScooterPlanning
{
    class ScooterProduction
    {
        public void Solve()
        {
            // actual solution
        }
    }

    class Program
    {
        static void Main(string[] args)
        {
            ScooterProduction sProd = new ScooterProduction();
            sProd.Solve(); // call solution
        }
    }
}
```



```

    }
  }
}

```

Creating the object of the designed model is implemented by loading it into solvers SolverContext class instance context. Custom model is loaded from an external file scooter.oml, the source code is shown in listing 2.

Listing 2 Object Model Loading

```

SolverContext context = SolverContext.GetContext();
context.LoadModel(FileFormat.OML, "scooter.oml");

```

3.3 Model in OML

The whole model is described in an external file using OML. The parameters in this example represents individual months. The model decision determines that we need variables, each variable will be a whole set of non-negative integers. Constraints in the model are determined by the example assignment. Section of the model in which is described the desired target states that we are trying to get the minimum total cost. Listing 3 shows the entire model designed using the OML.

Listing 3 Model described in OML file

```

Model[
  Parameters[
    Sets[Integers[1, 12]],
    Months
  ],
  Parameters[
    Integers[0, Infinity],
    DemandForecast[Months]
  ],
  Decisions[
    Integers[0, Infinity],
    ProductionNormal[Months],
    ProductionOT[Months],
    store[Months]
  ],
  Constraints[
    Caps -> Foreach[
      {iter1, Months},
      ProductionNormal[iter1] <= 300
    ],
    OT_Caps -> Foreach[
      {iter2, Months},
      ProductionOT[iter2] <= 375
    ],
    SupplyDemandJan -> Foreach[
      {iter3, Months},
      !(iter3 == 1) | ProductionNormal[iter3] +
ProductionOT[iter3] + 50 == DemandForecast[iter3] + store[iter3]
    ],
    SupplyDemandRest -> Foreach[
      {iter4, Months},
      !(iter4 != 1) | ProductionNormal[iter4] +
ProductionOT[iter4] + store[iter4 - 1] == DemandForecast[iter4] +
store[iter4]
    ]
  ],
  Goals[

```

```

        Minimize[
            Cost -> Annotation[Sum[
                {iter5, Months},
                store[iter5] * 100 + ProductionNormal[iter5] * 400 +
ProductionOT[iter5] * 500
            ], "order", 0]
        ]
    ]

```

3.4 Founded solution

We already have everything ready for the calculation of the final solution (calling Solve method from the Model context and writing solution report, listing 4).

Listing 4 The solution calculation and report display

```

Solution solution = context.Solve();
Report r = solution.GetReport();
Console.WriteLine(r.ToString());

```

After running the programme it displays the resulting message on the calculation and shows the founded optimal solution (listing 5).

Listing 5 Report with received results

```

===Solver Foundation Service Report===

Date: 1.11.2016 11:21:43
Version: Microsoft Solver Foundation 3.0.2.10889 Enterprise Edition
Model Name: DefaultModel
Capabilities Applied: MILP
Solve Time (ms): 1099
Total Time (ms): 2674
Solve Completion Status: Optimal
Solver Selected: Microsoft.SolverFoundation.Solvers.SimplexSolver
Directives:
Simplex(TimeLimit = -1, MaximumGoalCount = -1, Arithmetic = Default,
Pricing = Default, IterationLimit = -1, Algorithm = Default, Basis =
Default, GetSensitivity = False)
Algorithm: Primal
Arithmetic: Double
Variables: 36 -> 36 + 37
Rows: 37 -> 37
Nonzeros: 107
Eliminated Slack Variables: 0
Pricing (double): SteepestEdge
Basis: Slack
Pivot Count: 16
Phase 1 Pivots: 16 + 0
Phase 2 Pivots: 0 + 0
Factorings: 4 + 0
Degenerate Pivots: 0 (0,00 %)
Branches: 0
===Solution Details===
Goals:
Cost: 1716500
Decisions:
ProductionNormal(1): 250
ProductionNormal(2): 150
ProductionNormal(3): 250
ProductionNormal(4): 250

```

```

ProductionNormal(5): 300
ProductionNormal(6): 300
ProductionNormal(7): 300
ProductionNormal(8): 300
ProductionNormal(9): 290
ProductionNormal(10): 120
ProductionNormal(11): 200
ProductionNormal(12): 300
ProductionOT(1): 0
ProductionOT(2): 0
ProductionOT(3): 0
ProductionOT(4): 0
ProductionOT(5): 325
ProductionOT(6): 375
ProductionOT(7): 120
ProductionOT(8): 200
ProductionOT(9): 0
ProductionOT(10): 0
ProductionOT(11): 0
ProductionOT(12): 0
store(1): 0
store(2): 0
store(3): 0
store(4): 0
store(5): 25
store(6): 0
store(7): 0
store(8): 0
store(9): 0
store(10): 0
store(11): 0
store(12): 0

```

Table 2 Production decisions for the coming year

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sales forecast	300	150	250	250	600	700	420	500	290	120	200	300
Normal production	250	150	250	250	300	300	300	300	290	120	200	300
Overtime production	0	0	0	0	325	375	120	200	0	0	0	0
Stored items	0	0	0	0	25	0	0	0	0	0	0	0

Source: Own processing

4 Conclusions

The model according to the specified data finds the optimal solution. Total production cost is calculated to 1,716,500 CZK. Production will work overtime only for four months (May to August) and we only need a warehouse in May. Detailed final solution is shown in table 2.

Article showed the use of programming tools in Microsoft Visual C # library with Microsoft Solver Foundation for solving linear programming problems, the solution was specified model using algebraic language OML in a separate text file. The benefit of using this software is for the non-programmers who will use the ready-made programme in advance and design only model in an external OML file.

References

- Asllani, A. (2015). *Business Analytics with Management Science Models and Methods*. Upper Saddle River, NJ: Pearson. ISBN 978-0-13-376035-4.
- Beranek, L., Remeš, R. (2013). Evaluation of the Support of Entrepreneurial Competences of Students in the Subject E-commerce. In Kvasnicka, R. (Ed.), *Efficiency and Responsibility in Education* (pp 32-38). Prague, CR.
- Carson, Y., Maria, A. (1997). Simulation optimization: methods and applications. In *WSC '97*, 118-126. ISBN 0-7803-4278-X.
- Eikland, K., Notebaert, P. (2016). *Lpsolve 5.5* [online]. Retrieved from <http://lpsolve.sourceforge.net/>.
- Fico. (2016). *Xpress Optimization Suite* [online]. Retrieved from <http://www.fico.com/en/products/fico-xpress-optimization-suite>.
- Gen, M., Cheng, R. (2000). *Genetic Algorithms and Engineering Optimization*. Hoboken, NJ: Wiley & Sons. ISBN 0-471-31531-1.
- Goswami, A., Mishra, A. (2016). *Economic Modeling, Analysis, and Policy for Sustainability*. Hershey, PA: IGI. ISBN 978-1522-50095-7.
- Gurobi Optimization. (2016). *Gurobi* [online]. Houston, TX. Retrieved from <http://www.gurobi.com/>.
- Houda, M., Klicnarova, J. (2015). The comparison of stochastic and deterministic DEA models. In *Proceedings of The International Scientific Conference Inproforum 2015* (pp. 140-145). ISSN 2336-6788. Retrieved from <http://ocs.ef.jcu.cz/index.php/inproforum/INP2015/paper/view/700/496>.
- IBM. (2016). *IBM ILOG CPLEX Optimization studio* [online]. Retrieved from <http://www-03.ibm.com/software/products/en/ibmilogcpleoptistud>.
- Lindo Systems. (2016). *LINGO 16.0* [online]. Retrieved from <http://www.lindo.com/index.php/products/lingo-and-optimization-modeling>.
- Kreyszig, E., Kreyszig, H., Norminton, E. J. (2011). *Advanced Engineering Mathematics*. Hoboken, NJ: Wiley & Sons. ISBN 978-0-470-45836-5.
- Microsoft. (2013). *DevLabs : TC Labs: Solver Foundation* [online]. Redmond, WA. MSDN. Retrieved from <http://msdn.microsoft.com/en-us/devlabs/hh145003>.
- Microsoft. (2016). *Downloads – Visual Studio Official Site* [online]. Redmond, WA. Retrieved from <https://www.visualstudio.com/downloads/>.
- Rieger, F., Ditzl, P., Weiserova, H, et al. (1989). Circulation Effects in Operation of Sugar Vacuum Pans. *Zuckerindustrie*, 114(1), 45-48. ISSN 0344-8657.

Two Recursive Partitioning Methods and their Application for Credit Risk Evaluation

Michael Rost, Pavel Tlustý

Abstract: *The data mining methods reach a big attention in business application, especially in marketing area. We can say that the primary aim of such methods is to estimate behavior of consumers. As an example we could mention buying behavior, churn management, credit risk evaluation or fraud detection. For these purposes the analytical stuff in big companies usually use machine learning method like classification and regression trees, random forest, support vector machine, Bayesian networks, deep neural network or their combinations. Some of these methods also provides insight into “structure” and provide relative importance of explanatory variables. Such predictive models are nowadays based on huge amount of data. In our paper we are focused on some of above mentioned predictive models which are based on recursively partitioning space. More concretely we employ classification and regression trees (CART) methodology and chi-squared automatic detection (CHAID) for construction of predictive models for credit risk applicant assessment. Our dataset consist of several personal attributes. More concretely, we gathered information about following attributes: age, income, sex, marital status and number of kids, number of card in ownership, mortgage, loan and one dependent variable called “risk for a bank”. This dataset could be characterized as a small random sample from bank institution data warehouse. Data pre-processing and the numerical computation with model building were carried out in MySQL and in the programming language R 3.3.0. and in statistical software IBM SPSS 20.*

Key words: Data mining · Predictive modelling · Classification · Credit applicant

JEL Classification: G38 · G44 · C88

1 Introduction

Given the explosive growth of data collected from current business environment, data mining methods can potentially discover new business knowledge to improve managerial decision. Especially bank sector is a one such example. Every day the bank institutions evaluate their customers – applicant – for bank loan. For this purpose they gathered gigabytes of information about their customers and consequently construct data driven classification models with aim to categorize applicant to some internal risk categories. For these purposes the analytical stuff in big companies usually use data mining approach based on classification methods like classification and regression trees (Breiman, Friedman, Olshen, & Stone, 1998; Hothorn, Torsten, Hornik, & Zeileis, 2006b), random forest (Hastie, Tibsharani, & Friedman, 2001), support vector machine (Vapnik, 2000; Vapnik, Chervonenkis, 1971), Bayesian networks, deep neural network or their combinations. Some of these methods also provide insight into “structure” and provide relative importance of explanatory variables. Such predictive models are nowadays based on huge amount of data. In our paper we are focused on some of above mentioned predictive models which are based on recursively partitioning space. More concretely we employ classification and regression trees (CART) methodology and chi-squared automatic detection (CHAID) (Kass, 1980) for construction of predictive models for credit risk applicant assessment.

2 Data and methods

All analyzed data were collected by bank institution in the Czech Republic during the years 2013 - 2014. Data could be characterized as random subsample from bank internal database. This data set contains information from 2455 credit applicants on retail market. With SQL queries we obtained nine different variables which describe every particular customer e.g. applicant. In our case: Age (A), Income (I), Gender (G), Marital (Ma), Number of kids (Nk), Number of cards (Nc), Mortgage (Mo), Number of loans (L) and Risk for bank (R). In the table 1 there are provided basic descriptive statistics for these variables based on classical frequency analysis.

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Table 1 Descriptive characteristics for used explanatory and dependent variables – before transformation

Numerical variables	Descriptive characteristics						
	Name	Min.	The first quartile	Median	Mean	The third quartile	Max.
Age (A)	18	23	31	31.89	41	50	
Income (I)*	15.018	20.559	23.620	25.653	27.618	59.944	
Categorical variables	Categories and numbers of observation						
Gender	Female: 1228			Male: 1227			
Marital	Married: 1214		Single: 711		Divorced or separated, widowed: 530		
Number of kids	0: 587	1: 789	2: 934	3: 150	4: 31		
Number of cards	0: 325	1: 651	2: 661	3: 367	4: 121	5: 172	6: 158
Mortgage	No: 546			Yes: 1909			
Number of loans	0: 335	1: 1131	2: 724		3: 265		
Risk for bank	Bad loss: 559		Bad profit: 1475		Good risk: 421		

Source: Own processing; * Income is provided in thousands of CZK

At this point we have to say that we apply discretization during the pre-processing of data set of following variables: age, income, number of kids, number of cards and number of loans. The detailed categories of particular variables is as follows: age with categories: [0,26), [26,51) measured in years; income with categories: (0,20], (20,40], (40,60] measured in thousand CZK; gender with categories: F – female, M –male; marital status with categories: divorced; separated; widowed; married and single; number of kids in family with categories: [0,1); [1,3); [3,5); number of debt or credit cards with categories: [0,1), [1,3) and [3,7); mortgage with categories: no, yes; loans with categories: [0,1), [1,4) and finally risk for bank with categories: bad loss; bad profit; good risk given by bank risk managers.

For evaluation purpose was the data matrix randomly divided (sampling without replacement) into two non-overlapping subsets: training subset ($n_{\text{training}} = 1636$) and test subset ($n_{\text{test}} = 819$). Classification models were derived on training subset and consequently applied on test subset with aim to evaluate their differences in classification accuracy.

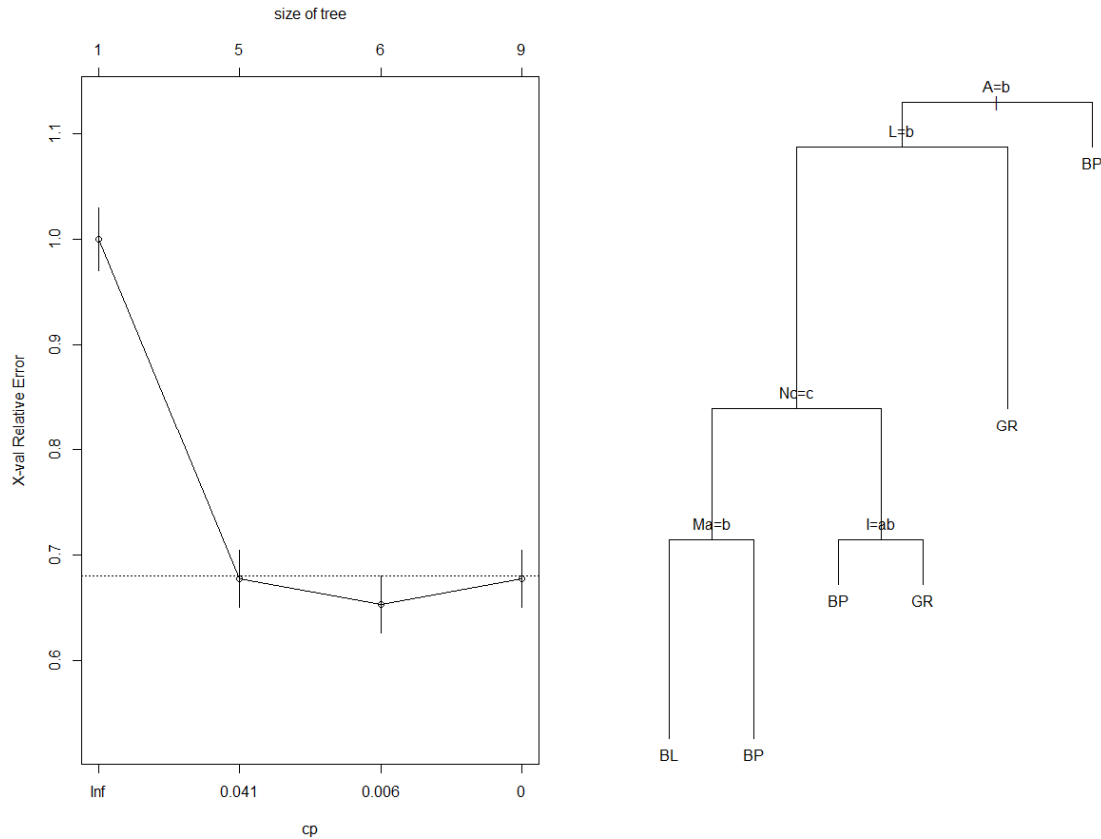
There are several different methods or algorithms which can handle this business problem. They could be signed as supervised classification method.

Next results from given classifier were analyzed in detail via CxC dimensional column normalized confusion matrix DD, in which diagonal elements represent the overall performance, and off-diagonal elements represent errors related to each class. Finally the performance results were graphically depicted with Cobweb transformation for better comparisons, due to fact that until now does not exist unified approach how to carry out ROC analysis in case of c groups, where $c > 3$. Data pre-processing and the numerical computation with model building were carried out in MySQL and in the programming language R 3.3.0. and in statistical software IBM SPSS 20.

3 Results

In case of CART methodology we constructed a sufficiently branched classification tree T_{max}. To manage such growing process we set the complexity parameter cp to zero because the low value of cp enables to raise such tree (Breiman, Friedman, Olshen, & Stone, 1998). In the next step we made a decision where to stop a growing process and prune the branched classification tree from the first step. For such decision we applied typically used rule called 1-SE rule (Therneau, & Atkinson, 2011). Visualization of this process is proposed on complexity graph along with unpruned classification tree see picture 1(left graph) and final pruned classification tree is shown on graph 1(right graph).

Figure 1 Complexity graph (left) and resulting classification tree (right) based on training data



Source: Own processing

Derived classification rules are provided in table 2 with some others characteristics like number of observation in particular node, number of misclassified person in particular node and maximal likelihood probability of membership.

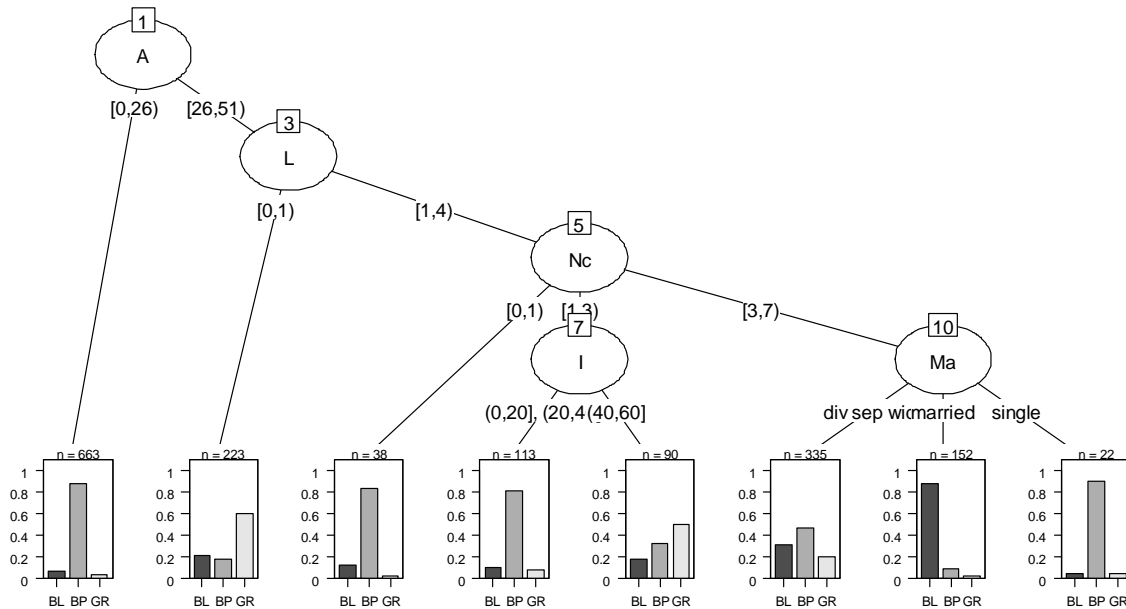
Table 2 Classification rules obtained by CART methodology – based on training data

Structure of classification tree – node numbering (terminal nodes are marked with asterisk)					Splitting node	Number of observation	Number of misclassified	M. l. e. of membership probability (rounded)		
								BL	BP	GR
1					root	1636	666	0.228	0.593	0.179
	2				A – age [26; 51)	973	587	0.331	0.397	0.272
		4			L – Number of loan [1;4)	750	404	0.365	0.461	0.174
			8		Nc – Number of card [3;7)	509	268	0.473	0.379	0.148
				*16	Ma – Marital status = married	152	18	0.881	0.09	0.029
				*17	Ma – Marital status = {divorced, widowed, single}	357	178	0.299	0.501	0.200
			9		Nc – Number of card [0; 3)	241	88	0.137	0.635	0.228
				*18	I – Income (0; 40]	151	27	0.112	0.821	0.067
				*19	I – Income (40;60]	90	45	0.177	0.322	0.501
		*5			L – Loan [0;1)	223	88	0.215	0.179	0.606
	*3				A – Age [0;26)	663	79	0.076	0.881	0.043

Source: Own processing

Figure 2 graphically depicted the resulting classification tree obtained by CHAID methodology. There is obvious distinction compared to CART. The rightmost node (number 10 in graph - Ma) is not binary. Due to lack of space we do not provide explicit classification rules as in case of CHAIS methodology. We provide only graphical result in the form classification tree, see figure 2.

Figure 2 Decision tree based on CHAID methodology



Source: Own processing

Efficiency of both classification methods is obvious from misclassification matrix, see table 3. We can say that both methods perform with the same efficiency on training data (73.59%). The same is true for test data (70.69%).

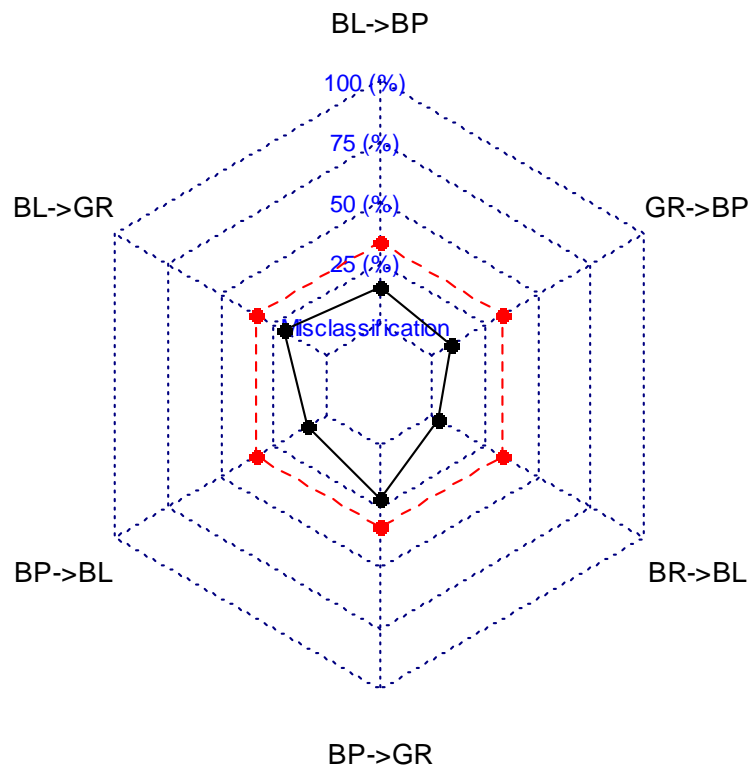
Table 3 Confusion matrix for both methods

		Predicted state		
		BL	BP	GR
True state	BL ($n_{train} =$; $n_{test}=186$)	0.88 ^a ; 0.88 ^b ; 0.88 ^c ; 0.88 ^d	0.15 ^a ; 0.17 ^b ; 0.15 ^c ; 0.17 ^d	0.20 ^a ; 0.19 ^b ; 0.20 ^c ; 0.19 ^d
	BP ($n_{train} =$; $n_{test}=505$)	0.09 ^a ; 0.12 ^b ; 0.09 ^c ; 0.12 ^d	0.76 ^a ; 0.74 ^b ; 0.76 ^c ; 0.74 ^d	0.22 ^a ; 0.31 ^b ; 0.22 ^c ; 0.31 ^d
	GR ($n_{train} =$; $n_{test}=128$)	0.03 ^a ; 0.00 ^b ; 0.03 ^c ; 0.00 ^d	0.09 ^a ; 0.08 ^b ; 0.09 ^c ; 0.08 ^d	0.58 ^a ; 0.50 ^b ; 0.58 ^c ; 0.50 ^d

^a estimated by CART on training sample; ^b estimated by CART on test sample; ^c estimated by CHAID on training sample; ^d estimated by CHAID on test sample;

Unfortunately, there does not exist a widely accepted method similar to ROC analysis for multiclass problems. So we decided to form a so called cobweb representation to compare classification results from CART and CHAID. For this purpose we used the misclassification values from confusion ratio matrixes. Due to fact that three-class classification confusion matrix from a six-dimensional point we formed following dimensions: BL to BP; GR to BP; BR to BL; BP to GR; BP to BL; BL to GR. For better understanding we provided a chance classification point with following coordinates (1/3; 1/3; 1/3; 1/3; 1/3; 1/3). From the resulting graph 3 it is apparent that the both classification methods perform better than the chance classifier, since the misclassification ratios are inside of the chance performance hexagon.

Figure 3 Misclassification Cobweb representation (true state \rightarrow decision state) for training dataset. Misclassification points for CHAID and CART are equal (black filled line) – based on training data



4 Conclusions

In this paper, we investigated the performance of two classification algorithms on data from retail bank institution. We can conclude that classification results obtained on test dataset are better in both cases than the chance classifier, since the both misclassification rates are inside the chance hexagon. The performance of both classification methods was surprisingly the same on both datasets. Perhaps such unique equality could be caused by discretization of explanatory variables into categories and intervals.

References

- Breiman, L., Friedman, J. H., Olshen, R. A., Stone, Ch. J. (1998). *Classification and Regression trees*. Chapman & Hall/CRC, Boca Raton, 359. ISBN: 0-412-04841-8.
- Hastie T., Tibshirani, R., Friedman, J. (2001). *The Elements of Statistical Learning, Data Mining, Inference and Precision*. Springer, New York, ISBN 0-387-95284-5.
- Hothorn, T., Hornik, K., & Zeileis, A. (2006b). Unbiased Recursive Partitioning: A Conditional Inference Frame-work. *Journal of Computational and Graphical Statistics* 15(3), 651-674.
- Kass, V. G. (1980). An Exploratory Technique for Investigating Large Quantities of Categorical Data. *Applied Statistics*, 29(2), 119-127.
- R package, version 3.1-50. Retrieved October 20, 2011. Available from <http://CRAN.R-project.org/package=rpart>
- Therneau, T. M., & Atkinson, B. R. port by Brian Ripley (2011). *rpart: Recursive Partitioning*.
- Vapnik, V. N. (2000). *The Nature of Statistical Learning Theory. Information Science and Statistics*. Springer-Verlag. ISBN 978-0-387-98780-4.
- Vapnik, V. N., Chervonenkis, A. (1971). On the uniform convergence of relative frequencies of events to their probabilities. *Theory of Probability and its Applications*, 16(2), 264-280.

Short-Run Elasticity of Substitution

Karol Szomolányi, Martin Lukáčik, Adriana Lukáčiková

Abstract: *We provide a strategy for estimating a short-run elasticity of factor substitution. The method is based on a co-integration estimation relationship between factor prices and average factor products. From the literature, it is known that this form is useless for estimating a long-run elasticity of substitution coefficient, because it is not consistent with a theory. However, restricting the long-run relationship according to the theory and estimating the short-run coefficients with the co-integration coefficient jointly in one step allows estimating the short-run elasticity of substitution. The co-integration term of the form captures possible underlying long-run processes and so it is useful in obtaining the unbiased estimate.*

To verify the method we use Jorgenson's sector data of the United States of America. In the results U.S. short-run elasticity of substitution is relatively small and it differs in different sectors. These values are between 0.05 and 0.64. In the conclusions we argue that the small and in different sectors different values of the coefficient is supported by the both empirical and theoretical research.

Key words: Elasticity of factor substitution · Long-run and short-run · Co-integration analysis · Neoclassical growth theory

JEL Classification: C13 · E23 · O40

1 Introduction

Chirinko (2008) and Klump, McAdam and Willman (2012) provide rich literature survey of elasticity of input substitution estimation problem. There are many ways to estimate the elasticity of substitution. We focus to the co-integration analysis of the factor prices. Caballero (1994) measures long-run values by exploiting the co-integration relations between the capital/output ratio and the user cost of capital. As argued in Chirinko and Mallick (2011), this estimation strategy faces some econometric difficulties in recovering production function parameters. In this paper we use similar analysis of labour/output and capital/output ratio. We use Chirinko's and Mallick's suggestion to form and estimate a co-integration econometric specification suitable to quantify short-run values of the elasticity of substitution.

Consider the co-integration estimation form

$$\Delta(y_t - x_t) = \alpha_0 + \beta_1 \Delta(p_t^x - p_t^y) + \lambda \left[(y_{t-1} - x_{t-1}) - \gamma_0 - \gamma_1 (p_{t-1}^x - p_{t-1}^y) \right] + u_t \quad (1)$$

where y_t , x_t , p_t^y and p_t^x are the logarithms of output y , factor x , the price of output and the price of factor x , u_t is a white-noise stochastic term. Coefficients β_1 and γ_1 are estimates (suggested by Caballero, 1994) of long-run and short-run elasticity of substitution and $-1 \leq \lambda \leq 0$ is a co-integration coefficient. Chirinko and Mallick (2011) argue that neoclassical growth theory assumes the constancy of the factor share $p_t^x + x_t - p_t^y - y_t$. However after substituting the factor share to the co-integration form (1), "the constancy holds if and only if the influence of relative prices is eliminated. In this case coefficient γ_1 must equal 1" (2011, p. 206) and the coefficient is not a measure of the long-run elasticity of substitution.

In fact, Szomolányi, Lukáčik and Lukáčiková (2013, 2015) estimated values of the coefficient close to 1 using U.S. and V4 (Visegrad Four country club, i.e. Czech Republic, Hungary, Poland and Slovakia) aggregated data of average product of labour and labour price. However, we argue that the estimation form (1) is suitable for estimating the short-run elasticity of substitution β_1 .

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According to Chirinko and Mallick (2011), three cases consistent with a general economic knowledge may exhibit the co-integration form (1). Firstly, co-integration relation holds. This may be reasonable according to the neoclassical growth theory, if labour is the factor. Then $\gamma_1 = 1$. Secondly, co-integration relation does not hold. This may be reasonable according to the theory, if capital is the factor. Finally, co-integration relation does not hold, but variables are driven by different underlying co-integration processes. By the first case, we can estimate co-integration form with $\gamma_1 = 1$. To estimate all coefficients in one step we rewrite the co-integration relation into the form suggested by Stock and Watson (1993).

$$\Delta(y_t - x_t) = \beta_0 + \beta_1 \Delta(p_t^x - p_t^y) + \lambda [(y_{t-1} - x_{t-1}) - (p_{t-1}^x - p_{t-1}^y)] + u_t \quad (2)$$

Szomolányi, Lukáčik and Lukáčiková (2015) showed that the co-integration form (2) is consistent with the normalised constant elasticity of substitution production function suggested by De La Grandville (1989) and Klump, McAdam and Willman (2012).

2 Data and Methods

To estimate the coefficients of the form (2) we use yearly data of logarithms of average labour and capital product quantities, $y_t - l_t$ and $y_t - k_t$, and labour and capital prices, $p_t^l - p_t^y$ and $p_t^k - p_t^y$, in the period 1960 – 2005 and in the 35 U.S. economy sectors obtained from Jorgenson (2008). In the first look on data we focus to the stationarity tests. Using augmented Dickey-Fuller and Phillips-Perron tests of unit roots (see Lukáčik and Lukáčiková, 2008) we state that the most of average factor product data series are non-stationary. Therefore we need to use their first differences in the estimation forms. Both (1) and (2) forms use the first differences of average factor products.

According to the first Chirinko's and Mallick's case in the introduction, we expect that the labour share ($p_t^l + l_t - p_t^y - y_t$), data series are stationary with no exogenous variable. In fact, using augmented Dickey-Fuller and Phillips-Perron tests of unit roots we state that the labour share data series are statistically significantly stationary at the 5% level in the most industries. Labour share data series of "Metal mining", "Coal mining", "Machinery non-electrical" and "Electrical machinery" industries are not stationary. Labour share of "Communications" industry is statistically significantly stationary at the 10% level. Therefore we state that co-integration form (2) is suitable for estimating short-run elasticity of substitution, β_1 .

Considering the third Chirinko's and Mallick's case in the introduction, we expect that the capital share ($p_t^k + k_t - p_t^y - y_t$) data series are not stationary. However, using Dickey-Fuller and Phillips-Perron tests of unit roots we state that the capital share data series are statistically significantly stationary at the 5% level in the most industries. Capital share data series of "Metal mining", "Coal mining" and "Motor vehicles" industries are not stationary. Note that tests using exogenous variables as constant and trend suggest unit root in the capital share data series. We explain the capital share stationarity by Chirinko's and Mallick's assumption. Average capital product and price ratio are co-integrated because of different underlying co-integration processes. Then the (1) form is not suitable for long-run elasticity of substitution estimate. But for the unbiased short-run elasticity of substitution β_1 estimate, we need to include variables capturing the processes into the estimation form. Considering that capital share is stationary, it is good candidate. Estimation form (2) uses this variable.

Summing up, the final econometric model is in the form:

$$\begin{aligned} \Delta(y_{it} - l_t) &= \beta_{l0i} + \beta_{l1i} \Delta(p_{it}^l - p_{it}^y) + \lambda_{li} [(y_{it-1} - l_{it-1}) - (p_{it-1}^l - p_{it-1}^y)] + u_{it} \\ \Delta(y_{it} - k_t) &= \beta_{k0i} + \beta_{k1i} \Delta(p_{it}^k - p_{it}^y) + \lambda_{ki} [(y_{it-1} - l_{it-1}) - (p_{it-1}^l - p_{it-1}^y)] + u_{it} \end{aligned} \quad \forall i = 1, 2, \dots, 35 \quad (3)$$

where an estimate of the short-run elasticity substitution in the sector i is denoted by β_{1i} . To capture cross-sectional dependence in the stochastic terms we use Seemingly Unrelated Regression method to estimate coefficients of (3). The set of instrument consists of the levels of the average factor products, and prices and first differences of the prices in all 35 sectors.

3 Research results

The estimates of the coefficients are in the Table 1. The most of coefficients are statistically significant at the 5% level (white rows). For testing the co-integration coefficients, λ_{il} and λ_{ki} , we use tables suggested by Banerjee, Dolado and Mestre (1998). Moreover, the co-integration coefficients are statistically significant for “Machinery, non-electical”, industry at the 10% level. We cannot confirm the capital co-integration relation, but we confirm labour co-integration relation for “Oil and gas extraction” and “Chemicals” industries. We do not consider estimates with statistically insignificant labour co-integration relation, because it is not consistent with the theory (under-painted rows). From the consistent estimates, we state that the short-run elasticity of substitution differs from industry to industry and it is between 0.05 (“Food and kindred products”) and 0.64 (“Transportation equipment & ordnance”).

Table 1 Estimate of the short-run elasticity of substitution in 35 U.S. sectors

Industry	β_l	$s_{\beta l}$	λ_l	t_{il}	λ_k	t_{ik}
Agriculture	0.149	0.007	-0.067	-8.195	-0.060	-12.483
Metal mining	0.372	0.014	-0.085	-6.509	-0.164	-9.509
Coal mining	0.205	0.009	0.046	5.863	0.006	0.952
Oil and gas extraction	0.570	0.008	-0.176	-12.210	-0.022	-2.394
Non-metallic mining	0.608	0.007	-0.024	-1.454	-0.097	-10.773
Construction	0.449	0.010	-0.050	-3.974	-0.026	-3.546
Food and kindred products	0.048	0.005	-0.147	-6.074	-0.009	-5.805
Tobacco	0.240	0.006	-0.030	-4.148	-0.056	-11.668
Textile mill products	0.227	0.011	-0.107	-4.483	-0.024	-3.390
Apparel	0.183	0.008	-0.110	-9.141	-0.023	-3.649
Lumber and wood	0.405	0.008	-0.204	-16.813	-0.120	-16.149
Furniture and fixtures	0.217	0.010	-0.133	-5.548	-0.157	-19.412
Paper and allied	0.256	0.007	-0.273	-25.274	-0.039	-6.151
Printing, publishing and allied	0.200	0.008	-0.282	-10.570	-0.039	-5.512
Chemicals	0.553	0.008	-0.080	-6.637	-0.010	-2.073
Petroleum and coal products	0.156	0.007	-0.074	-8.838	-0.025	-4.937
Rubber and misc plastics	0.383	0.009	-0.219	-9.115	-0.106	-12.859
Leather	0.174	0.010	-0.044	-4.521	-0.052	-9.609
Stone, clay, glass	0.410	0.008	-0.084	-6.172	-0.084	-13.725
Primary metal	0.416	0.011	-0.278	-13.576	-0.168	-15.381
Fabricated metal	0.276	0.008	-0.072	-9.122	-0.068	-13.919
Machinery, non-electical	0.477	0.011	-0.060	-3.206	-0.028	-3.005
Electrical machinery	0.269	0.009	0.074	9.217	-0.119	-21.365
Motor vehicles	0.445	0.009	-0.500	-20.917	-0.136	-16.539
Transportation equipment & ordnance	0.635	0.012	-0.719	-18.525	-0.325	-24.009
Instruments	0.605	0.011	-0.075	-6.469	-0.156	-17.152
Misc, manufacturing	0.218	0.008	0.033	3.925	-0.070	-14.009
Transportation	0.305	0.010	-0.033	-3.551	-0.070	-9.523
Communications	0.575	0.012	-0.041	-9.724	-0.039	-6.419
Electric utilities	0.430	0.011	-0.342	-18.226	-0.046	-7.995
Gas utilities	0.272	0.010	-0.014	-1.757	-0.116	-24.160
Trade	0.394	0.007	-0.048	-7.007	-0.056	-10.877
Finance Insurance and Real Estate	0.517	0.011	-0.112	-6.641	-0.130	-14.928
Services	0.298	0.008	0.001	0.098	-0.118	-22.443
Government enterprises	0.272	0.002	-0.215	-14.887	-0.031	-15.505

Source: Own processing

We test the stationarity of residuals by augmented Dickey-Fuller and Phillips-Perron tests. Using the Phillips-Perron test we reject the unit root hypothesis at 1% level of the statistical significance in all cases. Using the augmented Dickey-Fuller test we reject the unit root hypothesis at 1% level of statistical significance in all cases, but the residuals for capital estimates in the “Communication” sector are statistically significantly stationary at the 5% level.

4 Conclusions

Authors of the latest estimates prefer the long-run elasticity of substitution value 0.40 (Chirinko and Mallick, 2016), 0.60 (Klump, McAdam and Willman, 2007) and 0.70 (Klump, McAdam and Willman, 2008). These values are larger than our short-run estimates which are between 0.04 and 0.64. Moreover, all three papers consider the long-run elasticity substitution to be universal for each sector as well as for whole aggregated economy. However, in the conclusions, we support a statement that for a short term, elasticity of substitution is smaller than for a long term, and it can be different in a different industry. Our support is based on both empirical and theoretical research.

A summary by Chirinko (1993) found the short-run elasticity estimates varied widely, but they tended to be small and less than 0.30. The small value of the short-run elasticity is consistent with the theory of Jones (2003, 2005) and Jürgen (2009, 2010). Jürgen (2009) suggests that transition state economies have smaller substitution elasticity than the steady state economies. Jürgen (2010) predicts that competitive equilibrium can be realized only under Cobb-Douglas technology with the unit elasticity of substitution. Jones (2003) and (2005) consider Cobb-Douglas production function form in the long-run view and CES production function with an elasticity of substitution less than one from the short-run view, because input innovations are Pareto distributed from the long-run. This theory suggests that in the long-run, the elasticity of substitution is larger than in the short-run. The later Jones’ paper suggests that elasticity of substitution differs similarly in the “local” and “global” perspective. From the local perspective input innovations are distributed similarly as from the short term perspective, while from the global perspective input innovations are distributed similarly as from the long term perspective. Using the theory we should expect that the elasticity values depend on the aggregation rate in each industry. Moreover, Chirinko and Mallick (2016) estimated elasticity of substitution with properly aggregated data to be larger (0.657) than their “benchmark value of 0.406 based on homogeneity assumption” (2016, p. 24). This result supports Jones’ idea that the global elasticity of substitution is larger than local.

The estimation strategy presented in this paper could be useful for estimating an elasticity of substitution in the countries that suffer from small datasets and missing capital and capital income data-series as the post-communist countries. The results of the paper emphasize problems about analysis based on the dynamic stochastic general equilibrium (DSGE) model that maintain that elasticity of substitution equals to 1 (using Cobb-Douglas production function) highlighted by Chirinko and Mallick (2016). Such models surely overvalue the effect of price movements. Considering that DSGE models focus on short term economic relations, their bias is even larger, if a true short-run elasticity of substitution is very small.

Acknowledgement

This paper is supported by the Grant Agency of Slovak Republic - VEGA, grant no. 1/0444/15 "Econometric Analysis of Production Possibilities of the Economy and the Labour Market in Slovakia".

References

- Banerjee, A., Dolado, J. J., & Mestre, R. (1998). Error-Correction Mechanism Tests for Cointegration in a Single-Equation Framework. *Journal of Time Series Analysis*, 19(3), 267-283. doi: 10.1111/1467-9892.00091
- Caballero, R. J. (1994). Small Sample Bias and Adjustment Costs. *The Review of Economics and Statistics*, 76(1). doi: 10.2307/2109825
- Chirinko, R. S. (1993). *Econometric Models and Empirical Findings for Business Investment (Financial Markets, Institutions & Instruments)*. New York: Basil Blackwell.
- Chirinko, R. S. (2008). σ : The Long and Short of it. *Journal of Macroeconomics*, 30(2), 671-686. doi: 10.1016/j.jmacro.2007.10.010
- Chirinko, R. S., & Mallick, D. (2011). Cointegration, Factor Shares, and Production Function Parameters. *Economics Letters*, 112(2), 205-206. doi:10.1016/j.econlet.2011.04.002
- Chirinko, R. S., & Mallick, D. (2016). *The Substitution Elasticity, Factor Shares, Long-Run Growth, And The Low-Frequency Panel Model*. CESifo Working Paper Series 4895. CESifo Group Munich.
- De La Grandville, O. (1989). In Quest of the Slutsky Diamond. *American Economic Review*, 79(3).
- Jones, C. I. (2003). Growth, Capital Shares, and a New Perspective on Production Functions. In *Proceedings of Conference on Technology, Productivity and Public Policy*. San Francisco: Federal Reserve Bank of San Francisco, Center for the Study of Innovation and Productivity.

- Jones. C. I. (2005). The Shape of Production Functions and the Direction of Technical Change. *The Quarterly Journal of Economics*, 120(2). May. 517-549. doi: 10.1093/qje/120.2.517
- Jürgen. A. (2009). A Dual Elasticity of Substitution Production Function with an Application to Cross Country Inequality. *Economics Letters*, 102(1). 10-12. doi: 10.1016/j.econlet.2008.09.007
- Jürgen A. (2010). On the Dynamic Implications of the Cobb-Douglas Production Function. In *The Selected Works of Jürgen Antony*. The Haugue: bepress.
- Jorgenson. D. W. (2008). *35 Sector KLEM*. Harvard Dataverse. doi: 1902.1/10684.
- Klump. R., McAdam. P., & Willman. A. (2007). Factor Substitution and Factor Augmenting Technical Progress in the US. *Review of Economics and Statistics*. 89(1). 183-192. doi: 10.1162/rest.89.1.183.
- Klump. R., McAdam. P., & Willman. A. (2008). Unwrapping some Euro Area Growth Puzzles: Factor Substitution, Productivity and Unemployment. *Journal of Macroeconomics*, 30(2). 645-666. doi: 10.1016/j.jmacro.2007.16.005.
- Klump. R., McAdam. P., & Willman. A. (2012). The Normalized CES Production Function: Theory and Empirics. *Journal of Economic Surveys*, 26(5). doi: 10.1111/j.1467-6419.2012.00730.x.
- Lukáčik. M., & Lukáčiková. A. (2008). Význam testovania stacionarity v ekonometrii. *Ekonomika a informatika*, 6(1). 146-157.
- Szomolányi. K., Lukáčik. M., & Lukáčiková. A. (2013). Estimation of the Production Function Parameters in V4 Economies. In *Proceedings of 31st international conference Mathematical methods in economics* (pp. 898-902). Jihlava: College of Polytechnics.
- Szomolányi. K., Lukáčik. M., & Lukáčiková. A. (2015). Long-Run Elasticity of Substitution. In *Proceedings of 33rd international conference Mathematical methods in economics* (pp. 777-781). Plzeň: Faculty of Economics. University of West Bohemia.

The Algorithm Used for Numbering German Banknotes: What Counterfeiters Might Not Have Known

Pavel Tlustý, Marek Šulista

Abstract: *This paper deals with protection of banknotes and it introduces a less known algorithm used to protect former German banknotes which is a special mathematical model used for their numbering. This model, based on a check digit, may be suitable as a protection against counterfeiting of official documents such as university diplomas, certificates, driving licences etc.*

Key words: Check Digit · Counterfeiting of banknotes

JEL Classification: G23

1 Introduction

Producing or using counterfeit money is a form of fraud and it is almost as old as money itself. The history of banknotes counterfeiting has been developing beside the history of money including its development and looking for new protection features and new production technologies. Fake money is a detailed copy of legal tender and they are produced in the way that they can be very identified in the common money circulation. The higher availability of high-tech copy and reproductive computer technologies which enable us to produce almost unlimited amount of copies of the most complex make the work of money counterfeits easier.

While the majority of “amateurs” starts and ends with a laser copy machine, it is possible to come across fakes in the market which are relatively well made and at a flying sight at cash desks hardly discovered. The statistics of the Czech National Bank distinguish five dangerousness groups of fake banknotes and coins: very dangerous (level 1), dangerous (level 2), good quality (level 3), average quality (level 4), and finally poor quality (level 5), while the majority of the detected fakes belong to levels 4 or 5.

To protect the banknotes to the highest extent, they are equipped with many protection features of the graphical or the material nature such as special banknote paper, acoustic characteristics of the paper, relief, protection strip, hologram, microprinting, watermark, colour fibres, intaglio printing etc. (Brož and Hradecký, 2008). It is necessary to mention that the majority of them are concealed to the public. These features are examined by experts in testing laboratories.

2 Material and methods

This paper focuses on a less known algorithm used to protect banknotes which is a special mathematical model used for the numbering of former German marks. Every banknote has its own serial number which is usually an alphanumerical code consisting of letters and numbers. Regarding the fact that every banknote is an original, it is not possible for two banknotes to have the same serial number. It is a protection feature which is hardly used by ordinary people to examine if their banknotes are fakes or not.

However, when knowing the mathematical principle of the used code, it is possible to find out quite quickly if the given banknote with the given serial number exists or is counterfeited. It is obvious that this information is guarded very carefully by central banks. After the withdrawal of German marks from circulation, some pieces of information about the mathematical system used to number the banknotes of this currency in the last period of its validity were uncovered (Kriwet and Meyer, 2011). The mathematical model used for numbering the former German marks is based on the idea of a check digit. This digit is, according to Kirtland (2001), a form of redundancy check used for error detection on identification numbers, which are used in an application where they will at least sometimes be input manually. It is analogous to a binary parity bit used to check for errors in computer-generated data. It consists of one or more digits computed by an algorithm from the other digits (or letters) in the sequence input but also for other purposes.

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Many algorithms used for the calculation of check digits are algorithms invented by Luhn in 1954, Verhoeff in 1969, and by Damm in 2004 (Kirtland, 2001).

The check digit is used not only as a protection of banknotes. For example, in the Czech Republic; it is possible to come across this kind of coding in the case of the birth number assigned to every new-born child since 1954. The birth number is a ten digit number which can be divided by eleven without any remainder. The first two digits represent the year of birth; the second two digits express the month of birth – in the case of females 50 is added; and the third two digits represent the date of birth. The last four digits distinguish between people born on the same calendar day. The last digit serves as the check digit securing the divisibility by 11. Other examples, where the check digit is used, are ten-digit International Standard Book Number, automobile VIN numbers, barcodes, credit card or bank account numbers.

3 Results

The mathematical model based on the check digit used for protection against counterfeiting will be illustrated on former German banknotes. The serial number of the 50 mark banknote (see Figure 1) is DA7843100Z7.

Figure 1 Serial number of the 50 mark banknote



Source: authors

The letters used in the serial numbers were transferred to numbers according to the following table (Table 1):

Table 1 Letters transferred to numbers

A	D	G	K	L	N	S	U	Y	Z
0	1	2	3	4	5	6	7	8	9

Source: authors

The choice of the serial number letters has no mathematical meaning. Using the Table 1, the given 50 mark banknote’s serial number was transformed into 11 digit number 10784310097 ($a_1a_2a_3...a_{10}a_{11}$). The last digit a_{11} , so-called the check digit, is calculated in the way that the transformed number meets the check equation:

$$\pi(a_1) * \pi^2(a_2) * \pi^3(a_3) * \dots * \pi^9(a_9) * \pi^{10}(a_{10}) * a_{11} = 0,$$

where permutation π is defined as follows

$$\pi = \begin{pmatrix} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 1 & 5 & 7 & 6 & 2 & 8 & 3 & 0 & 9 & 4 \end{pmatrix}$$

and associative operation $*$ is defined by the following table

Table 2 Associative operations results

*	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
1	1	2	3	4	0	6	7	8	9	5
2	2	3	4	0	1	7	8	9	5	6
3	3	4	0	1	2	8	9	5	6	7
4	4	0	1	2	3	9	5	6	7	8
5	5	9	8	7	6	0	4	3	2	1
6	6	5	9	8	7	1	0	4	3	2
7	7	6	5	9	8	2	1	0	4	3
8	8	7	6	5	9	3	2	1	0	4
9	9	8	7	6	5	4	3	2	1	0

Source: authors

The given transformed banknote serial number 10784310097 is substituted into the check equation

$$\pi(1) * \pi^2(0) * \pi^3(7) * \pi^4(8) * \pi^5(4) * \pi^6(3) * \pi^7(1) * \pi^8(0) * \pi^9(0) * \pi^{10}(9) * 7 = 0,$$

particular permutations are evaluated as follows

$$\pi(1): 1 \rightarrow 5; \pi^2(0): 0 \rightarrow 1 \rightarrow 5; \pi^3(7): 7 \rightarrow 0 \rightarrow 1 \rightarrow 5; \pi^4(8): 8 \rightarrow 9 \rightarrow 4 \rightarrow 2 \rightarrow 7; \text{ etc.}$$

resulting in

$$5 * 5 * 5 * 7 * 5 * 3 * 0 * 0 * 1 * 2 * 7 = 0.$$

Using the Table 2, the resulting equation is evaluated as follows

$$\begin{aligned} 5 * 5 * 5 * 7 * 5 * 3 * 0 * 0 * 1 * 2 * 7 &= (5 * 5) * (5 * 7) * (5 * 3) * (0 * 0) * (1 * 2) * 7 = 0 * 3 * 7 * 0 * 3 * 7 \\ &= (0 * 3) * (7 * 0) * (3 * 7) = 3 * 7 * 5 = 5 * 5 = 0. \end{aligned}$$

Having evaluated the equation, it is clear that the right side of the check equation equals 0. It means that the secret mathematical condition for numbering of German banknotes is, in this case, met. It is easy to prove that if any digit in the serial number DA7843100Z7 is replaced, for example DA7843100Z8, the transformed number will not meet the check equation and such a banknote would be considered as fake.

4 Conclusion

The presented paper revealed in detail the algorithm used to protect the former German mark banknotes against counterfeiting. Apart from the possibility of counterfeiting, the use of the check digit is also used by central banks in analysing banknotes circulation. These checks are usually provided automatically in check nodes where banknotes are scanned and possible mistakes in scanning are detected using the principle of the check digits.

To analyse the amount of banknotes in circulation is important for every central bank from the inflation point of view and it is one of the major autonomous factors influencing liquidity. Another use of the check digit in the area with the economic background may be the sale and storage of products when by scanning products at cash desks, their barcode numbers go back to a main computer this evidence enable sellers more efficient shipping and storage. The value of the check digit is in verifying that the correct identification number has been transmitted and received.

References

- Brož, J., & Hradecký, M. (2008). *Platební prostředky jejich ochrana a padělání*. Praha: Tiskárny MV. ISBN 80-7312-055-0 -0.
- Kriwet, H., & Meyer, M. (2011). *Geschichte der D-Mark*. In Planet Wissen.
- Kirtland, J. (2001). *Identification numbers and check digit schemes*. Washington, DC: Mathematical Association of America. ISBN 0883857200.

Session 6

New Challenges for International Trade and Tourism

Green Marketing Practice of Car Producers

Jana Příkrylová, Eva Jaderná

Abstract: The development and maintenance of sustainable business has become an essential part of the aims of car producers, and thus, their Corporate Social Responsibility is strongly connected with the concept of Green Solutions in production. While “Go green” is a popular marketing slogan, it entails a necessity in the cars fleet market. Bijtelling, a special approach to taxation in the Netherlands, represents the market force pushing car producers to design greener vehicles and will make the object of this paper.

Key words: Sustainability · Corporate Social Responsibility · Green Solution · Bijtelling

JEL Classification: M39

1 Introduction

Corporate Social Responsibility is one of the most important marketing strategies followed by companies in the B2B and the B2C market. It presents a competitive advantage for companies. The point is that companies act in conformity with the principles of sustainability and ethical behavior. Most companies in the automotive industry are following this trend. An example of best practice is the ŠKODA AUTO project – „One tree planted for every ŠKODA sold in the Czech Republic“. Thanks to ŠKODA AUTO 500 000 trees have been planted in more than 50 towns and villages across the Czech Republic. (Škoda auto a. s., 2016a)

The strategy of Corporate Social Responsibility is based on 3 main approaches: economic, social and environmental. (Cimler, Zadražilová, 2007) In this paper, we focused on the environmental approach. Integrative environmental management means that every element in the corporate value chain is involved in the minimization of the firm's total environmental impact from start to finish of the supply chain, as well as from the beginning to the end of the product life cycle (Hollensen, 1998) For this reason, it is necessary not only to advertise sustainable products, but to introduce Green Solutions into processes across the entire company.

Green solutions mean technical solutions or company activities aimed at reducing the impact of production on the environment. The most common green solutions in car production focus on.

- Waste reduction,
- Developing products that protect/ do not damage the environment,
- Ecological solutions for the current products,
- Transformation and improvement of the production process,
- Development of a relationship with suppliers (sustainable processes and supply chain)
- Controlling the product impact (whole production chain),
- Using renewable energy sources.

A significant attribute of Green Solutions is emission reduction. It also represents the issue pursued in this paper.

2 Methods

The main research question refers to the introduction of Green Solutions in the practices of car producers. In pursuance of Student Grant Competition, case studies of market stimulation for sustainability were elaborated. One of the most important criterion as such is taxation. A best practice in taxation in the Netherlands will be described in this paper as a case study. It gives an idea of what is Bijtelling and the impact of this taxation on car sales in the Netherlands – illustrated through more examples of car producers (VW, Hyundai, Fiat, Ford, Renault, ŠKODA – selected representatives of these brands). The paper presents the results of an analysis of secondary resources in the field of Green Solutions or Corporate Social Responsibility, and describes several best practices of sustainability across the world.

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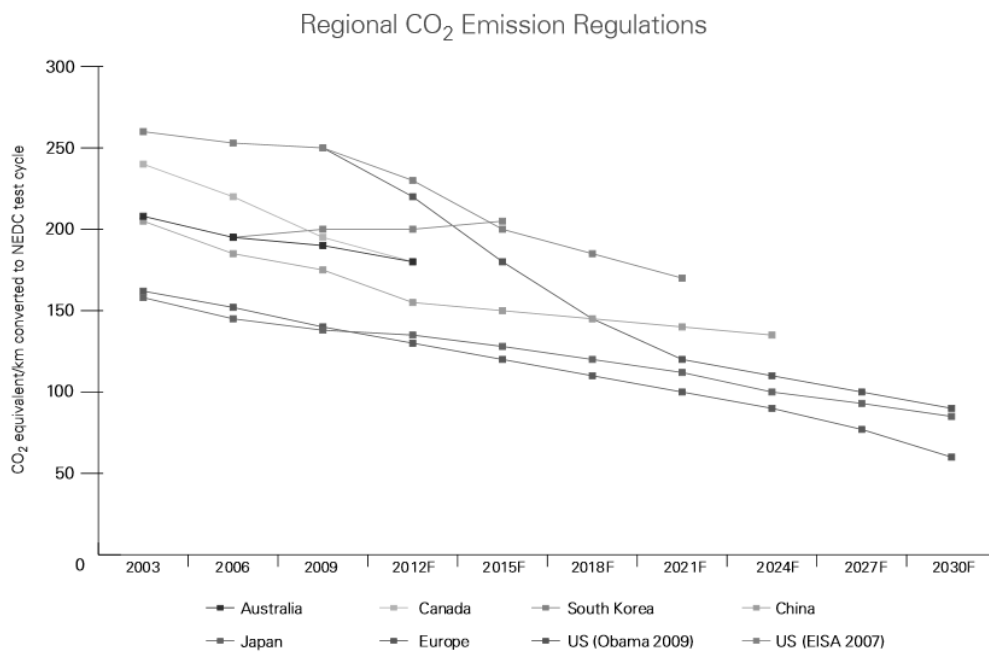
3 Research results

Car producers assess the problem of reducing emissions as the main goal of Green Marketing. Emission heights were introduced as a major characteristic of Green Solutions. This activity is supported by the state in various ways. Mainly, states encourage the production of environmentally friendly cars (CNG, LPG, electric, hybrid). They follow 3 main approaches:

- Emission standards,
- Direct state support,
- Taxation.

The Emission Regulation is shown in Figure 1 (Progress of emission limits in the most significant automotive markets in the world).

Figure 1 Progress of emission limits in the most significant automotive markets in the world



Source: KPMG International, 2010

The European Union has been complying with emission standards (European Emission Standards) since 1993. Euro 6 is the latest emission standard covering all types of vehicles - passenger cars (category M), light commercial vehicles (category N1) and truck and buses. The Euro 6 regulations are focused on tail-pipe emissions such as: all NOx emissions can be at a level of 0.46 grams-per kilowatt-hour (g/kWh), particulate Matter (PM) of 0.01 gm/kWh, permissible levels of PM close to 95%. (Cummins, 2011)

The second approach, as mentioned above, is direct state support. State governments stimulate the production or use of cars with alternative motorization by incentivizing, reducing tax and other benefits. The following table (Table 1 State incentives for hybrid/electric car purchase) presents selected examples of state support for alternative motorized models.

Table 1 State incentives for hybrid/electric car purchase

Country	Incentives	Comment
Australia	Increased board of “luxury“ tax	AUS\$ 60 136 > AUS\$ 75 375
Austria	Subsidy for electric automobiles for companies	€ 2000 - € 4000
Denmark	Eco tax removal	Tax at registration, derived from the price of the automobile
France	State subsidy for car purchase	€ 6 300
Italy	Free parking in yellow and blue zones in Milan	
Sweden	State subsidy for automobiles with emissions up to 50g CO ₂ /km	SEK 40 000

Source: Processed according to Broul, 2014

One of the most important approaches of state support to sustainability in the automotive industry is taxation. It can take different shapes. This paper looks at case study made on taxation in the Netherlands.

Case study – Taxation in the Netherlands

Taxation in the Netherlands is very specific and works firstly with CO₂ emissions under the so called environmental taxes belonging to BPM (taxation on cars and motorcycles), Bijtelling, Road tax and VAT. BPM is a tax payed for the first registration of a car. It depends on the CO₂ values and it regards all newly acquired cars. Table 2 (Emission class for calculating BPM for cars) presents the division into classes and BPM tariffs for all classes in 2016.

Table 2 Emission class for calculating BPM for cars

Class from g CO ₂ /km	Class to g CO ₂ /km	Fixed item	Variable item
A	B	C	D
0	79	175 €	6 €
80	106	649 €	69 €
107	155	2 512 €	124 €
156	174	8 588 €	239 €
175	-	13 129 €	478 €

Source: Dolejší based on Tax and Customs Administration - Belastingdienst, 2016a

The road tax is a yearly tax for car owners, except of cars with emissions <50g/km CO₂. V.A.T. (Value added tax) in the automotive industry, in the Netherlands is of 21%.

As previously stated, this article will deal with Bijtelling, a specific form of taxation. It means “addition” in English. This tax is for fleet customers, who use fleet cars for personal purposes. The tax is focused on the use of cars for trips over 500 km a year (Tax and Customs Administration – Belastingdienst, 2016b).

The calculation of Bijtelling is based on defined emission classes, which establish the proportion of car value added, to avoid the use of fleet cars for the employees’ personal purposes. Table 3 (Overview of emission classes for the calculation of Bijtelling) states the rate of taxation for the use of fleet cars by employees for personal purposes.

Table 3 Overview of emission classes for calculation Bijtelling

Emission (g CO ₂ /km)	Bijtelling
0	4%
1-50	15%
51-106	21%
>106	25%

Source: Dolejší based on Internal materials of ŠKODA AUTO a.s., 2016

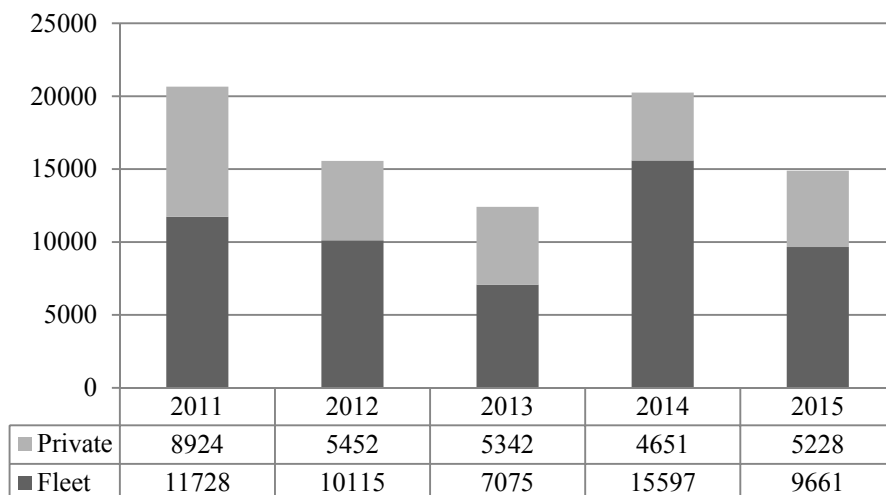
For example, the Octavia model of ŠKODA (diesel engine) was taxed at 14 – 20% in 2016 and ŠKODA Octavia (petrol engine) at 20 – 25%. The standards of emissions are changed every year and the difference between 2015 and 2016 in the highest level of Bijtelling tax was 4 g CO₂/km (in 2015 – 25% for emission >110 g CO₂/km).

Bijtelling and BPM affected the sales of all car manufacturers operating in the Netherlands. While the taxes aim at improving the environment, they have a negative impact on businesses. This adds up to the fact that long-term sales planning cannot be done accurately as the government is changing the tax percentage from one year to the other.

Škoda Auto, plc. illustrates these changes clearly. Because the sales of fleet cars make up for 60% of car sales in the Netherlands (Figure 2 Sales of ŠKODA AUTO Cars in the Netherlands), Bijtelling taxes and their changes are indispensable for devising innovation and development strategies. It is necessary to work with this information and propose new Green Solutions in the production of cars.

There are more importers in the Dutch market who offer fleet cars and who noticed the impact of Bijtelling and its changes on their sales which makes its effects worth mentioning.

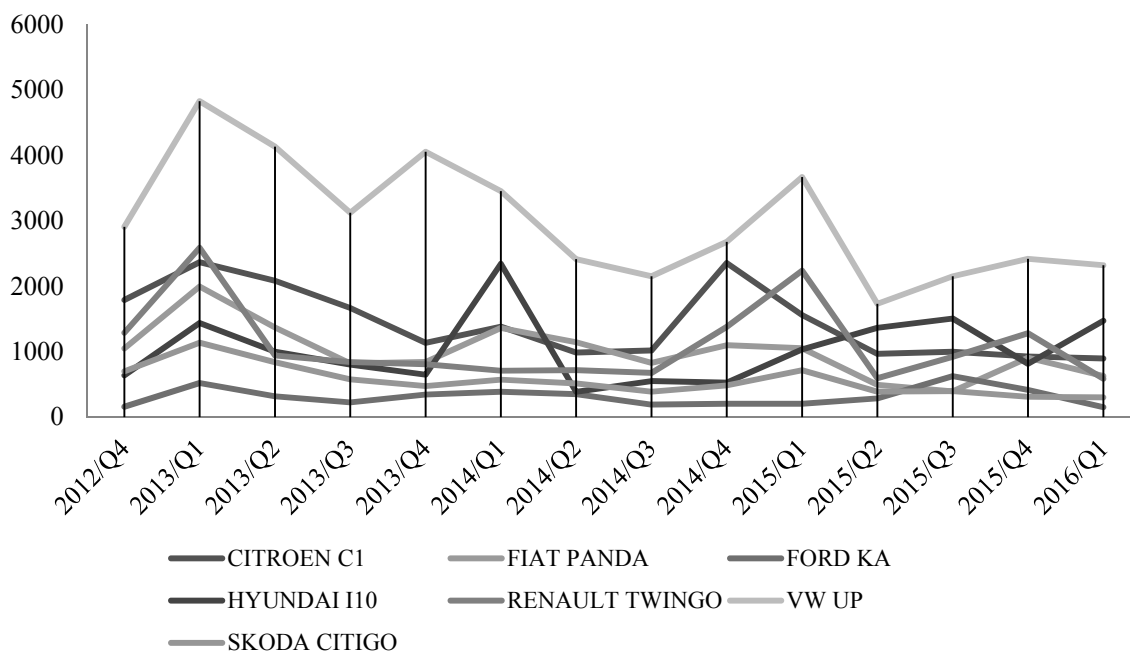
Figure 2 Sales of ŠKODA AUTO Cars in the Netherlands



Source: Dataforce, 2014

The changes in taxation in the Netherlands have an extensive impact on all corporations in the automotive sector. This impact is represented in Figure 3 (Sales of selected models in car segment A00 from Q4/2012 to Q1/2016).

Figure 3 Sales of selected models in car segment A00 from Q4/2012 to Q1/2016



Source: Dolejší based on Internal materials of ŠKODA AUTO, plc., 2016

Segment A00 represents the following selected cars:

- Citroen C1,
- Fiat Panda,
- Ford Ka,
- Hyundai i10,
- Renault Twingo,
- Volkswagen UP!
- Škoda Citigo.

These models were selected because of their high value in the Dutch market and because they stayed on the market the entire following period. (Internal materials of ŠKODA AUTO, plc., 2016) Figure 3 shows the sales cycles which demonstrate the impact of Bijtelling changes. At the end of the year (before the new level of taxation) sales are higher than at the beginning of the year. The top of the growth curve can be seen in the first quarter of the year. The swing is significantly noticeable in Volkswagen UP! and Hyundai i10.

All these models belong to the A00 car segment defined as small cars. The other car segments are A0 (compact cars), A (small family cars). These categories represent the majority (80%) of car sales in the following period. Cars are further classified in B car category (medium class) and C category (big luxury cars). In the Netherlands, the sales of the latter are very low.

4 Conclusions

Green Marketing Strategy as a part of Corporate Social Responsibility exhibits many approaches and can be achieved in several ways. One major issue, inter alia, is the environmental aspect. Companies are expected to act sustainably and, as a result, there are Green Solutions in manufacturing in the most areas of industry.

State governments want to support these solutions as well as the acquisition of sustainable products. This paper presents Green Solutions in the automotive industry. This can be an example of developing environmentally friendly products as well as more ecological solutions to existing goods. Such approaches can be supported and stimulated in many ways.

Many countries require emission standards (Euro 6), taxation and offer direct state support focused on sales of hybrid/electric cars. This case study discusses taxation in the Netherlands. The Netherlands has regular taxation (BPM, Road Tax) along with a specific tax Bijtelling. This tax refers to the use of fleet cars for personal reasons. The impact of the changes in the tax rate is easily noticeable. At the end of year, the sales of cars are at the top of the curve because customers expect an increase in the requirements for emission reduction. At the beginning of the year, new limits regarding emissions are communicated and they become stricter with every year.

ŠKODA AUTO, plc. offers mainly fleet cars in the Dutch market (in 2015 – 9661 fleet cars sold) and feels the impact of Bijtelling extensively. For all car producers, the emission standards and the pressure to reduce emissions have become very difficult.

Therefore, it is necessary to support the development of new technologies and to introduce suitable Green Solutions in production. Companies can work with these solutions through their marketing activities and present their corporation as a sustainable one, following the principles of Corporate Social Responsibility.

References

- Broul, L., & Dolejší, M., & Jirsová, M. & Košťál, D. (2014). *Tesla Motors: Případová studie*. Mladá Boleslav: ŠKODA AUTO Vysoká škola.
- Cimler, P., & Zdražilová, D. (2007). *Retail management*. Praha: Management Press, 307. ISBN 978-80-7261-167-6.
- Cummins (2011). *Euro6* [online]. Retrieved November 2, 2016 from http://cumminseuro6.com/customise/upload/files/20_a.pdf.
- Dataforce (2014) *Software: Přehled registrací nových vozů v Evropě*. Frankfurt nad Mohanem.
- Hollensen, S. (1998). *Global Marketing. A market-responsive approach*. Hertfordshire: Prentice Hall, 370. ISBN 0-13-261090-6.
- Internal materials of ŠKODA AUTO, plc., 2016.
- KPMG International (2016). *The Transformation of the Automotive Industry: The Environmental Regulation Effect* [online]. KPMG International | KPMG | GLOBAL. Retrieved February 28, 2016 from <https://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/transformation-automotive-industry.pdf>.
- Škoda Auto a.s. (2016a). *Za každý prodaný vůz vysadíme strom* [online]. Retrieved November 2, 2016 from <http://www.skoda-auto.cz/o-spolecnosti/zivotni-prostredi/skoda-stromky/>.
- Tax and Customs Administration – Belastingdienst (2016a). *BPM tariff passenger car. Individuals* [online]. Retrieved March 20, 2016 from http://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/individuals/cars/bpm/calculate_and_pay_bpm/bpm_tariff/bpm_tariff_passenger_car.
- Tax and Customs Administration – Belastingdienst. (2016b). *Private use of company car. Individuals* [online]. Retrieved March 21, 2016 from http://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/business/payroll_taxes/you_are_not_established_in_the_netherlands_are_you_required_to_withhold_payroll_taxes/when_you_are_going_to_withhold_payroll_taxes/private_use_of_company_car1.

New teaching Trends in the Field of Trade and Tourism

Radim Dušek, Jan Šalamoun

Abstract: *The aim of this paper is to describe an application of the project-based learning method, which was implemented to Management of Commerce study programme in the academic year 2015/16, and to define course's processes that should be improved to ensure a higher level of students competencies. A suitable method of such key competencies development can be an implementation and wider use of project-based learning methods. This approach can be characterized by creating the students' research teams to work individually on long-term projects, which are connected to business practice and that are designed to solve problems.*

Based on implementation of the project-based learning methods on the Faculty of Economics, the University of South Bohemia in České Budějovice in recent years, the Department of Trade and Tourism created and started own subject called Specialization project in the academic year 2015/16. The purpose was to integrate and develop competencies of every student through working on projects in the areas of trade, marketing and tourism. All projects were specified by particular companies, which expected students' relevant recommendations for solving concrete problems.

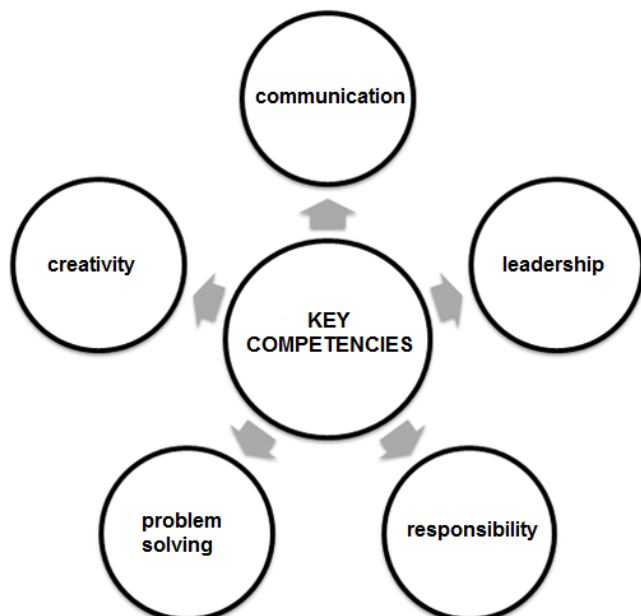
Key words: Competency · Project-based learning methods · Tourism · Trade

JEL Classification: A22 · I21

1 Introduction

According to the needs of employers, economically educated graduate should be communicative and independent individual, who is able to work in a team and is able to take an effective action to solve tasks and problems (Dušek, 2014; Koucký, Ryška & Zelenka, 2014). For a satisfactory skills' level in mentioned areas, the students should have a certain personal assumptions. Only in this case, the competencies can be further developed and deepened, for example at the university (Bender, 2012).

Figure 1 Important key competencies



Source: Armstrong, 2011; Mitchell, Skinner & White, 2010; Belz & Siegrist, 2001

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The suitable method of mentioned key competencies development can be an implementation and wider use of project-based learning methods. This approach can be characterized by creating the students' research teams to work individually on long-term projects, which are connected to business practice and are designed to solve the real problems (Slavík, 2012; Atkinson, 2001).

However, the successful implementation of the project-based learning method depends on the basic students skills in certain key competencies. For example the ability to work in team, communicate or understand and solve the problems. During the work on the projects these competencies are further systematically developed (Kašová, 2013; Mitchell, Skinner & White, 2010). The most important key competencies examples are shown in the figure 1.

2 Methods

The aim of this paper is to describe an application of the project-based learning method, which was implemented to Management of Commerce study programme in the academic year 2015/16, and to define course's processes that should be improved to ensure a higher level of students' competencies. The structure of the new Specialized project course was inspired by various researches focused on effective competency-based development and project-based learning methods (Allen, 2005; Atkinson, 2001; Bender, 2012; Krompf, 2007; Lee & Lim, 2012; Maltese, 2012; Weber, Finley & Crawford, 2009). To adapt the course to the local conditions we built it on the results of the research called REFLEX - The Flexible Professional in the Knowledge Society published in 2014, which contains relevant data about Czech graduates' success on the labor market and the employers' needs – for example the most the required graduates' competencies as shown in the table 1.

Table 1 The most required competencies by Czech employers

Key competency	%
Professional expertise	19.5
Interpersonal skills	19.1
Commercial/entrepreneurial skills	17.6
Inovative creative skills	16.0
Strategic/organizational skills	14.2
General academic skills	13.6
Total	100.0

Source: Koucký, Ryška & Zelenka, 2014

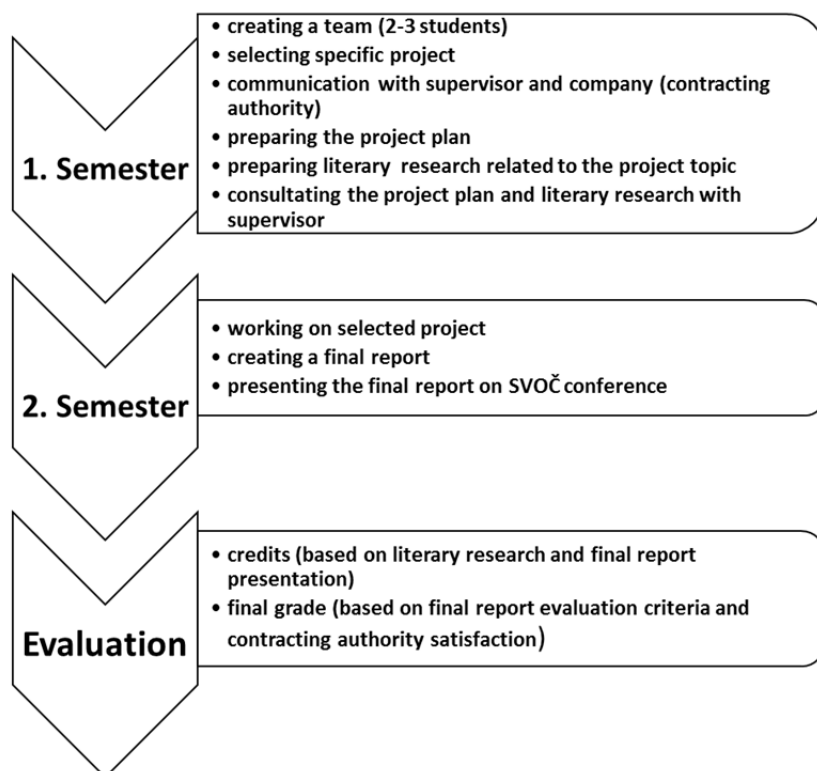
Based on the study of various researches about implementing project-based learning courses mentioned above, we defined the general objectives that should be fulfilled by the implementation of the Specialization project course to the Management of Commerce study programme:

1. Integration of a wide range of knowledge and skills.
2. Connection with practice and the business reality.
3. Linking the students knowledge and skills with the experience, which helps to increases efficiency in the learning process.
4. Activate the student to lifelong learning.
5. Developing the ability to work and to communicate in a team.
6. Developing the organizational skills.

3 Research results

The Specialization project course purpose is to integrate and develop competencies of each student through working on different projects in the areas of trade, marketing and tourism. It is inspired by project-based learning methods, so all projects are specified in cooperation with various companies. According to course structure, at first students should obtain enough relevant theoretical sources in the reseach area and then start to work on concrete solutions to a given problem by a company, which expects relevant recommendations suggested by students.

Due to the necessary knowledge and skills level of participating students, the Specialization project course is intended only for students of Management of Commerce study programme, who are in their last year of study. The whole process flow of created Specialized project course is shown in the figure 2.

Figure 2 The Specialization project course structure

Source: Own processing

3.1 Project topics

Final report, respectively project documentation, which is the main course output, should contain relevant recommendations for solving concrete problems in accordance with the aim of the project. The projects were mostly focused on the following topics:

1. Marketing research,
2. Data mining,
3. Event management,
4. Brand management,
5. Marketing,
6. Destination management,
7. Tourism and service management.

3.2 Project evaluation

As mentioned in the figure 2, the first semester of the course is evaluated with a credit (based on quality project plan and literary research made by all teams), while the second semester is evaluated with both credit and examination. Students receive credits for presenting the project outputs at the SVOČ conference, which is intended mainly for students to introduce their scientific works. The special section only for the Specialization project course presentations was created for SVOČ conference 2016. There were presented 12 final reports by students' teams. Every speaker had a certain amount of time to inform the audience, the conference committee and other participants about their final results.

Final grade for every team is always based on criteria prepared by course guarantor in cooperation with supervisors. The main criteria are as follows:

1. Level of target achievement,
2. Quality of SVOČ presentation,
3. Quality of literary research,
4. Quality of final report,
5. Contracting authority satisfaction,
6. Quality of the team self reflection.

3.3 Course feedback and suggestions

Based on the Specialization project course comprehensive feedback by both students and contracting authorities, we can confirm our initial expectations that in the new course, theory and practice are effectively combined, so that, in effect, the students are more enthusiastic about this new project-based learning method. On the other hand, there were certain weaknesses that had an impact on the project results of some students' teams. Following this, we were able to define the processes which should be modified in academic year 2016/17 to make course more efficient, especially in the area of communication between course participants.

The main recommendations are as follows:

1. Improve the communication process between the students' team, the participating company and the supervisors.
2. Setting the rules of communication and cooperation within the students' team.
3. Greater involvement of participating companies at the SVOČ conference.

However, the contracting authorities' feedback shows that the companies appreciate the opportunity to test students' competencies and knowledge in practice, so employers are able to choose the right candidates for their actual graduate jobs more easily. This finding is confirmed by the recent employment of several graduates in the cooperating companies. These students were in fact members of the most successful teams in the Specialization project course.

4 Conclusions

The aim of this paper is to describe an application of the project-based learning method, which was implemented to Management of Commerce study programme in the academic year 2015/16, and to define course's processes that should be improved to ensure a higher level of students' competencies. Based on the study of various researches about project-based learning courses implementation, the new two semesters course called Specialization project was set up for academic year 2015/16. The main purpose was to integrate and develop competencies of each student through working on projects in the areas of trade, marketing and tourism. The course have been inspired by project-based learning methods, so all projects for students' teams are specified in cooperation with various companies.

According to course structure, students should at first obtain enough relevant theoretical sources in the research area and then start to work on concrete solutions to a given problem by a company, which expects students' relevant recommendations in the final report. After the first run of course Specialization project we were able to define the processes which should be more efficient. It is particularly useful to improve the communication process between the student team, the participating company and the supervisors and setting the rules of communication and cooperation within the students' teams too.

References

- Allen, J. (2005). Measuring Competencies of Higher Education Graduates. *New Directions for Institutional Research*, 126, 49-59.
- Armstrong, M. (2011). *Armstrong's Handbook of Human Resource Management Practice*. Philadelphia: Kogan Page.
- Atkinson, J. (2001). *Developing teams through project-based learning*. Hampshire: Gower Publishing.
- Belz, H., & Siegrist, M. (2001). *Klíčové kompetence a jejich rozvíjení*. Praha: Portál.
- Bender, W. N. (2012). *Project-based learning: differentiating instruction for the 21st century*. Thousand Oaks: Corwin.
- Chamoro-Premuzic, T., & Furnham, A. (2005). *Personality and Intellectual Competence*. New Jersey: Lawrence Erlbaum Associates.
- Dušek, R. (2014). *Kompetence v řízení lidských zdrojů malých a středních podniků*. České Budějovice. Dissertation thesis. University of South Bohemia, Faculty of Economics.
- Kašová, J. (2013). *Cesta za žákovskými projekty: metodická příručka projektové výuky a zážitkové pedagogiky*. Praha: Prázdninová škola Lipnice.
- Slavík, M. (2012). *Vysokoškolská pedagogika pro odborné vzdělávání*. Praha: Grada.
- Mitchell, G, Skinner, L., & White, B. (2010). Essential Soft Skills for Success in the Twenty-first Century Workforce as Perceived by Business Educators. *Delta Pi Epsilon Journal*, 52 (1), 43-53.
- Koucký, J., Ryška, R., & Zelenka, M. (2014). *Reflexe vzdělání a uplatnění absolventů vysokých škol. Výsledky šetření REFLEX 2013*. Praha: Univerzita Karlova.
- Klaus, P. (2007). *The Hard Truth about Soft Skills: Workplace Lessons Smart People Wish They'd Learned Sooner*. New York: Harper Collins e-books.
- Krompf, W. M. (2007). Identify core competencies for job success. *Infoline: Tips, Tools, and Intelligence For Trainers*, 24 (12).
- Lee, H. J., & Lim, C. (2012). Peer Evaluation in Blended Team Project-Based Learning: What Do Students Find Important? *Educational Technology & Society*, 15(4), 214-224.
- Maltese, R. (2012). *Project Based Learning: 25 Projects for 21st Century Learning*. Indianapolis: Dog Ear Publishing.
- Weber, M., Finley, D., & Crawford, A. (2009). An exploratory study identifying soft skill competencies in entry-level managers. *Tourism & Hospitality Research*, 9(4), 353-361. doi: 10.1057/thr.2009.22.

Session 7

Managing Changes and Innovations

CSR in the Context of Sustainable Development

Darja Holátová, Vlasta Doležalová

Abstract: *European Union trends towards sustainable development are increasingly applied to the corporate sector in the form of his social engagement and social responsibility. In the corporate sector, we are talking about corporate social responsibility. This philosophy integrates into business not only economic issues but also social and environmental ones trying to find balance between corporate profitability and responsibility. Corporate Social Responsibility is a business strategy. The brand value and reputation are increasingly seen as a company's most valuable assets, CSR can build the loyalty and trust that ensure a bright the sustainable development and future for corporate. By integrating CSR into corporate strategy and into business as core value, you are not only making a significant contribution to a better society. Corporations themselves visible, create your image and thus fight for their position, sustainable development and on the market. This fact is aware not only large corporations, but also small and medium sized enterprises and therefore social responsibility involved in their activities more frequently.*

Keywords: Corporate Social Responsibility (CSR) · Sustainable development · SMEs

JEL: L20 · M12 · M14

1 Introduction

Corporate Social Responsibility and Sustainable Development. The idea of increasing the profits of enterprises is becoming a phenomenon of the present times, as well as a factor in sustainability and sustainable development. Sustainable development should be included in thinking and in doing business. Combining business, successful entrepreneurial activities and the fulfilment of other corporate interests would be for the benefit of all involved and even for the whole of society (Haid & Járková, 2012).

The public demands that companies adhere to the rules, respect the environment, maintain a good relationship with employees and business partners and show an interest in what is happening around them. This increases the pressure of groups and individuals who have an interest in the organisations or who are affected by the activities of the organisation. They attempt to directly or indirectly influence the operation of companies and their actions.

However, these are not only obligations towards natural resources, this responsibility is executed on several levels. It is a voluntary adoption of the environmental, economic and social liabilities of the company. Corporate Social Responsibility cannot be summarised in one definition recognised by a company. It is a complex concept.

Corporate Social Responsibility, according to ČSN EN ISO 26000:2010, is the responsibility of the organisation for the impacts of its decisions and activities on society and the environment, and for ethical behaviour contributing to the sustainable development, health and welfare of society; it takes into account the expectations of stakeholders; is in accordance with the applicable legislation and international standards of behaviour and is integrated throughout the organisation and applied in its relations.

There is no uniform definition of CSR. This is due to the fact that CSR actually has no specific defining boundaries and is based on a voluntary basis. The reported definitions are not specific enough to give space to the widest possible application, which is probably also the objective of the organisations from which they come. We can mention, for example, the most famous and most quoted definition: "CSR is the voluntary integration of social and environmental aspects into everyday corporate operations and interactions with corporate stakeholders" (Green Paper, 2001). CSR is a way of doing business that meets or exceeds the ethical, legal, commercial and societal expectations. It is the continuous commitment of companies to behave ethically and to contribute to economic growth, while striving to improve the quality of life for employees and their families, as well as the local community and society as a whole (WBCSD (1999)).

Buchoholtz and Carroll (2012) extend the basic characteristics with a dimension involving the economic, legislative, ethical and philanthropic expectations that society has towards a business entity at a given time. By economic responsibility is understood the commitment to the company to meet the needs of the market and to capitalise on the

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owners' investment; by legislative responsibility is understood the enterprise's obligation to comply with relevant legislation; by ethical responsibility is understood the enterprise's obligation to act in accordance with the expectations of society; and by philanthropic responsibility is understood the company's commitment to beneficial activities and the support of the volunteerism of employees.

Because a company is an integral part of society, this fact determines its basic rights and obligations that arise towards the wider community, including contributing towards the improvement of the quality of life (Kunz, 2012). Corporate Social Responsibility implies the initiatives and activities of companies with significant economic and social consequences, and also impacts on the environment (Mishra & Modi, 2013). Socially responsible companies behave so as to be credible and transparent, their activities are 'voluntary', companies adopt a proactive, rather than only a reactive policy. The company management anticipates and actively creates new, positive trends.

In connection with the development of the whole of society, together with changing economic conditions, the needs and requirements of customers also change. They require better quality, more efficient products, better and faster services. Businesses want to make a profit and meet the expectations of owners and investors, they want to maintain their competitiveness. At the same time, they are already beginning to perceive that the expectations of society and interested groups are an important factor in their further development and may contribute to their good name and thus to the sustainable development of the organisation.

Sustainable development is a concept that is fundamentally different from the social responsibility and sustainable development of a particular organisation. Sustainable development refers to the way in which a company's needs are being met. Sustainability of the existence of a particular organisation may, or may not, be consistent with sustainable development. It depends on how the organisation is managed and controlled (ISO 26000).

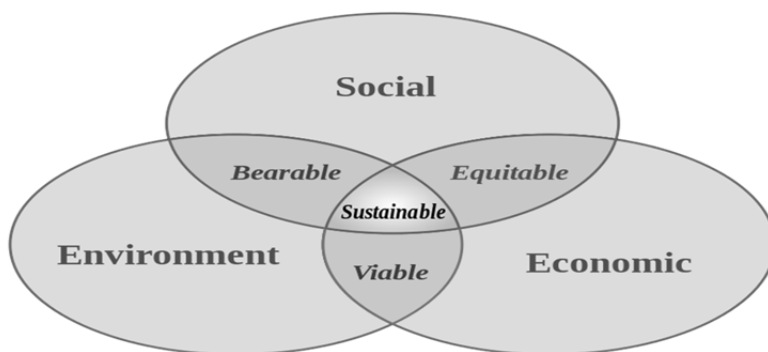
A common definition of sustainability traces back to a 1987 World Commission on Environment and Development report entitled, *Our Common Future*, which defines sustainability as follows:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Another popular view of sustainability consists of the overlap of three "pillars" of sustainability that must be considered in concert: Ecological factors, social factors, and economic factors (Libra guides, 2016).

In this sense, a commonly shared representation of sustainability can be seen really as the result of three dimensions, as in the Figure 1: economic (i.e., the capacity to generate income and employment for the sustenance of the population), social (i.e., the capacity to ensure conditions of stability, democracy, participation and justice, as well as the possibility to guarantee conditions of human well-being – security, health, education – equally distributed to all classes and genders) and environmental (i.e., the capacity to maintain quality and reproducibility of natural resources).

Figure 1 Three dimensions of sustainability



Source : Barile,S., Luca Carrubbo, Francesca Iandolo and Francesco Caputo (2013)

Compared to social responsibility, sustainable development is development that meets the needs of the present, without compromising the ability of future generations to fulfil their own needs.

Corporate Social Responsibility is based on the concept of sustainable development. A company currently has a tendency to consider its surroundings, judge the consequences of its actions. CSR therefore, as one of the methods of advocated sustainable development around the globe, becomes a method of gaining a competitive advantage (Werther & Chandler, 2011). The authors further state guidelines related to Corporate Social Responsibility, which they classify as: environmental sustainability, growth of prosperity, globalisation, free flow of information and the growing importance of good reputation and brand. CSR, the concept of Corporate Social Responsibility, cannot replace or take over the state's obligation in the area of laws or legal regulations, but companies must adhere to those laws.

2 Methodology and Data

The primary data were obtained by means of a questionnaire survey of 302 respondents of small and medium-sized enterprises in the Region of South Bohemia in the Czech Republic in 2013 and 2014. In the examined sample were represented in the sectors: trade 20%, transport 6%, services 26%, construction 10%, manufacturing 30% and agriculture 8%. Respondents (owners and managers) focused on the characteristic features of the surveyed enterprises and their human resource management strategies, evaluation of individual processes and areas of human resource management process and corporate social responsibility area. The information database was formed by data of a quantitative as well as qualitative nature. Based on technical literature, 9 basic processes were determined that are implemented in enterprises in general: Corporate Social Responsibility, Human Resource Management, Marketing, Manufacture of Products and Services, Trade and Sales, Financial Management, Quality Management, Information Internal Processes, Communication with the Public – Media.

Engaged of companies in various activities of social responsibility are divided into: donations, voluntary actions and sponsorship, minimising the negative impact on the environment, superior employment policy, other activities, not engaged in any activities.

3 Results

In the context of the survey of European SMEs, it can be seen that competitive advantage is not the first priority for SMEs. Issues of dialogue with stakeholders become existential for them. The most important topic for small and medium-sized enterprises is work relationships and therefore Human Resource Management. However, during our research, was found prioritisation of individual processes in small and medium-sized enterprises (evaluated by managers or respondents authorised by managers) was identified. Owners and managers of enterprises reviewed the various processes in order of importance, at levels of 1 to 9 (integers), with a list that reviewed processes for each undertaking separately. Evaluation of importance by an enterprise as level 1 means the most important process in the company, while the value of 9 is equal to the least important process, selected from a list of 9 evaluated processes. In practice, this meant that the owners and managers of businesses chronologically compiled the importance of consecutive processes. Each process has its specific value, i.e. No two processes are located on the same level of importance. The results classified the process of human resources management at the 6th place and process of Social Corporate Responsibility at 8th place according to the importance.

Following this research was evaluated the functioning of individual processes by managers or respondents authorised by managers. Functioning of processes was evaluated as very weak. The management quality of Corporate Social Responsibility was evaluated at 7th place and management quality of human resources at 5th place from all evaluated processes (Doležalová, Holátová 2015).

A statistical evaluation shows table 1, that the value of the first quartile (X1st.Qu.) was 49 250; the value of quartile (median) was 70 000; the value of the third quartile (X3rd.Qu.) was 90 000. The simple arithmetic average of evaluation of the level of the functioning of processes was 61 820 (mean) and the standard deviation (sd) for the analysed variable in the file was 36 922.

Table 1 Evaluation of the functioning of processes of social responsibility

Min.	X1st.Qu.	Median	Mean	X3rd.Qu.	Max.	NA.s	sd
0.000	49.250	70.000	61.820	90.000	100.000	15.000	36.922

Source: Holátová, Doležalová (2015)

This evaluation testifies to the fact that the managers evaluated of processes as insufficiently important although they still speak about this as about the essential.

The research also showed in which areas of social responsibility the surveyed companies are involved. Table no 2 : 62.7% of respondents in the companies show engagement in social responsibility primarily in activities of donations, volunteering and sponsorships.

Another area in which firms are involved is the area of minimizing the negative impact of business on the environment - 43.32% of respondents. Respondents also reported that 13.2% of companies are committed to superior employee policy and 20.79% state that they are engaged in other unspecified activities and 17.16% reported that they are not engaged in any activities.

Table 2 Percentage of companies engaged in various activities of social responsibility

Engagement of companies in activities	Engagement of companies in %
donations, voluntary actions and sponsorship	62.70
minimising the negative impact on the environment	43.23
superior employment policy	13.20
other activities	20.79
not engaged in any activities	17.16

Source: Holátová, Doležalová (2015)

4 Discussion

On September 25th 2015, OCN countries adopted a set of goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years. For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and people. Within the goals are 169 targets, to put a bit of meat on the bones. Targets under goal one, for example, include reducing by at least half the number of people living in poverty by 2030, and eradicating extreme poverty (people living on less than \$1.25 a day). Under goal five, there's a target on eliminating violence against women, while goal 16 has a target to promote the rule of law and equal access to justice (The guardian, 2015).

Figure 2 The Global Goals for Sustainable Development

United Nations (2015)

17 goals:

- 1) end poverty in all its forms everywhere
- 2) end hunger, achieve food security and improved nutrition, and promote sustainable agriculture
- 3) ensure healthy lives and promote wellbeing for all at all ages
- 4) ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- 5) achieve gender equality and empower all women and girls
- 6) ensure availability and sustainable management of water and sanitation for all
- 7) ensure access to affordable, reliable, sustainable and modern energy for all
- 8) promote sustained, inclusive, sustainable economic growth, full and productive employment, decent work for all
- 9) build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
- 10) reduce inequality within and among countries
- 11) make cities and human settlements inclusive, safe, resilient and sustainable
- 12) ensure sustainable consumption and production patterns
- 13) take urgent action to combat climate change and its impacts
- 14) conserve and sustainably use the oceans, seas and marine resources for sustainable development

- 15) protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss
- 16) promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- 17) strengthen the means of implementation and revitalise the global partnership for sustainable development

Werther and Chandler (2011) further indicate five basic trends related to the growing importance of Corporate Social Responsibility, i.e. to enhance prosperity, environmental sustainability, globalisation, free flow of information and the aforementioned growing importance of the company's reputation and brand.

Although many definitions have been attributed to the concept of Corporate Social Responsibility, all are essentially based on the basic definitions presented by the European Commission (Crowther & Aras, 2008): "Corporate Social Responsibility is a concept in which companies voluntarily integrate social and environmental interest in their business operations, and in interaction with their stakeholders."

Corporate Social Responsibility is an important topic in the European Union in the field of social and economic policy. Entrenched in this concept is also the state's approach which should support voluntary activities in various forms.

The key question for business entities is: Why should the company be socially responsible? Reported advantages for companies in terms of this concept are customer loyalty, good reputation, inner functioning of the system and the decrease of business risks. The advantages, however, are long-term in nature and many companies see only the costs of this decision

The elements that make up social responsibility reflect the current expectations of society, and therefore are constantly changing according to the changing interests and expectations of society and of an organisation that reflects these interests (ISO 9004). The organisation therefore must respond to the changing environment and respond to new demands. Many large corporations reassess their attitudes and respond to public expectations, the demands of their clients and the pressure of the environment in cases where their conduct is inconsistent with the generally perceived principles and expectations of the surroundings regarding responsible and correct behaviour.

Responding to public demands has become part of the strategy of many multinational and local companies that understand that this policy pays off for them in the long term. It has an impact on the overall rating of the company. Competitive advantage is sought, attitudes are reviewed and new ways explored, organisations change their strategies and management tools.

Many companies seeking competitive advantage are aware of these facts and are forced to respect them. In the global competitive environment, they begin to adopt more new features in their strategies. Business entities are realising that a narrow view of the manufacture and sale of their production and the sale of products and services is no longer sufficient. The corporate sector has come under increasing pressure of this trend and is under the influence of the pressure of stakeholders to demonstrably become involved in socially responsible activities (Jenkins, 2009).

Discussion on the basic principles, approach to CSR issues, measures and instruments have been and are constant topics. The European Commission has published a new policy on Corporate Social Responsibility. By taking steps better meeting their social responsibility, enterprises can help themselves as well as society as a whole.

The new strategy of the European Commission on Corporate Social Responsibility (CSR) aims to create favourable conditions for sustainable growth and job creation in the medium and long-term horizons. The European Commission presented new, simpler definitions of social responsibility as "the responsibility of enterprises for their impacts on society". The new policy also puts forward an action programme to cover eight areas, such as strengthening the market reward for CSR, and better linking of the European and global approaches to CSR (European Commission, 2011).

The standard adopted in 2011, ISO 26000:2010, Guidance on Social Responsibility is the current document supporting the philosophy and practice of CSR. This standard provides guidance on the integration of socially responsible behaviour in an organisation. It emphasises the importance of the results and improvement of the profile for the organisation in the area of social responsibility and its sustainable development (ISO 26000).

Although CSR philosophy implies the voluntariness of activities, general pressure on employers and entrepreneurs keeps growing and there is a visible shift from voluntariness towards obligation and legal bonds through the establishment of directives, regulations and agreements. However, CSR represents a method of managing a company and building relations with partners which contributes to the improvement of the reputation and credibility of the company (Freeman & Moutchnik, 2013).

Specifically, social responsibility is reflected by the integration of positive attitudes, practices and programmes in the business strategy of the company at the level of its top management. The Triple Bottom Line principle has a framework of three parts: social, environmental and financial. Many organisations have adopted this framework and evaluate their performance in the broader context (Slaper & Hall, 2011), indicating that the company concentrates not only on economic growth, which is primarily its objective, but also on the social and environmental aspects of its activities.

An increasing number of companies is aware of the importance of long-term investments in their own development, realising that orientation only on immediate profits and short-term goals is no longer a sustainable policy. Enterprises and representatives of various social spheres collaborate to improve the existing deficiencies of a company. A "win-win" situation is created in which everyone involved benefits. Corporate Social Responsibility encompasses the principles of conduct that are based on standards, guidelines and rules of conduct that are considered moral and correct in the context of a particular situation. This behaviour should fit into the framework of the objective to contribute to the sustainable development and welfare of society. Although there is no exhaustive list of principles of social responsibility, there is broad agreement that at least seven principles should be applied: human rights, international standards, principle of legality, principle of interested parties, principle of ethical conduct, principle of transparency, principle of responsibility (ISO 26000).

The role of Corporate Social Responsibility is currently increasing, particularly in the areas of business activities, such as general marketing strategy and tactics. Corporate responsibility is expected to enhance the positive image of a company, and to encourage customer interest and commitment to products (Pergelova & Angulo-Ruiz, 2013).

Reasons for considering involvement in socially responsible activities (Wehrich, Cannice, Koontz, 2013) are many.

Corporate Social Responsibility was originally created as a response to the growing negative impact of large, typically multinational companies. As pointed out by Jenkins (2009), the issue was increasingly being associated merely with large companies. However, as stated by Enderle (2004), in the past decade there has been a significant shift, combined with the recognition by SMEs of the growing importance of these very small fish to focus on social and environmental impacts.

The involvement of employees in a company plays a less obvious, albeit important role. It assists employees to develop new skills, increases their motivation and can lead to greater innovative activity and creativity. An international study conducted by authors Kim & Scullion (2013) deals with the effect of the concept of Corporate Social Responsibility on employee motivation.

Every company must monitor its own financial health and legal obligations, as well as those within the wider social and economic contexts. A company should be a "responsible corporate citizen", whether working in any field, at home or abroad, in developed countries or even third world countries. Multinational organisations sometimes tend to infiltrate their business into countries that have cheap labour, low taxes and where social demands are not so high. Therefore, there is a legitimate effort to encourage organisations to respect the unwritten standards, whether in the form of public codes of conduct, or the increasingly more widespread "social brands" (Torugsa, O'Donohue, Hecker, 2013).

The authors, came to the conclusion that active responsibility management, implemented in all three areas, can lead to increased financial gain. Thus, if a company has all three abilities, it actively collaborates with stakeholders and shares a common vision and strategy with them

Figure 3 The Triple Bottom Line principle of CSR



Source: Library (2016)

To achieve sustainable success in the constantly changing and uncertain environment, it is essential that organisations regularly monitor, measure, analyse and review their performance (ISO 9004). According to authors Pérez & Rodríguez del Bosque (2013), precise and detailed measurement of corporate responsibility is a complicated task.

There are two aspects of recognition and social responsibility. One aspect is that the organisation should understand how its decisions and activities influence others and the environment. Another aspect is that the organisation should understand the company's expectations regarding responsible behaviour in relation to these impacts.

Recognition of responsibility includes identification of problems caused by the decisions and activities of the organisation, and of the methods of dealing with these problems so that the organisation contributes to the sustainable development and welfare of society (ISO 26000).

5 Conclusion

The corporate sector and mostly small and medium-sized enterprises are coming under increasing pressure to demonstrably engage in activities that are referred to as socially responsible (Jenkins, 2009). While many such activities become part of the legislation, companies practising social responsibility should go beyond this framework. Kotler and Lee (2005) suggest that, just like taking care of our bodies is manifested in appearance and in a longer and happier life, social responsibility has the same effect on corporate practice.

Corporate responsibility as one of the methods of globally promoted sustainable development is therefore becoming a trend in management and the means of gaining competitive advantage (Werther & Chandler, 2011)

References

- Barile S., Carrubbo, L., Iandolo, F. & Caputo, F. (2013). From 'EGO' to 'ECO' in B2B relationships [online]. *Journal of Business Market Management*, 6(4), 228-253. Available from: <http://econpapers.repec.org/article/zbwfbubjbm/90646.htm>.
- Buchholtz, A. K., Carroll A. B. (2012). *Business and Society. Ethics and stakeholder management*. 8th ed. South-Western Cengage Learning.
- Crowther, D., Aras, G. (2008). *Corporate Social Responsibility*. 1. ed. Holstebro: Ventus Publishing. ISBN 978-87-7681-415-1. Available from: <http://bookboon.com/cz/student/organisation/defining-corporatesocial-responsibility>.
- CSR Europe (2014). *CSR Europe – 20 years of business-policy interaction driving the CSR movement [online]*. Available from: <http://www.csreurope.org/history>.
- Doležalová, V., & Holátová, D. (2015). Human Resource Management and Human Resource Development in SME's in the South Bohemia Region in the Czech Republic [online]. In *International Business & Education Conferences in London* (pp. 981-987). ISSN 1539-8757, ISSN 2157-9660. Available from: <http://www.cluteinstitute.com/conference-proceedings/LN15Proceedings.pdf>.
- Enderle, G. 2004. Global competition and corporate responsibilities of small and medium-sized enterprises. *Business Ethics: A European Review* 13(1), 50-63. DOI: 10.1111/j.1467-8608.2004.00349.x
- EN ISO 26000:2010. (2010). *Guidance on social responsibility*.
- EN ISO 9004:2009. (2010). *Managing for the sustained success of an organization – A quality management approach*
- European Commission (2011). *Corporate Social Responsibility: a new definition, a new agenda for action* [online]. Published on: 25/10/2011 http://ec.europa.eu/enterprise/newsroom/cf/itemdetail.cfm?item_id=5511.
- Freeman, E., & Moutchnik, A. (2013). Stakeholder management and CSR: questions and answers [online]. In *Umwelt Wirtschafts Forum*, Springer Verlag, Bd. 21, Nr. 1. Available from: <http://link.springer.com/article/10.1007/s00550-013-0266-3>.
- Haid – Járková, J. (2012). Udržitelnost (konečně) vstoupila i do ČR. *Moderní řízení*, 47(8).
- Holátová D., & Doležalová, V. (2015). Corporate Social Responsibility and Human Resource Management In *Proceedings of 18th Annual International Conference Enterprise and Competitive Environment* (pp. 276-28). Brno: Mendel University in Brno. ISBN 978-80-7509-342-4.
- Jenkins, H., A. (2009). A 'business opportunity' model of corporate social responsibility for small- and medium-sized enterprises. *Business Ethics: A European Review*. 18(1), 21-36. DOI: 10.1111/j.1467-8608.2009.01546.x
- Kim, Ch., H., & Scullion, H. (2013). The effect of Corporate Social Responsibility (CSR) on employee motivation: A cross-national study. *Poznan University of Economics Review*. 13(2), 5-30. DOI: 10.3389/ipsyg.2016.00144.
- Kotler, P., Lee, N. (2005). *Corporate Social Responsibility: Doing the Most Good for Your Company and Your Cause*. Wiley.
- Kunz, V., (2012) *Společenská odpovědnost firem*. Praha: Grada Publishing.
- Libra Guides (2016). *Sustainability: What is Sustainability?* [online]. Available from: <http://libguides.olympic.edu/c.php?g=231976&p=1541387>.
- Mishra, S., & Modi, S. (2013). *Positive and negative corporate social responsibility, financial leverage, and idiosyncratic risk*. *Journal of business ethics*, 117 (2), s. 431-448. DOI: 10.1007/s10551-012-1526-9.
- Pérez, A., Rodríguez del Bosque, I. (2013). Measuring CSR Image: Three Studies to Develop and to Validate a Reliable Measurement Tool. *Journal of Business Ethics*, 118(2), 265-286. DOI: 10.1007/s10551-012-1588-8.
- Pergelova, A., Angulo-Ruiz, L., F. (2013). Marketing and Corporate Social Performance: Steering the wheel towards marketing's impact on society. *Social Business*, 3(3), 201-224. DOI: 10.1362/204440813X13778729134282.
- Slaper, T., F., & Hall, T., J. (2011). The Triple Bottom Line: What Is It and How Does It Work? *Indiana Business Review*, 86(1).

- The guardian (2015). *Sustainable development goals: all you need to know* [online]. Available from: <https://www.theguardian.com/global-development/2015/jan/19/sustainable-development-goals-united-nations>.
- Torugsa, N., O'Donohue, W., & Hecker, R. (2013). Proactive CSR: An Empirical Analysis of the Role of its Economic, Social and Environmental Dimensions on the Association between Capabilities and Performance. *Journal of Business Ethics*. 115(2), 383-402. DOI: 10.1007/s10551-012-1405-4.
- United Nations (2015). Sustainable development goals [online]. Available from: <http://www.un.org/sustainabledevelopment/sustainable-development-goals>.
- WBCSD (1999). *Corporate Social Responsibility: Meeting changing expectation*. World Business Council for Sustainable Development.
- Werther, W., & Chandler, B. (2011). *Strategic corporate social responsibility. Stakeholders in a global environment*. London: SAGE Publications.

Supplier Evaluation System in the Management of Quality

Jindřich Fuka, Dagmar Bednářová, Otto Martínek

Abstract: *The right choice of suppliers is one of the key roles of management. For securing the quality of products is important to have effective processes and also good resources from suppliers. Supplier evaluation system represents an effective tool for eliminating inappropriate choices of suppliers. Inappropriate supplier would bring to the company not only additional costs but also bad reputation amongst customers.*

Assessment of supplier evaluation system was carried out in a medium-sized engineering company. Preliminary evaluation of the supplier provides information on whether the supplier is able to meet specific requirements. Ongoing evaluation of suppliers provides information about their current level of fulfilling specific requirements for their deliveries.

For the selected company were created following suggestions that should make supplier evaluation system more efficient: Evaluation of suppliers (More categories for suppliers according to the results of their evaluation), Preliminary evaluation of suppliers (Require supply samples before selecting the supplier, Always visit the supplier during the evaluation audit), Ongoing evaluation of suppliers, Carry out continuous assessment on a quarterly basis and take into account the development during the year, Conclude an agreement with suppliers about the level of quality and assign greater weight to the quality.

Key words: Supplier evaluation system · Quality management · Suppliers · Quality

JEL Classification: M0

1 Introduction

The importance of quality management is nowadays more significant than ever before. Enterprises are using the quality management more and more to improve their market position, their processes and overall performance to gain competitive advantage.

One of the specific parts of quality management system is a supplier evaluation system which is especially important for manufacturing companies because manufacturing is the main purpose of their existence.

Implementation of supplier evaluation system ensures that contracts for supplies will be signed only with those suppliers that are able to meet set requirements and ensure high quality of deliveries so the company can produce quality products and services.

It is, therefore, evident that it is important to have an effective system for supplier evaluation, which will help to ensure satisfaction of final customer by quality products and services thanks to smooth production.

The main goal of this paper is to analyze supplier evaluation system in selected medium-sized engineering company and suggest ways to make it more effective.

2 Literature review

Hutyra (2007) and Veber (2007) writes that the term “quality” is a term which is related to products, services, processes and other aspects of the business. The resulting quality is assessed according to the level of agreement between the way that processes were designed and the way they are running in the reality. Therefore it is possible to define quality as the fulfillment of specific demands.

Quality is nowadays one of the critical factors of the success in the business. Without management of quality is impossible to success on the market because customers can be in these days satisfied only by quality products which they want just in the right time and for a reasonable cost. Thus, managers and owners of companies are implementing

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quality standards which are helping them to succeed in the market amongst the other competitors. (Spejchalová, 2012; Janíček, Marek & al., 2013).

Hutyra (2007) points out that there are many other definitions of quality, such as:

- suitability for use,
- compliance with specific requirements,
- how customer defines quality,
- minimalization of losses

Bednářová (2013) agrees with these definitions of quality and she is pointing out that all of them are focused on the customer. Because it is possible to define quality in different ways Hutyra (2007) believes that it is necessary to create one universal definition of quality which would be valid worldwide. This kind of definition can be found in the norm ISO 9000:2005, which defines quality as the degree of compliance with the requirements set by inherent characteristics. Requirements are needs or expectations, which are set by the final customer or by the company. Inherent characteristics are the internal attributes of the object (product, service, process, source or system), which are also called quality features.

2.1 Quality management

Quality management is applied throughout the whole organization. Thus it is not focused only on production, but also on sales department, research and development, human resources etc. (Spejchalová, 2012).

Quality management is according to ISO 9000:2005 defined as coordinated activities for determining the direction of the organization and managing it with regard to the quality. (Palatková, 2011)

Quality management is a continuous never ending process which requires intense effort. This effort results in creation, stabilization and application of high-quality products and services that customers and other stakeholders expect and it contributes to the improvement of business processes and also to the improvement of relationships with stakeholders of the company eg. suppliers, employees, customers etc. (Armstrong, 2007). Charvát (2006) further suggest that cooperation and participation of all employees are the fundamental part of quality management.

Armstrong (2007) writes that one of the main reasons for implementing the quality management system is to spread awareness amongst the employees about the fact that quality is irreplaceable and highly important for the success of the company and its future development. Implementation should lead to a transformation of the company on a unit that exists primarily to satisfy needs and desires of customers in the best possible way. Dolezal, Máchal and Lacko (2012) then adds that another reason for implementing the quality management system is to ensure that needs and desires of customers are transformed into usable information that will allow the company to provide quality products and services and use all available resources efficiently.

Another reason for implementing the quality management system is an improvement of company image. Products and services with poor quality are one of the main reasons for loss of the customers and for lower revenues. Therefore certified quality management system serves as assurance of quality products and services and in current and potential customers of the certified company creates greater trust in production and company itself. (Spejchalová, 2012).

2.2 Importance of purchase

Vávřová (2007) states that the purchase has a significant role in the success of the enterprise from operational and also strategic perspective. The purchase represents every activity that is concerned with the acquiring necessary resources and their further use in the enterprise. The purchase is therefore understood as:

- function - a task in the context of other corporate activities,
- process – sequence of actions that results in the acquisition of the necessary resources
- organizational unit – a set of activities grouped into one department focused on purchase

Companies are not able to acquire or produce by themselves every material, stock, component etc. that they need for the products and services they are offering to customers. Especially big companies are focused on strategic activities and therefore they have to buy material, stocks, components etc. from suppliers. Purchase process has become one of the most important processes. Through purchase process is company systematically securing raw materials, services and information so that the production and operations can resume in the normal way and meet customer requirements in terms of quantity, quality, time and place of delivery (Nenádál, 2006).

Before purchasing itself it is necessary to set requirements for suppliers. These requirements are depending on the type of product or service or size of business. (Lévay, 2013). The company must establish and implement a specific way of inspection and other activities to ensure that the purchased material, stocks, components etc. meets the specified requirements for purchased goods. Therefore it is appropriate to establish a system for the evaluation and selection of suppliers based on these requirements (Lévay, 2013).

2.3 Suppliers and relationships with suppliers

Vochozka, Mulač et al. (2012) reported that relationships with suppliers are one of the basic principles of quality management and represent an important factor in the implementation of ISO standards (especially series 9001). Relationships with suppliers also play an important role in continuous improvement of business performance. Open and effective communication between business partners and their mutual cooperation is very important for improvement of their relationship.

Good customer-supplier relationship leads to higher quality of deliveries and suppliers are more able to meet the requirements of the purchaser. That's why today's quality management is about true mutually beneficial relationships with suppliers. Therefore, the current trend is to elevate traditional relationships with suppliers to partnerships (Nenadál, Noskievičová, Petříková, Plura & Tošenovský, 2008).

Bednarova (2013) writes that the choice of supplier is one of the key activities of quality managers. For a properly functioning system of quality, it is necessary to have not only quality processes but also quality resources from suppliers as inputs into these processes, to achieve quality outputs. Therefore, the quality of suppliers and their deliveries is extremely important for the company.

2.4 Requirements for deliveries

Setting requirements for the supply is important activity within the purchase process. If the buyer underestimates the importance of defining clear and comprehensive requirements on demanded supplies, then the supplier will not be able to satisfy these requirements. As a result, there is an excessively large number of complaints, additional costs and therefore increasing mistrust among partners (Nenadál, 2006).

Bednarova (2013) and Nenadál, Noskievičová, Petříková, Plura and Tošenovský (2008) writes that every customer has a right to determine his own requirements on his suppliers and deliveries, which he buys from them. Hutyra (2007) points out that on the other hand, the buyer is obliged to define requirements on his supplier in time and clearly communicate these requirements. According to Tomka and Vávrová (2014), the purchase process doesn't end after acquiring the deliveries because after that follows the evaluation of suppliers by the enterprise's own criteria. Evaluation of suppliers is the basis for creating a solid customer-supplier relationship. Evaluation of suppliers should be simple, fast, and it should be carried out regularly and also whenever the customer deems appropriate (Hutyra, 2007).

2.5 Supplier evaluation

Pre-selection evaluation of the supplier

Nenadál, Noskievičová, Petříková, Plura and Tošenovský (2008) are suggesting that the main goal of supplier evaluation is to choose at least one supplier that will be able to meet specific requirements for supplies for a long-term period. It is possible to understand supplier evaluation system as prevention before unreliable suppliers.

Gordon (2008) is stating that analysis of suppliers for the purpose of their evaluation is not easy. It needs a great deal of information for the purpose of analyzing supplier but access to these informations is often restricted. Supplier evaluation system is limited not only by the lack of the information but also by the fact that some activities of suppliers are difficult to measure. As a result of these limitations should company own, develop or buy tools, that will allow to overcome these limitations. Another option for overcoming these limitations is just asking the supplier for needed information, which should not be a problem, if there are good relationships, or outsource the evaluation of suppliers to the specialized external company. In any case, the basic for supplier evaluation should be the creation of their database.

Each organization usually creates its own database of potential suppliers. From this database are chosen suitable suppliers. Selected suppliers will be under detailed evaluation until there is only one (or a small group) that is suitable to make deliveries for a specific contract. The output of pre-selection evaluation of the supplier is a list of suppliers which are able to meet company requirements (Nenadál, 2006).

The purchasing department, or another part of the company which is responsible for the purchase, needs to specify desirable characteristics (attributes) of wanted supplies and the importance of each characteristic. The importance of each characteristic depends on the nature of manufactured products (Kotler & Keller, 2007).

Ongoing evaluation of suppliers

Until this time there has been mentioned only process of pre-evaluation of suppliers. Hutyra (2007) states, that in addition to this evaluation it is also important to do another form of evaluation and that is ongoing evaluation of suppliers. According to Svozilová (2011) systematic monitoring and evaluation of suppliers helps to lower the risk of defects of own products. Thanks to that there is a lower possibility that the customer will receive a product (or service) which is not 100% ok which helps to avoid possible dissatisfaction of customers. Hutyra (2007) states that results of the ongoing evaluation are communicated with suppliers immediately after the completion of the evaluation process. They can comment the results. Any shortcomings are then consulted with them. If the supplier has a negative evaluation and doesn't remove the shortcomings in agreed time, then the contract with the supplier is terminated.

Lévay (2013) suggests that doing evaluation of suppliers on a regular basis is a very effective tool which allows the company to manage suppliers. Managing suppliers effectively saves time, costs and it helps to avoid potential problems with them.

Optimal outcome of supplier evaluation is a finding that the status of deliveries, on which company agreed with suppliers, has been achieved. This compliance is ensured by the joint planning of quality of deliveries. This planning is most effective when it is planned together with the supplier. (Nenádál, Noskiewičová, Petříková, Plura & Tošenovski, 2008).

Selection of suitable suppliers

The main goal of supplier selection process is to select a suitable business partner that will be beneficial for the company. His selection is a strategic decision that should not be rushed but thoroughly thought through. The supplier should be selected on the basis of a long-term strategy and not on immediate enthusiasm or excitement. The main tool for selecting the right supplier should be the supplier evaluation process (Kucera, 2014).

3 Methods

The main goal is characterizing the current supplier evaluation system in the selected company and create suggestions which should make it more effective. Monitoring of the supplier evaluation system was carried out in a medium-sized engineering company. The company was visited for several times and individual processes were observed with a focus on the buying process. The buying process is the most important process for the purpose of this paper because the evaluation of suppliers is part of the buying process. To obtain necessary information to analyze buying process and the current system of evaluation of suppliers were used following methods:

- a semi-structured interview which brought the knowledge of the current situation of the supplier evaluation system. This kind of interview was executed several times with different managers. During these interviews were asked open questions and they were further developed during the interview to obtain as much information as possible;
- the observation that was used for monitoring the normal operations and activities of the quality manager;
- analysis of the internal documents which was the key source of information about the quality system in the enterprise and its application in the supplier evaluation system. Mainly were analyzed the cards of suppliers where the results of the evaluation are recorded and quality manual and results of audits.

4 Research results

Selected engineering company is certified by ČSN EN ISO 9001: 2009. Currently, it also meets the requirements of ISO 14001 and ISO 18001, but these standards are not certified yet. The current goal is to get the company certified according to ISO TS 16 949, which would allow the company to enter the automotive industry.

4.1 Costs of quality management system

The quality of the production is ensured by tools of top quality, professional measuring instruments and with the latest production technology and qualified personnel. Enterprise is focused not only on the quality of internal processes but also on the quality of employees, from which the enterprise requires a significant commitment to the quality. All employees must be aware that any poor quality will affect not only the company but also them. The quality of materials is important because it is not possible to produce a quality product with materials that have bad quality. Therefore, the supplier evaluation system is considered for very important part of the effective quality system.

Table 9 Maintenance costs of quality management system (source: internal documentation)

Recertification audit (1x in 3 years)	The first part of auditing process consists of big test of the whole quality management system and its level of fulfillment of ISO requirements.	60 000 CZK
Small audit (2x in 3 years)	Second and third part are the same. It is a small audit of documentation and test of the level to which is company system of quality complying with the requirements that were set in the first part of the auditing process.	30 000 CZK
Auditor (1x in a year)	Unbiased employee of external auditing company that will carry out the audit	31 000 CZK
Mandatory training of employees (1x in a year)	Training of all employees that is focused mainly on current quality management system and on safety of work and work environment.	120 000 CZK
Total maintaining costs of quality management system for 3 years		573 000 CZK
Average yearly costs of maintaining quality management system		191 000 CZK

Source: authors

The decision to implement certified quality management system according to ISO norms was made in 2005. The basic version of quality management system was already established in the company but it matched the requirements of ISO norms approximately around 60%. Therefore the system had to be altered to fully match the ISO standards.

One employee was working for one year at adjustments and implementation of the quality management system according to ISO standards. During this time he analyzed processes, documentation and other aspects of quality and he was adjusting that it would match requirements of ISO standards. Costs of his work were approximately 300 000 CZK. These 300 000 CZK are considered as a single initial investment.

After this single initial investment, there is only one additional group of costs and that is costs of maintenance of the system. The maintenance of the system basically consist of repeating mandatory audits. The process of auditing consists of three parts and it is repeated every three years. Each part is performed once in the three years. Average yearly costs of maintaining are 191 000 CZK. Description of each part of auditing process is in table 1.

4.2 Benefits of quality management system

It is difficult to quantify benefits of quality management system but it is possible to divide them into categories. These categories represents the main benefits which come from the quality management system. Categories are:

- Position on the market – certified quality management system creates a better market position for the company. Mainly due to the higher quality of services and products and therefore more satisfied customers.
- Lower costs for defective products and services – quality management system should increase the effectivity of company processes and thanks to that there should be less defective products and services. That means that the costs for defective products and services should be lower, especially in production where is this kind of costs highest.
- The higher commitment of employees – every employee has to know, that it is important to do his job perfectly and with maximum effort, because every product, service, process etc. which he carries out in poor quality can affect him and the whole company. Employees which understands that wants to be more involved in the quality management system and they are a bigger asset for the company.
- Evaluation and selection of suppliers – for the company whose main activity is production it is one of the biggest benefits. Quality supplies are a necessity for production. An effective system of selection and evaluation of suppliers lowers the risk of bad supplies and complication in production.

4.3 Suppliers

Suppliers are registered in a company database. They are categorized into groups according to their importance for the company and nature of supply. The most important group are suppliers of metallurgical materials because without this type of materials would be the production impossible. The company has 23 active suppliers and currently is not seeking for new ones. The company is trying to build long-term relationships with suppliers and tries to further develop these relationships through regular evaluation of the suppliers. Relationships with suppliers are also developed through mutual participation in developing products, rationalization and mutual advisory services. This usually leads to the product improvement and therefore to greater customer satisfaction.

4.4 Requirements for supplies

Requirements for supplies are based on the customer requirements for the product. After customer defines his requirements for the product, the company can define specific requirements for needed supplies and therefore also requirements for suppliers. Suppliers have to be able to deliver supplies on the time, in the demanded quality and quantity. Each delivery is checked before the takeover. The completeness of the delivery is checked and there is also inspection of the packaging. In the case of damaged packaging must be the whole content of package checked.

After these controls, the deliveries are accepted and stocked or, in the case of problems, file a complaint with the supplier. If there are excessive amounts of complaints at one supplier, then the evaluation of supplier is revisited. The main goal of complaint process is to acquire supplies in the agreed state or, in case if it necessary, appropriate financial compensation. Procedures mentioned above are defined by the buying process which is one of the main processes in the company. Inputs for the buying process are:

- definition of the final product by customer,
- financial resources of the company,
- results of evaluation of related suppliers.

Outputs of the buying process are:

- realized supplies,
- protocols, certificates and evaluation of supplier which is used for decision about further purchases from the supplier.

Sales department is responsible for the stated buying process

4.5 Supplier evaluation system

An important step is to choose a supplier that can meet the requirements for the supplies in the long-term period. Supplier evaluation system in the monitored company consists of pre-selection evaluation and ongoing evaluation of the suppliers. This system is described below.

4.6 Pre-selection evaluation of the supplier

In the case that new supplier is needed the company uses mainly references from its current suppliers or customers to choose a new supplier. If these references are satisfactory, then company performs audit at supplier to check if the supplier has effective quality system. After that company seeks additional informations about supplier's ability to fulfill the terms of the specific contract. Part of the evaluation of new supplier is the assessment of the first two deliveries. Those first two deliveries are checked for the right quantity, quality, completeness of documentation and integrity of the packaging. On the basis of quality of first two deliveries it is decided about the future cooperation with supplier.

4.7 Choosing the supplier

Choosing the supplier, whether new or existing for further cooperation, always precedes process of supplier evaluation. The new supplier is selected on the basis of pre-selection evaluation. In the case of choosing one of the current suppliers is supplier selected on the basis of his annual evaluation. This evaluation asses his ability to fulfill his commitments during the year, his quality system and level of cooperation.

4.8 Ongoing evaluation of suppliers

Ongoing evaluation of suppliers take place at the end of the year. The supplier is assessed for his performance in the last year by specific criteria in four categories as follows:

- evaluation of quality system;
- evaluation of quality of deliveries;
- adherence to deadlines of deliveries;
- evaluation of cooperation.

In each category can supplier achieve 100%. Each supplier has an evaluation card, where are written results of assessment of each category. Obtained percentages are used for the final overall evaluation.

a) Evaluation of quality system

Company is assessing the quality management system that is implemented at the supplier. The system should be certified while different kinds of certifications are rated differently. If the system is not certified than the company assess the supplier's quality system through following types of audit:

- performing audit of supplier by company's own employees,
- retaking results of audit made by another company which is considered as reliable,
- retaking results of audit made by external auditing company.

Percentages obtained on the basis of evaluation results of different kinds of quality management system are displayed in the table 2.

Table 10 Criteria for evaluating category „quality system“ (source: internal documentation)

Obtained percentages	Type of certification / audit
100%	ISO TS 16 949
90%	ISO 9001
results of audit	audit made by company's own employees or retaken results of audit from another company
74%	without certification / audit

Source: authors

b) Evaluation of quality of deliveries

The quality of deliveries directly affects the quality of final products. It is assessed whether the delivery matches ordered quality, quantity and if the documentation is complete and integrity of the packaging. Final evaluation is made with following formula:

$$QS = 101 - \frac{\sum WE1*1 + \sum WE2*5 + \sum WE3*100}{\sum WE} \quad (1)$$

where deliveries are categorized into the following groups:

- WE1 – Delivery without deviation, with complete documentation in prescribed and undamaged packaging, size and quality corresponding to the requirements of the customer.
- WE2 – Delivery is not 100% correct, there are some deviations from the requirements of the customer but it is possible to release conditionally the material for further processing.
- WE3 – Supply does not meet the requirements of the customer and it can not be released to the production.
- WE – all deliveries

c) *Adherence to deadlines of deliveries*

This is an important factor that affects the continuity of production. It prevents additional costs of downtime in production. Basic criteria for evaluating this category is ration between deliveries on time and all deliveries. For deliveries on time are considered all deliveries that are delivered three days earlier or three days later. Final evaluation is made with following formula:

$$DD = \frac{\text{Deliveries on time}}{\text{All deliveries}} * 100 \quad (2)$$

d) *Evaluation of cooperation*

Collaboration is evaluated on the basis of communication with the supplier and experiences which company has with the supplier. Enterprise is assessing mainly following:

- Initiative of the supplier
- Style of communication
- Corrective actions
- Reaction on problem
- Self-improving
- Abiding of quality agreement

In the table below are displayed percentages and criteria that supplier must fulfil to obtain them.

Table 11 Criteria for evaluation of cooperation

Obtained percentages	Criteria
100 – 90%	Supplier is willing and helpful, he is initiative and he is suggesting improvements, he is active in solving problems, he is presenting corrective actions, he is constantly working on his self-improvement and he is fully abiding quality agreement.
89,9 – 75%	Supplier is fulfilling his responsibilities but he is dos not do anything extra without asking him, he is not initiative, he is maintaining his system on the same level without any effort to improve, he is reacting on problems reluctantly, he is abiding quality agreement with some exceptions.
less than 75%	There are troubles with supplier, he reacts late on problems, he does not want to make corrective actions and improve his system, he does not abide the quality agreement

Source: internal documentation

Evaluator on basis of his experiences with the supplier evaluates the cooperation with the supplier. This category is subjective and depends on the approach and expertise of the evaluator. There is a bigger likelihood of errors.

4.9 Overall evaluation of suppliers

Overall rating is influenced by the results in individual categories. Each category has different importance. Some are more important than others. Because of that has each category different weight to express its importance. See table 4.

Table 12 Weights of categories

Category	Weight of category
evaluation of quality system	0.20
evaluation of quality of deliveries	0.30
adherence to deadlines of deliveries	0.30
evaluation of cooperation	0.20

Source: internal documentation

Final evaluation of supplier is calculated as summing of multiples of obtained percentages in each category and weight of appropriate category. The formula is as follows:

Final percentage rating = $0,20 * \% \text{ obtained for quality system} + 0,30 * \% \text{ obtained for quality of deliveries} + 0,30 * \% \text{ for adherence to deadlines of deliveries} + \% \text{ obtained for cooperation}$

On the basis of final percentage rating is supplier assigned to a certain group of suppliers. There are three groups which are named simply A, B and C. The percentage ranges with corresponding groups are displayed in the following table.

Table 13 Percentage range for grading in each category (source: internal documentation)

Percentage range	Grade in categories
100 – 90%	A
89,9 – 75%	B
less than 75%	C

Source: internal documentation

These groups indicate the extent to which the supplier is able to meet company's requirements during the year.

There are some additional rules for classification of suppliers:

- „A“ – Suitable suppliers
Suppliers in this group can not have less than 75% in any category. Simultaneously he has to have at least 90% in two categories and one of them has to quality system or quality of deliveries.
- „B“ – Suitable suppliers with objections
- Into this group belong suppliers that don't meet the requirements for “A” group and simultaneously they do not obtain less than 75% from each category except the cooperation.
- „C“ – Unsuitable suppliers

Suppliers that obtained in at least one of the categories, except the category of cooperation, less than 75% are categorized as “C”.

Final results of evaluation of suppliers is communicated with them. Suppliers from group “B” and “C” has to work on improvement. If the supplier is in the “C” category for a long time period or if he does not work on his improvement than the contract with him is terminated.

5 Conclusions

Selected enterprise is already applying the concept of quality for several years and it is continually working on improving its processes. The current of suppliers evaluation, which is a part of enterprise's quality system, provides sufficient information for the selecting and assessing suitability of potential and current suppliers, however there is some room for improvements. On the basis of conducted analysis have been identified following proposals for improvement of supplier evaluation system.

a) Overall evaluation of suppliers

Extension overall evaluation for category „D“. Suppliers are categorized in three groups (A, B, C). The main objective of these categories is to motivate suppliers to achieve a better rating. The proposal is to tighten up the evaluation of suppliers by creating fourth group of suppliers. By creating the fourth “D” category would some suppliers be reclassified to lower category. Individual categories and percentages which supplier has to obtain to be assigned to them are displayed in the table 7.

Table 7 Suggested extension of overall evaluation

Category	Percentage range	Final evaluation
A	100 – 95%	Suitable suppliers
B	94,9 – 85%	Suitable suppliers with rebuke
C	84,9 – 75%	Suppliers with conditions to improve
D	less than 75%	Unsuitable suppliers

Source: internal documentation

Creation of fourth category would enhance the effort of suppliers to improve. It would also make easier to identify their individual shortcomings. Suppliers in category “C” would need to make immediate corrective actions.

b) Pre-selection evaluation of the supplier

- **Demand supply samples before selecting a supplier.** Part of the pre-selection supplier evaluation system is assessment of quality and other aspects of first two deliveries. It would be more effective to request samples of supplies for the preliminary examination and approval. This would help to avoid the problems that would arise

in the case of low-quality raw materials in the first two deliveries. The proposed procedure would increase the quality of supplier selection before the beginning of cooperation.

- **Always visit the supplier during the evaluation audit.** In pre-selection phase is supplier always subjected to audit to explore and verify level of his quality system. However, in some cases are used results of audits performed by another trustworthy supplier's customers or results of audits made by external auditing company. The recommendation is to stop using results of audits made by other companies and always perform audit by company resources to become more familiar with the potential supplier.

c) *Ongoing supplier evaluation*

- **Perform evaluation quarterly.** Evaluate suppliers quarterly would allow creation of fifth category in supplier evaluation system, concretely „Development of supplier evaluation“. This category would better reflect the ability and willingness of suppliers to improve.
- **Conclude quality agreement with suppliers.** At this time the selected company does not have quality agreement with any supplier. It would be appropriate to conclude quality agreement with suppliers. In the agreement would be determined mutual goals of quality, customer requirements and other circumstances of mutual cooperation.

This paper deals with supplier evaluation system in selected medium-sized engineering company. Brief literature review is located at the beginning of this paper. Then follows analysis of the supplier evaluation system and at the end were suggested proposals for improvements that should make the system more efficient.

Acknowledgement

This paper is based on the thesis of Ing. Otto Martínek.

This paper was supported by the Project No. GA JU 053/2016/S.

References

- Armstrong, M. (2007). *Řízení lidských zdrojů: nejnovější trendy a postupy*. 10. ed. Praha: Grada. ISBN 978-80-247-1407-3.
- Bednářová, D. (2013). *Řízení kvality*. V Českých Budějovicích: Jihočeská univerzita, Ekonomická fakulta. ISBN 978-80-7394-404-9.
- Doležal, J., Máchal, P., & Lacko, B. (2012). *Projektový management podle IPMA*. 2 ed. Praha: Grada. ISBN 978-80-247-4275-5.
- Gordon, S. R. (2008). *Supplier evaluation and performance excellence: a guide to meaningful metrics and successful results*. Ft. Lauderdale, FL: J. Ross Pub. ISBN 1932159800.
- Charvát, J. (2006). *Firemní strategie pro praxi*. Praha: Grada. ISBN 80-247-1389-6.
- Janíček, P., & Marek, J. (2013). *Expertní inženýrství v systémovém pojetí*. Praha: Grada. ISBN 978-80-247-4127-7.
- Kotler, P., & Keller, L. K. (2007). *Marketing management*. Praha: Grada. ISBN 978-80-247-1359-5.
- Kučera, M. (2014). *Rozvoj dodavatelů*. 37. ISBN 978-1502255655.
- Levay, R. (2016). Nakupování [online]. [cit. 2016-11-18]. Available from: <http://www.ikvalita.cz/tools.php?ID=126>
- Martínek, O. (2016). *Hodnocení dodavatelů v systému managementu kvality ve vybraném podniku* [thesis]. Jihočeská univerzita v Českých Budějovicích.
- Nenadál, J. (2006). *Management partnerství s dodavateli: nové perspektivy firemního nakupování*. Praha: Management Press. ISBN 80-7261-152-6.
- Nenadál, J. (2008). *Moderní management jakosti: principy, postupy, metody*. Praha: Management Press. ISBN 978-80-7261-186-7.
- Palatková, M. (2011). *Marketingový management destinací*. Praha: Grada Publishing. ISBN 978-80-247-3749-2.
- Spejchalová, D. (2012). *Management kvality*. Praha: VSEM.
- Svozilová, A. (2011). *Zlepšování podnikových procesů*. Praha: Grada. ISBN 978-80-247-3938-0.
- Tomek, G., & Vávrová, V. (2014). *Integrované řízení výroby: od operativního řízení výroby k dodavatelskému řetězci*. Praha: Grada. ISBN 978-80-247-4486-5.
- Tomek, G., & Vávrová, V. (2007). *Řízení výroby a nákupu*. Praha: Grada. ISBN 978-80-247-1479-0.
- Veber, J. (2007). *Řízení jakosti a ochrana spotřebitele*. 2 ed. Praha: Grada. ISBN 978-80-247-1782-1.
- Vochozka, M., & Mulač, P. (2012). *Podniková ekonomika*. Praha: Grada. ISBN 978-80-247-4372-1.

Crisis Management and Human Resources

Miroslav Němec, Darja Holátová

Abstract: *The objective of this research is to analyse the situation in terms of economic, legal, organizational and human resources aspect by available scientific methods and using the knowledge of the relevant literature, then determine critical points and limits and summarize the research results. Next task is to label and describe the expected outcomes and recommendations for further development of the road management on the Czech Republic. This idea will be extended in an article intended to be published in the Inproforum 2016 collection of papers and amended in the following discussions.*

Key words: Management · Crisis Management · Human Resources Management · Road Management

JEL Classification: L20 · M12

1 Introduction

Crisis management is an integral part of company management. It concerns project management, process management and also management of human resources. Crisis management involves finding and assessing risks relating to human factor, i.e. undesirable consequences for an organization. (Smejkal, V., Rais. (2010).

Crisis is a situation characterized by impaired balance between basic elements of a system and attitudes of people to the existing system. It can be an extraordinary event, danger threatening the company's existence, serious accident or adverse economic situation. (Zapletalová, et al., 2012). Crisis, often reduced to major events..., are traditionally perceived as exceptional situations. It is possible analyzing crisis as a process of organizational weakening (Roux-Dufort , 2007). Accidents and unforeseen side effects time and again believed the promises of risk management and damage control (Pearson, Roux-Dufort, Clair 2007).

Crisis management requires people who are able to foresee and manage the staff in crisis situations and successfully communicate. The qualification, the personal assumptions and managing people of risk managers are one of the important conditions of future enterprise's development. Right now it is clear that the strategy of successful enterprise is based on the management, on the managers, who are oriented to the situation's solution and they have the ability to create and develop the vision with the appropriate time horizon of risk managementu (Hrazdilová Bočková Kateřina, Monika Dohnanská, Hylčíková daniela, Vaníčková Radka,(2016)

Human resource management is a strategic and logically coherent approach to management of the most valuable asset of any organisation, i.e. its staff, that jointly and individually contributes to achieving organisation's goals (Armstrong, 2014). It is a philosophy of human resource management and also an essential precondition of continuing business success, hence, nothing can be compared to human resources. Efficient steering of workers as well as taking advantage of their professional skills, ingeniousness and creativity in fulfilment of set objectives can be crucial competitive advantage of any organisation (Dytrt, 2006).

The article concerns a long-term research into the situation of road management in the Pardubický Region. The observations have been running since 2002. The gained, updated and amended results would be used as a background for dissertation.

Development of road management in the Czech Republic after 1989 was influenced by social changes, especially by the transfer from the centrally planned to market economy. Road management before 1989 had a unified personnel, organizational and material structure, similar to that of the army. The Czech Republic as a part of the European area is crossed by the Trans-European road network forming a unified road infrastructure with 1st, 2nd and 3rd class roads in our country. This aspect was not fully reflected after 1989 as an integral part of social, organizational and economic changes. Certain deviations in the post-1989 development exceeded the impassable limits for a feasible, safe, accessible and capacity-sufficient road infrastructure. This fact presents a safety risk within the European and national context.

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2 Material and Methods

Research is based on long-term observations to enable us being acquainted with the development stages of the object in focus, especially to foresee the points when quantity becomes quality, or contrarily, insufficient quantity becomes poor quality.

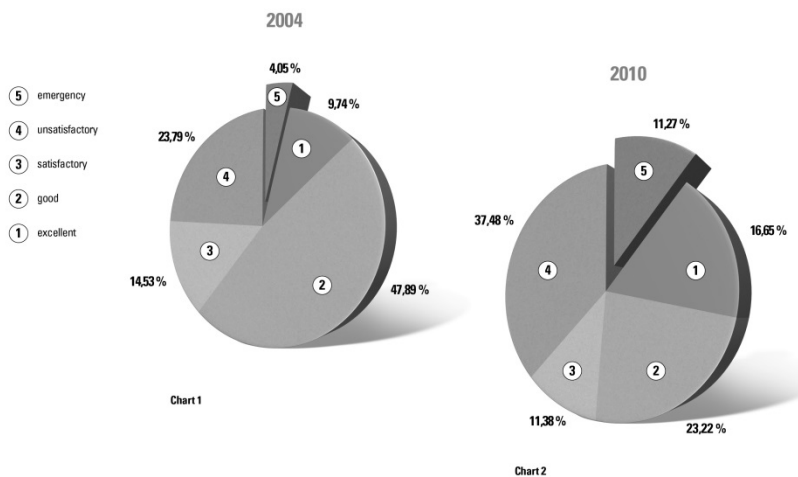
Analytical comparison was used as a main basic method, based on personal interviews, questionnaire and study of the national statistics. The research used the method of analytical comparison based on personal interview, questionnaires and studies of the national statistics.

The author plans to use analytical comparison method in his further research, based on interviews, questionnaires, reference literature study, experience of foreign practices, analysis of the corresponding legislation in comparison with the research results. The expected research outcomes will determine the future development, marking of critical places and points of the transfer of quantity into quality, or insufficient quantity into low quality. The research aims to recommend owners of 1st, 2nd and 3rd class road owners in the Czech Republic reactions based on specific economic, legal, human resource and organizational measures to divert emergency situations.

3 Results

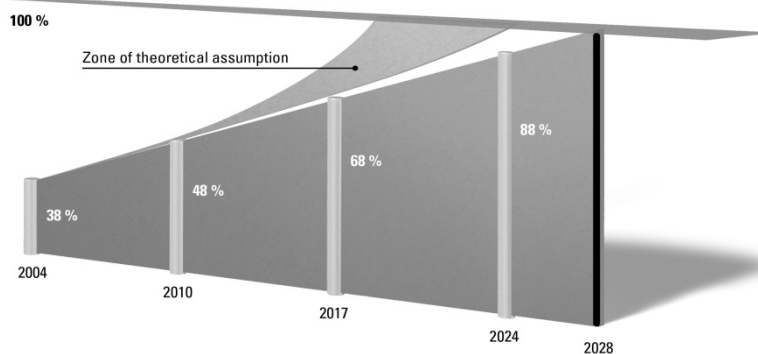
The results are indicated in the following charts and comments. Research of 2nd class roads in the Pardubický Region (Figure 1) was made in the whole range of its 915 km. In 2004, roughly 10% of these roads were labelled with number one, i.e. new or almost new. This section of the chart was extended to nearly 17% by 2010, especially in the form of modernized spinal roads. On the contrary, emergency and unsuitable condition roads made over 38% in 2004; the research in 2010 revealed almost 49% of this parameter. This growth reflected the road surface condition graded with marks 2 and 3 (good and satisfactory). The development is described in Figure 2.

Figure 1 Situation of 2nd class road surfaces in the Pardubicky Region



Source: PavEx Consulting (2004), PavEx Consulting (2010), ŘSD ČR (2004, 2010).

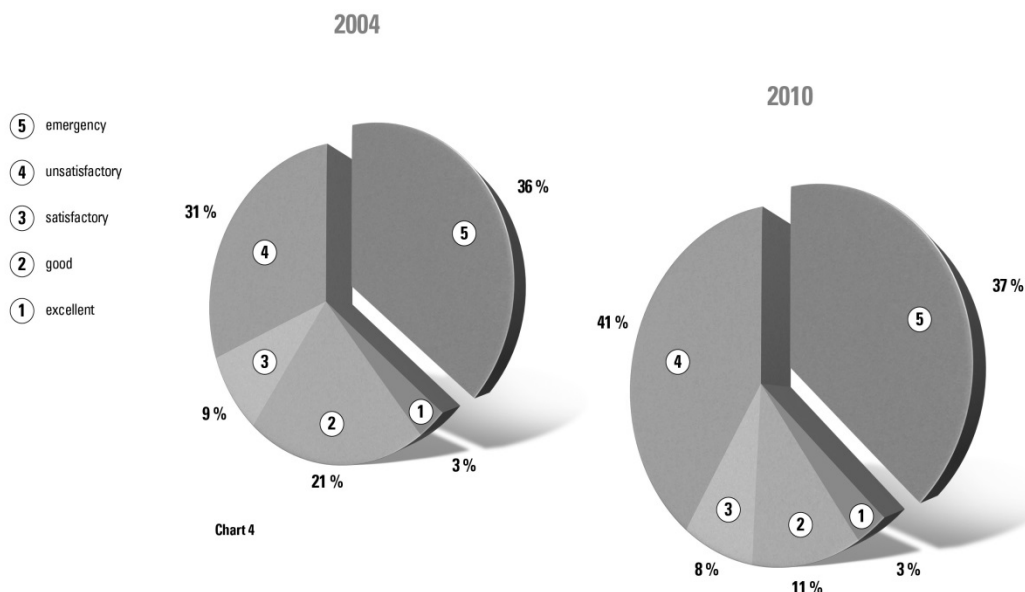
Figure 2 Development of 2nd class road surfaces in Pardubicky region before 2017 final assessment



Source: own research (PavEx Consulting (2004), PavEx Consulting (2010))

Unsatisfactory and emergency condition roads are indicated in Figure 2. Linear extrapolation was used to make an estimation of the development of 2nd class roads surface in the Pardubický Region. The prognosis shows that after a six-year period as at 1st January 2017 there will be 68% of unsatisfactory roads. Unless road owners change their attitude to their property, we can expect that in 2028, all surfaces of the 2nd class roads will fit in the category of “emergency” and “unsatisfactory.”

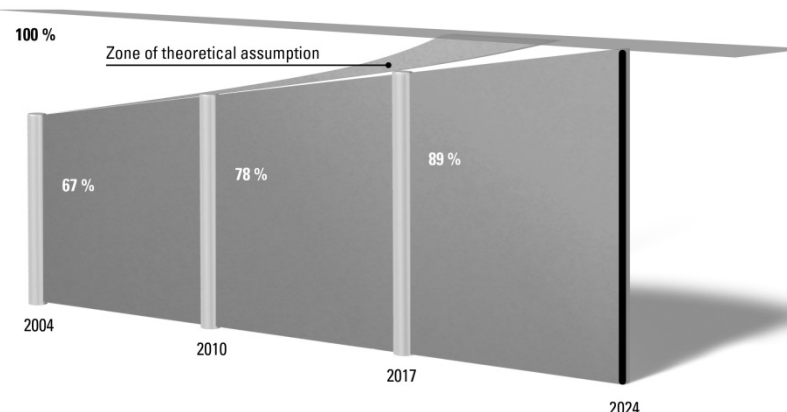
Figure 3 Situation of 3rd class road surfaces in the district of Chrudim



Source: PavEx Consulting (2004), PavEx Consulting (2010), SÚS (2004, 2010).

The research was carried out in the district of Chrudim (Figure 3). Situation in other districts (e.g. Pardubice, Svitavy and Ústí nad Orlicí) in the Region is roughly the same. Extrapolation was made and therefore this road category in other districts was not researched. In 2004, almost 67% of 3rd class roads in the Chrudim and Pardubice districts were found in unsatisfactory and emergency condition. In 2010 this number grew to almost 78%. New and repaired roads classified with grade one stayed on 3%. However, the number of roads classified with grade 2 and 3 fell to category emergency and unsatisfactory in 2010. The pie charts demonstrate that research from the period 2004-2010 shows a declining trend of the road property condition.

Figure 4 Development of 3rd class road surfaces in Pardubický region before 2017 final assessment



Source: own research (PavEx Consulting (2004), PavEx Consulting (2010))

Linear extrapolation was used to estimate the development of the 3rd class roads in the Pardubický Region. 89% of surfaces of 3rd class roads in the Pardubický Region will be in unsatisfactory and emergency condition in 2017. It is expected that in 2024 one hundred percent of road surfaces will be in the same condition.

4 Conclusion

This overview presents a serious problem across the whole society because it is expected that the situation will be more or less similar in other regions of the Czech Republic. The state, as an owner of 1st class roads, will encounter fewer problems. The problem is of economic, legislative and organizational nature and addresses, among others, crisis management of human resources.

Crisis management is a continuous activity whose aim is to reduce the probability of risk occurrence, impact and eliminate crisis management. (Zuzák, Konigová, 2009). From this view Human resource management means not only management and steering of people and creating favourable conditions for their working activity and reproduction of their labour power in the light of organisation's goals, but also promotion of efficient human resource deployment in the interests of the organisation as well as cost-effective utilisation of human potential of organisation's staff, development of its potential, appreciation of organisation's human capital and rational management of the entire HR system of the organisation (Holátová et al., 2012).

Managing risk is a challenge for many reasons. There are a lot of barriers to effective risk management, including organizational, practical, procedural, and personal. There are many ways to overcome the barriers to managing risk (Pullan and Murray-Webster Ruth, 2011).

References

- Armstrong, M., & Taylor, S. (2014). *Armstrong's Handbook of Human Resource Management Practice*. 13th ed.. London: Kogan Page Publishers.
- Dytrt, Z. (2006). *Dobré jméno firmy*. 1st ed. Praha: Alfa Publishing.
- Hrazdilová Bočková, K., Dohnanská, M., Hylčíková, D., & Vaničková, R. (2016). Project Manager's Competencies. *Economics World*, 4(6).
- Pearson, M. Ch., Roux-Dufort, Ch., & Clair, A. J. (2007). *International Handbook of Organizational Crisis Management*. Český statistický úřad. *údaje 2004, 2010, 2015*.
- ŘSD ČR (2004, 2010). *Interní podklady Ředitelství silnic a dálnic České republiky 2004 a 2010*.
- SÚS (2004, 2010). *Interní podklady Správy a údržby silnic v České republice 2004 a 2010*.
- PavEx Consulting (2004). *Stav povrchu vozovek silnic II. a III. třídy v Pardubickém kraji, rok 2004*. PavEx Consulting, s.r.o.
- PavEx Consulting (2010). *Stav povrchu vozovek silnic II. a III. třídy v Pardubickém kraji k 31.7.2010*, PavEx Consulting, s.r.o.
- Smejkal, V., & Rais, K. (2010). *Řízení rizik ve firmách a jiných organizacích*. Grada Publishing.
- Roux-Dufort, Ch. (2007). Is Crisis Management (Only) a Management of Exceptions? *Journal of Contingencies and Crisis Management*, 15(7). DOI: 10.1111/j.1468-5973.2007.00507.x
- Pullan, P. & Murray-Webster, R. (2011). *A Short Guide to Facilitating Risk Management: Engaging People to Identify, own and manage risk*. Routledge. ISBN 978-1409407300.
- Zapletalová, Š., et al. (2012). *Krizový management podniku pro 21.století*. Ekopress.
- Zuzák, R., & Konigová, M. (2009). *Krizové řízení podniku*. Grada Publishing.

Project Management And Its Impact On Growth Rate Of Small and Medium-sized Enterprises

Jaroslav Vrchota, Petr Řehoř, Monika Maříková, Ladislav Rolínek

Abstract: *The aim of the managers in SMEs is to have a competitive enterprise on the market, to develop and achieve some positive results. Project management can play a significant role in facilitating this contribution; however, SMEs require less structured forms of project management than those used by larger, traditional organizations. Project management is the set of managerial activities needed to lead a project to a successful end. The paper deals with finding whether the project management of SMEs influences the growth rate of an enterprise. Data were gathered as questionnaires and interviews from 183 enterprises operating in the Czech Republic. The research was made in the period of 2014-15. Authors in the paper failed to confirm that the organizations with project management have better growth rate.*

Key words: Project · Growth rate · SME · Management

JEL Classification: L20 · M10

1 Introduction

Small and medium enterprises (SMEs) are increasingly seen as playing an important role in the economies of many countries (Olawele and Garwe, 2010). SMEs enhance competition and entrepreneurship and hence have external benefits on economy-wide efficiency, innovation, and aggregate productivity growth (Beck, 2007). One of the best ways to address unemployment is to leverage the employment creation potential of small businesses and to promote small business development (FinMark Trust, 2006).

Sectors of SMES are variable and dynamic (Pošvář and Erbes, 2002). All sectors of the SMEs are characterized by certain developments and trends, which gradually or even very intermittently causes the industry changes. Life cycle industry is heavily dependent on the development of demand, which is then reflected in the growth rate of the industry (Sedláčková and Buchta, 2006). The macroeconomic environment influences the SMEs by an expected growth rate of the economy, the state fiscal policy, monetary offering, expected interest rates, inflation, etc. (Synek, et al., 2011). An entrepreneur or a top manager must be almost equally interested in both prosperity and continuity of the development and performance improvement company (growth rate) and on the prevention, monitoring and risk management, including crisis management (Veber and Srpová, 2012). If an enterprise grows, it means that the market is interested in the production or services, its management is successful in their work and the enterprise is profitable (Furková, 2014). The phenomenal aspect of the growth rate of an enterprise is mainly revenue growth (turnover). Business growth is therefore connected to expanding its activities, but it also raises more risk arising precisely from the growth. Consideration of the correct growth rate of an enterprise is one of the strategic decisions of managers (Synek, et al., 2011).

There are many different definitions of business growth and ways of measuring this growth. Business growth is typically defined and measured, using absolute or relative changes in sales, assets, employment, productivity, profits and profit margins. In addition, sales growth is also easier to measure compared with some other indices and is much more likely to be recorded. Sales are a good indicator of size and growth. Sales may also be considered a precise indicator of how a firm is competing relative to their market (Barringer, et al., 2005).

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The first stream, and conceivably the largest, examines growth as an outcome. For the most part, this stream of literature uses growth as the dependent variable and essentially has as its primary goal to explain varying growth rates and/or increments of growth (McKelvie and Wiklund, 2010).

High growth tends to be associated with a firm's entrepreneurial behavior (Brown, et al., 2001). Thus, growth tends to be considered a logical consequence of innovative, proactive and risk-taking behaviour on the part of the firm, as these are the dimensions which define an entrepreneurial orientation (EO). The relationship between the EO of the firm and its performance has been thoroughly investigated, from both a conceptual (Lumpkin and Dess, 1996) and an empirical point of view (Wiklund and Shepherd, 2005). As for the dynamism of the environment, the most usual argument is that the influence of EO on performance becomes more intense when the firm acts in a dynamic environment. Lumpkin and Dess (2001) show that in this type of environment, firms that behave more proactively and aggressively will achieve better performance.

Gilbert et al. (2006) find that the most commonly used predictor measures are the personal characteristics of the entrepreneur, the resources available to the firm, the strategy of the firm, the geographic location of the firm, and its industry context. In a well-cited study that essentially summarizes into one paper many of the major previous findings spread out in the literature, (Baum, et al., 2001) use multiple levels (i.e., individual, firm, and industry) to try to explain growth differences in the review of the literature of the growth specifically of small firms. Despite hundreds of studies into explaining firm-level growth differences, the main finding in this stream of literature is that researchers have been unable to isolate variables that have a consistent effect on growth across studies (Shepherd and Wiklund, 2009).

Managerial competencies are very important to the survival and growth of SMEs. Managerial competencies are sets of knowledge, skills, behaviors and attitudes that contribute to personal effectiveness (Hellriegel, et al., 2008). The ability to manage projects is one of management competencies. Projects involve unique, one-time initiatives, such as launching new products, and investing in the company's infrastructure. Projects drive business innovation and change (Shenhar and Dvir, 2007).

More and more companies recognize the benefits of using PM tools, techniques, methodologies and processes in a shifting, complex and unpredictable environment for change management effectiveness purposes (Clarke, 1999). Furthermore, it is a PM reality that using PM tools and techniques can significantly help the project to succeed although it does not guarantee its success (Mingus, 2002).

2 Methods

The aim of this paper is to compare the effect of project management at the growth rate of SMEs in Czech Republic. As part of the calculation was laid null hypothesis that the project and non-project businesses achieve similar growth rates and the alternative hypothesis that project managed enterprises achieve different growth rates. Data acquisition was carried out under the projects of Gaju 79/2013/S and Gaju 053/2016/S through questionnaires and interviews in 183 companies from the Czech Republic between 2014 and 2015. Growth rates were determined by managers from of selected companies in their responses. (Rolínek, 2016)

A partial objective is to evaluate the relation between the importance of project and a growth of rate within the sectors of the national economy as classified by OECD (2014) at:

- A1 Industry: High and Medium High Technology
- A2 Industry: Medium Low and Low Technology
- B1 Knowledge-intensive market services
- B2 Less knowledge-intensive market services
- C Agriculture, construction and utilities

Data were tested using two-sample Wilcoxon test and his asymptotic variant. This test is a non-parametrical two-sample test, which is most frequently used, when the condition of data normality is not met. Let X_1, \dots, X_n and Y_1, \dots, Y_m be two independent random samples from two continuous distributions, whose distribution functions can only differ in displacement. $x_{0,50}$, $y_{0,50}$ states for the median of the first and second distribution. The hypothesis that the distribution functions of the two distributions are the same is always tested, in other words, the medians are tested for equality. The result of test is compared to the alternative hypothesis (the first of medians $x_{0,50}$ of companies which have strategies, is greater than the latter) (Freund, Wilson, et al. 2010; Friedrich and Majovská, 2010, Budíková and Králová, 2010).

In the first stage, all $(n + m)$ values X_1, \dots, X_n and Y_1, \dots, Y_m are arranged in ascending order by size. The entire process takes place electronically using test statistics software and this step is not described in the article, because it is

a lapidary operation. Furthermore, the totals of orders X_1, \dots, X_n are identified and stated as T_1 . The sum of the values in the order of companies which do not have strategy Y_1, \dots, Y_m will be stated as T_2 . The next step was to calculate the test statistics for U_1 and U_2 , while applies that $U_1 + U_2 = mn$ (Friedrich and Majovská, 2010).

If statistics $\min \{U_1, U_2\} \geq$ tabulated critical value, for the selected ranges of both selections and chosen level of significance, then than we may reject the null hypothesis of the identity of the compared groups on the significance level $\alpha = 0.05$ and $\alpha = 0.1$. Since for both samples in all test cases applies that n, m are greater than 30 the asymptotic variant of the Wilcoxon test (Mann-Whitney test) is undertaken, which is used for n and m higher than thirty (Budíková and Králová, 2010, Wonnacot, 1995).

Critical codomain for right-side alternative id $W = \langle K_2, n \rangle$. Non-negative values k_1 and k_2 are strictly defined in critical literature. H_0 is rejected on the level of significance α , if $U_0 \in W$ (Freund and Wilson, et al., 2010, Friedrich and Majovská, 2010).

3 Research results

Using a two-tailed Wilcoxon test (Mann-Whitney U test) at the chosen significance level $\alpha = 0.05$, where X = project management and Y = nonproject management hypotheses $H_0 = x_{0,50} - y_{0,50} = 0$ and $H_A = x_{0,50} > y_{0,50}$ are tested for the entire sample of 183 businesses and individual sector enterprises divided according to the OECD. For greater clarity, the final data of the software Statistics are summarized in the following Table 1, and each category accompanied by a graphic representation of results and a brief commentary.

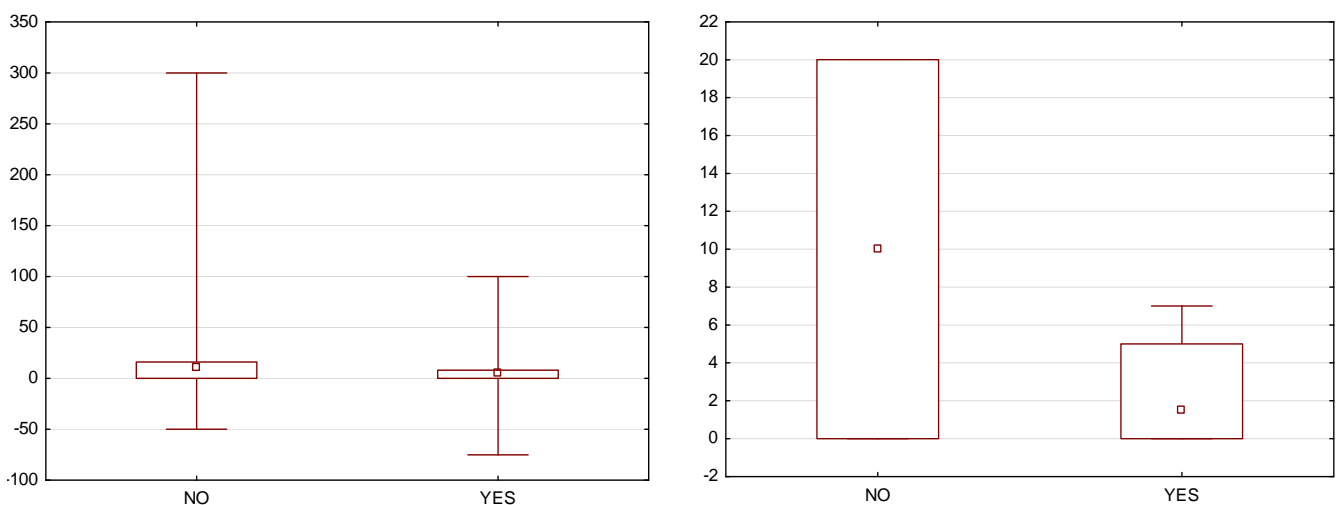
Table 1 Mann-Whitneyův U test: The relation of strategic and non-strategic businesses and the growth rate

	NO	YES	U	Z	p-value
SME - CZ	12757.50	4078.500	2647.500	2.452056	0.014205
A1	72.00000	48.00000	12.00000	1.793776	0.072850
A2	335.0000	130.0000	82.00000	-0.257938	0.796455
B1	646.0000	344.0000	191.0000	0.915929	0.359705
B2	1397.000	433.0000	313.0000	0.409718	0.682013
C	554.5000	40.50000	25.50000	2.261130	0.023752

Source: Own processing

As the above table 1 shows, we managed to disprove the null hypothesis of conformity of the two samples and we proved the alternative hypothesis. P-value is less than the established $\alpha = 0.05$. Thanks to the positive value of Z , it is apparent that a higher growth rate is reached by enterprises with project management. The figure 1 below reveals the diversity of both samples mostly for the maximum values.

Figure 1 Box plot of project and non-project managed enterprises with their growth rate on the vertical axis (SME – CZ left, A1 right)

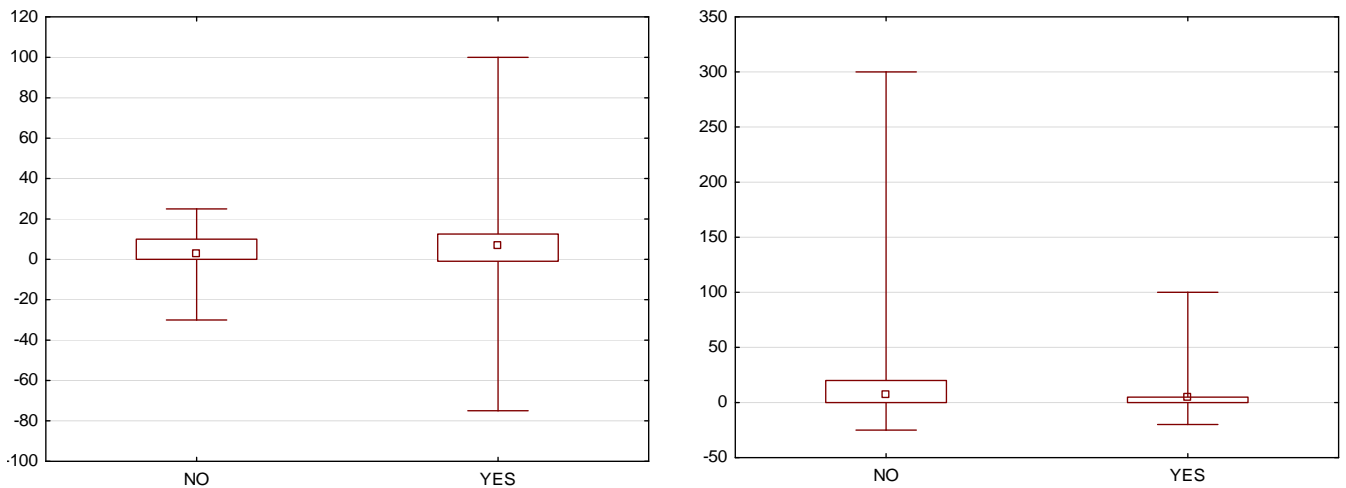


Source: Own processing

Enterprises in the category of A1 failed to reject the null hypothesis, where the p-value was 0.072 at the significance level of 95%. However, the graphical representation (figure 1) clearly suggests that enterprises without project management reached a greater median value compared to enterprises with project management by less than 7%. Greater values were also revealed in the upper-quartile which is at 20%. Both groups have the same lower quartiles and minimum values that are at 0%.

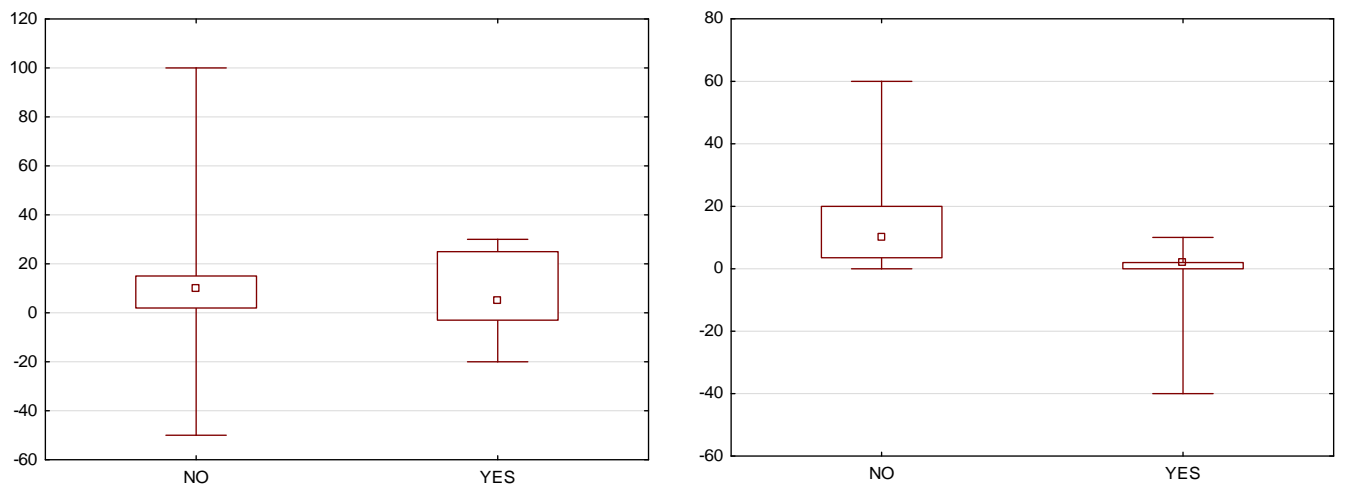
Neither A2, nor B1 and B2 (figure 2 and 3) showed a difference between enterprises with and without project management. In all three cases, the value p-value was higher than the alpha level of 0.05. The box-plots revealed that, although in all cases the groups differ primarily in their maximum and minimum values, and also at the level of the upper and lower quartiles, the visual impression is not statistically confirmed since medians of enterprises with and without project management are always at almost identical level.

Figure 2 Box plot of project and non-project managed enterprises with their growth rate on the vertical axis (A2 left, B1 right)



Source: Own processing

Figure 3 Box plot of project and non-project managed enterprises with their growth rate on the vertical axis (B2 left, C right)



Source: Own processing

In C category with enterprises in construction and agriculture, we managed to reject the null hypothesis in favour of an alternative, the p-value = 0.0238 and is less than the alpha = 0.05. As the resulting value of Z is positive, we can say that enterprises without the project management have higher growth rates than their colleagues with project management. As the figure 3 shows, non-project enterprises have higher maximum growth rates and 17% higher upper-quartile. In contrast, enterprises with project management have a minimum value of 40%. Values of both medians ranged from 0-10%.

4 Conclusions

According to survey results, project management is implemented in only 1/5 from a total of 183 organizations in Czech Republic. Such a low figure is surely related to high administration and the overall complexity that is necessary to prepare and implement projects. Most projects are created due to the potential acquisition of funds from the EU. Not in all cases, SMEs would receive the funds. Managers therefore rather pay attention to developing plans and raising funds from their own resources. By our confirmed hypothesis, these simpler and less time-consuming and risk activity brings higher rate of growth. Although growth is connected to expanding the activities, and therefore is seen as favourable season, at the same time it is worth noting that many businesses cannot cope with the situation in the period of growth. This may lead to their demise. To ensure that this scenario does not become actual fact, an enterprise should prevent such situation by product innovation and adequate quality (as stated by Veber and Srpová, 2012). In the Czech Republic, almost 4/5 of SMEs have not designed and implemented any projects so far. The managers do not realize or they do not know what the benefit is in a project-management organization. Potential advantages of project management can be defined in the following listing: every activity is connected to accountability, clear identification of the time and cost framework, flexible resource allocation and monitoring during its implementation.

The literature existing on entrepreneurship implicitly assumes that entrepreneurial orientation (EO) and growth orientation are positively related with each other. However, few studies, whether theoretical or empirical, analyse such relation in an explicit manner. Instead, most previous works have focused on the EO-performance relation, even though growth and profitability do not always correlate positively (Moreno and Casillas, 2008). The authors discussed the effect of the project and the growth rate. However, the results were surprising for them. They expected that SME manager with project management would reach higher growth rate. The results showed just the contrary. Higher growth rates are related to SMEs without project management. Within hypothesis testing, we failed to prove that the enterprises in the sample with project management achieve greater growth rates. During a detailed analysis of the sector with, we confirmed the project's impact on the growth rate within the technologically demanding industry (A1) and agriculture and construction (C) - in both cases there is a negative effects, the growth rate is lower. It may be due to the fact that organizations that have projects are implemented over a longer period of time. The resulting effects on business growth may be delayed for several years. A number of projects is related to the development of human capital. And it certainly takes time to improve the skills of employees, which is reflected in their higher productivity and thus consequently the overall growth rate.

Although enterprises with project management do not achieve a higher growth rate, the authors agree that the only way organizations can change, implement a strategy, innovate, or gain competitive advantage is through projects. With high demand for growth and innovation, the share of operations in most organizations is declining and the share of projects is on the rise. No business enterprise can survive if it is focused only on improving its operations. The next untapped candidate for significant improvements in a company's pursuit of competitiveness is the project activity of the organization. Projects are the engines that drive innovations from idea to commercialization. But projects are also the drivers that make organizations better, stronger, and more efficient (Shenhar and Dvir, 2007).

Business growth of rate may best be conceived of as a collective term for several rather different empirical phenomena, with different underlying causal mechanisms, requiring separate theoretical explanations (Davidsson and Wiklund, 2000). Established firms must learn to act entrepreneurially is no longer a novelty, and the reasons they could benefit from doing so are generally well known (Ireland, et al., 2003; Zahra, et al., 1999).

Acknowledgement

This paper was supported by GAJU 79/2013 / S and GAJU 053/2016/S.

References

- Barringer, B.R., Jones, F.F., Neubaum, C., & Donald, O. (2005). A Quantitative content analysis of the characteristics of rapid growth firms and their founders. *J. Bus. Venture*, 20(5), 663-687.
- Baum, R.J., Locke, E.A., & Smith, K.G. (2001). A multidimensional model of venture growth. *Academy of Management Journal*, 44, 292-303.
- Beck, T. (2007). *Financing Constraints of SMEs in Developing Countries: Evidence, Determinants and Solutions* [online]. Available from: <http://arno.uvt.nl/show.cgi?fid=95654>
- Beck, T. (2005). SMEs, Growth, and Poverty: Cross-Country Evidence. *Journal of Economic Growth*, 10, 199-229.
- Brown, T.E., Davidsson, P., & Wiklund, J. (2001). An operationalization of Stevenson's conceptualization of entrepreneurship as opportunity-based firm behavior. *Strategic Management Journal*, 22, 953-968.
- Budíková, M., & Králová, M. (2010). *Průvodce základními statistickými metodami*. Praha: Grada.
- Clarke, A., & Cooper, C. (1999). *Everybody's staring at me*. London: Changing Faces.

- Davidsson, P., & Wiklund, J. (2000). Conceptual and empirical challenges in the study of firm growth. In D.Sexton & H.Landström (Eds.) *The Blackwell handbook of entrepreneurship* (pp. 179-199). Oxford, MA: Blackwell.
- FinMark Trust (2006). *FinScope Small Business Survey Report* [online]. Available at: <http://www.finmarktrust.org.za>.
- Freund, R. J., Wilson, W., J. (2010). *Statistical methods*. Boston: Elsevier.
- Friedrich, V., Majovská, R. (2010). *Výběr z ekonomické statistiky: od OECD k České republice*. Praha: Wolters Kluwer Česká republika.
- Furková, A. (2014). Multiple selections of alternatives under constraints: Case study of European Countries in area of research and development, *Trendy v podnikání*, 5(1).
- Gilbert, B.A., McDougall, P.P., & Audretsch, D.B. (2006). New venture growth: A review and extension. *Journal of Management*, 32, 926-950.
- Hellriegel, D., Jackson, S.E., Slocum, J., Staude, G., Amos, T., Klopper, H.P., Louw, L., & Oosthuizen, T. (2008). *Management*. 2nd South Africa edition. Oxford University Press. Oxford.
- Ireland, R.D., Hitt, M.A., & Sirmon, D.G. (2003). A model of strategic entrepreneurship: The construct and its dimensions. *Journal of Management*, 29, 963-989.
- Lumpkin, G.T., & Dess, G.G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review*, 21(1), 135-172.
- Lumpkin, G.T. & Dess, G.G. (2001). Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle. *Journal of Business Venturing*, 16, 429-451.
- McKelvie, A., & Wiklund, J. (2010). Advancing Firm Growth Research: A Focus on Growth Mode Instead of Growth Rate. *Entrepreneurship, theory and practice*, 34(2), 261-288.
- Mingus, M. (2002). *Conceptual change in projects*, NY: Progre.
- Moreno, A.M., & Casillas, J.C. (2008). Entrepreneurial Orientation and Growth of SMEs: A Causal Model. *Entrepreneurship, theory and practice*, 32(3), 507-528.
- Olawale, F., & Garwe, D. (2010). Obstacles to the growth of new SMEs in South Africa: A principal component analysis approach. *African Journal of Business Management*, 729-738.
- Pošvář, Z., & Erbes, J. (2002). *Management*. Brno: MZLU.
- Rolínek, L. (2016). *Krise malých a středních podniků, příčiny a jejich řešení*. Praha: Wolters Kluwer.
- Sedláčková, H., & Buchta, K. (2006). *Strategická analýza*. Praha: C.H.Beck.
- Shenhar, A. J., & Dvir, D. (2007). *Project management*. Boston: Harvard Business School Press.
- Shepherd, D., & Wiklund, J. (2009). Are we comparing apples with apples or apples with oranges? Appropriateness of knowledge accumulation across growth studies. *Entrepreneurship Theory and Practice*, 33, 105-123.
- Synek, M., et al. (2011). *Manažerská ekonomika*. Praha: Grada.
- Veber, J., & Srpová J., et al. (2012). *Podnikání malé a střední firmy*. Praha: Grada.
- Wiklund, J., & Shepherd, D. (2005). Entrepreneurial orientation and small business performance: A configurational approach. *Journal of Business Venturing*, 20(1), 71-91.
- Wonnacot, T. H. (1995). *Statistika pro obchod a hospodářství*. Praha: Victoria Publishing.
- Zahra, S.A., Jennings, D.F., & Kuratko, D.F. (1999). The antecedents and consequences of firm-level entrepreneurship: The state of the field. *Entrepreneurship Theory and Practice*, 24, 45-65.

Session 8

The Application of Private Law
after the Legislative Changes in the Czech Republic

New Institutions of Civil Law in Practice

Rudolf Hrubý

Abstract: *In this contribution the author focuses on some of the key changes that were brought to the Czech civil law by a comprehensive recodification of substantive private law. Special attention is given to a restored legal instrument brought into the Czech legal system by the New Civil Code called tenancy, which is a legal relationship where the tenant has beside the right of use also usufructuary right. Considerations are not limited to changes in the relative property rights, i.e. already mentioned tenancy, but it also deals with the changes in the area of absolute property rights.*

Key words: Real property · Ownership rights · The new Civil Code · Possession · Usucaption · Pre-emption right

JEL Classification: K1

1 Introduction

In the present paper the author focuses on the key changes that were brought to the Czech private law by a comprehensive recodification of substantive law. This recodification was accomplished by several pieces of new legislation, which were the new Civil Code, i.e. Act no. 89/2012 Coll., Civil Code ("NOZ"), then the Business Corporations Act, i.e. Law no. 90/2012 Coll., the commercial companies and cooperatives (Business Corporations Act) ("ZOK"), and last but not least the law on private international law, i.e. Act no. 91/2012 Coll., on private international law ("ZMPS"). These acts came into effect on January 1, 2014. An important part of the recodification consists of a series of accompanying laws, but unfortunately many of them are still in the legislative process.

The author considers as the key change the adoption of the new Civil Code. This act brought number of fundamental changes, inter alia, in the field of land use. Several old-new institutes of civil law have been re-established (e.g. tenancy) and will be subject to closer scrutiny. It should be added, that the author's ambition is not to assess all changes in the regulation of private law relations and their development, while this would significantly exceed the size of this contribution.

The author observes the changes in tenure arrangements and other absolute property rights, but also points out the new institutes in relative property rights. With regard to the inadequate application practice and the lack of a unifying jurisprudence of higher courts, there are many of the conclusions based only in doctrine.

2 Legislative changes

Absolute property rights

Legal institutions such as possession or usucaption have undergone a remarkable historical development and both have a significant tradition in our country. These institutions mean a very important tool that beside the ownership right allows to arrogate the usefulness of things. (Pekárek, M, Průchová, I, 1996) If a person has a thing in his power⁶⁰, the fact that he or she wants such thing for herself founds a peaceful state, that is protected by law (Eliáš, K, 2014).

Special attention has been dedicated to honest holder as a person who has a convincing reason in good faith, that this person has ownership right. Honest holder has similar rights to thing like a person with the ownership right, but only within the period of honest tenure. In terms of property protection is essential that after a statutory period of honest tenure, holder may acquire ownership thanks to the institution of usucaption. NOZ regulates this institute in a more comprehensive way, compared to the previous legislation of the Act no. 40/1964 Coll., Civil Code. Detailed arrangements are useful, especially when the previous practice was based nearly only on the practice of the courts. NOZ distinguishes ordinary and extraordinary usucaption. Extraordinary was introduced again after absence of about forty

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⁶⁰ According to section 489 NOZ is a thing in a legal sense (hereinafter a "thing") everything that is different from a person and serves the needs of people.

years. This institute was included in the General Austrian Civil Code of 1811 and lasted until the first half of the twentieth century.

Although these provisions seem at first glance like more casuistic and detailed, it is not able to solve all aspects associated with this institute and all the recipient of law have to wait for the unifying judicial practice. Anyway I believe that people are provided more legal certainty than in the previous civil code, since some of the pre-war case law of the Austrian and the democratic Czechoslovakia courts will undoubtedly be applicable. From my experience, quite extensive legal argumentation with very old judgments appeared before district courts in the south Bohemia at this moment. First experience with the application of old-new institutes signals a return to the time distant legal authorities and the efforts to build on the legal development of the pre-communist era.

Another significant change is visible in the area of pre-emption rights. This area has undergone a fairly major change in the statutory pre-emption rights. The legislature did so with deferred effect from 1 January 2015, quashing the statutory pre-emption rights of co-owners transferring the co-ownership shares. The provision of § 140 ObčZ provided that when co-owner transferred a co-ownership share, co-owners have the right of purchase, unless it is a transferred to a close person. This statutory pre-emption right of co-owners expired after one year from the effective date of the new law, i.e. the date of 1 January 2015. Exceptions were saved in some specific situations, typically in agricultural or family enterprise.

Pre-emptive right applies to the owner of the land or building if these are owned by different entities. The owner of the land on which is set up the building, which is not under the existing legislation part of the land and did not become a part of the land on the date of entry into force of the new Civil Code, has the pre-emption right. The same applies *vice versa*. The agreement, which excludes or limits pre-emptive rights shall be disregarded. This is a pre-emption right, which can not be completely ruled out by contractual arrangements.

In the existing practice, it is clear that a number of co-owners gained greater flexibility in the management of their co-ownership share. These shares are sold without major restrictions and interference with other co-owners. If co-owners want to prevent a number of unpleasant disputes, they can do so only by the establishment of pre-emption rights in the contractual agreement. Only in such cases they will be able to influence with whom they will own their immovables in the future.

Relative property rights

One of the most important change could be seen in re-establishing the institution of “tenancy” again for the use of land against payment. Although the farm tenancy has deep roots in the area of Bohemia, within the period from 1950’s to 1980’s it was something absolutely unimaginable because of the communist legal theory.

The institute of tenancy was included in the General Austrian Civil Code of 1811 and lasted until the first half of the twentieth century. The original roots are deeper and we can come across this institute already in Roman law. The feudal legal theory in our country was influenced by the reception of Roman law and understood peasant tenancies as a part of the original landlord’s ownership. Since the fifteenth century, the institute of peasant tenancy has been known and exercised in Bohemian countries (Vaněček, V, 1945).

Until the first half of the twentieth century, agricultural land was tenanted when owner was not able or did not want to farm at his land. Temporary tenancy was the most usual form of this obligation (Dědina, V, 1930). After the change of political system at the end of 1940’s, the institution of tenancy became redundant due to the prevailing convictions in the society. Real socialism in practice meant that owners were deprived of their disposal rights, the right of use (“*usus*”) and usufructary rights (“*ususfructus*”). Agricultural land was not tenanted any more because owners were only formally holding their possessions. Re-introduction of tenancy does not appear in a fundamental amendment of the socialistic code, which was an act No. 509/1991 Coll.

Re-establishment of this basic contractual relationship between owner and user of land was enshrined in art. 2332 NOZ, which stated that by tenancy contract landlord agrees to leave tenancy subject for temporary use and enjoyment to tenant farmer. Subject to this contract can be only things bringing benefits or fruits. The term of enjoyment is not defined within the regulation of tenancy, but in art. 1285 NOZ, which defines usufructuary right as a servitude, i.e. the right to use, to take benefits and fruits including extraordinary income. Agricultural land can be tenanted for both definite and indefinite period.

However, the new legislation did not avoid few weaknesses. I am of the opinion that for most of the people it would be hard to distinguish between the lease and tenancy. The tenancy includes the option to take the fruits and benefits and

the lease includes only the option to take benefits. This distinction, however, from the perspective of the practice appears to be crucial, especially when the new regulation dedicates to the institution of tenancy 26 provisions, which solves many aspects differently from lease relationships. A typical example is the different treatment of the notice period, but it is also about other important aspects.

With regard to this uncertainty, I also have to point to other provisions of new legislation, according to which any treaty is assessed by its actual content, not according to its label (though often wrong). A number of the contracting parties may be rather unpleasantly surprised over time, especially when the court then examines the signed contract as a rental, instead of tenancy and applies completely different provisions of law than the contracting parties intended at the beginning. I believe that for many participants of previous lease contracts it is very difficult to correctly choose the applicable institute.

NOZ guarantees that with the change in ownership simultaneously the rights and obligations of tenancy are transferred. This general rule is breached because of *lex specialis* stating that if the new owner has reasonable grounds to doubt that he bought a thing subjected to tenancy, he has the right to terminate the lease contract or agricultural tenancy within three months after he knew or had to get to know that the thing was leased. Unfortunately, the new legislation significantly weakened the position of the tenant farmer. If one takes into account the fact that about 80% of agricultural land in the Czech Republic, is subject to agricultural tenancy, then such provisions may bring certain problems into agricultural production.

3 Results - View of the neighbouring country

In this contribution, we also have a look into the legal order of the closest neighbour of the Czech Republic – the Slovak Republic. Private law of our neighbour has been profoundly influenced by the still incomplete reform of the civil law. Originally, a joint federal Czechoslovak "reform" of the civil law was executed in the form of an extensive amendment two years after velvet revolution, i.e. in 1991, mainly due to adapt as soon as possible civil rights to the period of transition from a planned economy to a market economy. In the framework of the socialist reprocessing of private law, this field of law suffered an intentional division of substantive private law. As a matter of a fact, all ideas about the comprehensive civil code, as the all-embracing and universal code for private law were rejected by the ruling communist party. In the Slovakia, there are still applicable following key acts:

- Civil Code, i.e. law no. 40/1964 Coll.
- Family Act, i.e. Act no. 36/2005 Coll.
- Act on International Private and Procedural Law, i.e. law no. 97/1963 Coll.
- as well as other legislation.

At this moment, I see as one of the key differences between Czech and Slovak private law in the enshrining an old principle of civil law – so called “superficial principle”. Although the principle *superficies solo cedit* is enshrined in almost all countries of current Europe, in Slovakia was applicable only until 1950, when it was abolished by first joint Czechoslovak civil code.⁶¹ This law broke a number of established principles of civil law. In the field of land law was expressly specified that the building is not part of the plot (land). Unfortunately, this has not changed even after the adoption of the next Civil Code in 1964,⁶² although this has not expressly stated a negation of the principle *superficies solo cedit*. Despite the expectations of public, professionals and academicians, there was not the political will to enforce this principle back even when a major amendment to the Civil Code in 1991 was adopted. In contrast, this amendment implemented to the text the negation of this principle *expressis verbis*, when the provisions of § 120 of the Civil Code provides that "part of a thing is all that in accordance with its nature belongs to a thing and cannot be separated unless that would devalued such thing. Buildings, rivers and groundwater are not part of the plot."

⁶¹ Act no. 141/1950 Coll., Civil Code, often called the medium one because it replaced the General Civil Code from 1811, and was subsequently replaced by another civil code from 1964. This act marked the completion of the legal biennials in civil law. In.: KUKLÍK, Jan. Vývoj československého práva 1945 - 1989. Praha : Linde, 2009. ISBN 978-80-7201-741-6. s. 518.

⁶² Law no. 40/1964 Coll., civil code, as amended by no. 35/1965 Coll. (Indirectly), 58/1969 Coll., 131/1982 Coll., 131/1982 Coll., 94/1988 Coll., 188/1988 Coll., 87/1990 Coll., 105/1990 Coll., 116/1990 Coll., 87/1991 Coll., 509/1991 Coll., 264/1992 Coll., 278/1993 Coll., 249/1994 Coll., 153/1997 Coll., 211/1997 Coll., 252/1999 Coll., 218/2000 Coll., 261/2001 Coll., 281 / 2001 Coll., 23/2002 Coll., 34/2002 Coll., 95/2002 Coll., 184/2002 Coll., 215/2002 Coll., 526/2002 Z . a., 526/2002 Coll., 504/2003 Coll., 515/2003 Coll., 150/2004 Coll., 150/2004 Coll., 404/2004 Coll ., 635/2004 Coll., 635/2004 Coll., 171/2005 Coll., 266/2005 Coll., 336/2005 Coll., 118/2006 Coll., 188/2006 Coll., 84/2007 Coll., 209/2007 Coll., 335/2007 Coll., 568/2007 Coll., 214/2008 Coll., 379 / 2008 Coll., 477/2008 Coll., 186/2009 Coll., 575/2009 Coll., 129/2010 Coll., 546/2010 Coll., 130/2011 Z . a., 161/2011 Coll., 69/2012 Coll., 180/2013 Coll., 102/2014 Coll., 102/2014 Coll., 106/2014 Coll ., 335/2014 Coll., 39/2015 Coll., 117/2015 Coll., 239/2015 Coll., 273/2015 Coll., 438/2015 Coll., 91/2016 Coll., 125/2016 Coll.), is still valid and effective part of the Slovak legal order.

For this reason, many of today's buildings or other structures are established on foreign land and the owner of the building in these cases differs from the landowner. In practice it may be an unpleasant reason for "neighbour disputes".

Finally, it is important to note that the Slovak legislature has failed to specifically regulate the agricultural tenancy until now. At the moment, there is *lex specialis* in the form of Act no. 503/2003 Coll., on lease of agricultural land, farm and forest land and the amendment of certain laws, which falls under the land law, but that does not establish the institute of tenancy, including all of its special attributes. In my opinion, the terminology incorrectly talks about the lease contract, while the economic functions, respectively specific use of rendered things resembles a tenancy. A characteristic feature of tenancy that distinguishes it from the institution of the lease contract is that owner leaves to the tenant not only the rights of use, but also the usufructuary rights. The tenant usually cultivates the thing the way that it is able to deliver income and he appropriates this income (Kabelková, E., 2013).

Finally, we can only recommend that the Slovak legislator should attempt to eliminate the private law disintegration in similar way of recodification as his Czech colleague did, while it is necessary to consider the return to the proven traditional institutes of continental private law. However, it should be noted that simple cribbing from Czech land law is not appropriate, when our legislation suffers from a number of shortcomings that would on the other hand were enough on substantially more comprehensive publication.

4 Conclusions

In my contribution I intended to highlight selected issues of a new application practice in civil law. At the moment, the new Civil Code is still very young code of private law and we have to wait for settled judicature practice of courts for a number of institutes. To a large extent the applicability of the earlier judgments is uncertain.

It is clear that the case law is not possible to use in all decided cases. The Supreme Court of the Czech Republic took a standpoint in decision with file number 30 Cdo 2433/2013, which states that: "Except the cases stipulated by law, it is not possible to register person as owner only on the finding such person acting in good faith in the land registration, but concluded (absolute) illegal transfer agreement. The court cannot infer that in this case there has been acquired ownership right to immovable property from a non-owner (as in the new legislation), because for such a conclusion there absents relevant substantive provisions of the (previous) Civil Code or other legislation which would remember such a situation."

The Supreme Court in its decision unambiguously give out that immovable property can not be acquired by non-owner only on the basis of good faith in the land registry. Such a ruling, however, appears to be inconsistent with § 984 NOZ. An earlier ruling certainly can not be applied. In each case it will be necessary to examine what is the meaning and purpose of the court decision and what is the legal regulation *de lege lata*.

Finally, the new legislation did not avoid some mistakes during its preparation and brought its recipients certain lack of clarity in e.g. contractual acting as mentioned above. But it can be expected, that application practice of courts will such uncertainties resolve in the future.

List of abbreviations

Sb.	Collection of Laws
Sb. m. s.	Collection of International Treaties
NOZ	Law no. 89/2012 Coll., Civil Code
ObčZ	Law no. 40/1964 Coll., Civil Code
ZOK	Law no. 90/2012 Coll., the Commercial Companies Cooperatives (Business Corporations Act)

References

- Bezouška, P. (2013). *Pacht, pachtýř, propachtovatel a pachtovné* [online]. Praha: IHNEC.cz, 24.06.2013, [cit. 2014-03-01]. Available from: <<http://zpravy.ihned.cz/c1-58686050-pacht-pachtyrpropachtovatel-a-pachtovne>>.
- Dědina, V. (1930). *Československá vlastivěda, díl VI*. Praha: Sfinx.
- Důvodová zpráva k zákonu č. 141/1950 Sb., občanský zákoník
- Důvodová zpráva k zákonu č. 89/2012 Sb., občanský zákoník
- Eliáš, K. (2014). *Občanské právo pro každého: pohledem (nejen) tvůrců nového občanského zákoníku*. 2.ed. Praha: Wolters Kluwer. ISBN 978-80-7478-493-4.
- Eliáš, K. (2013). Pacht. *Obchodněprávní revue*, 2/2013 (3).
- Grmelová, N. (2010). Slučitelnost definice pojmu „podnik“ v českém a španělském právu s právem EU [online]. *European Offroads of social science*, 2010(1), 18-26. Available from: http://www.euoffroads.cz/edice/a4106c6/_2010__obsah_casopisu.
- Hajn, P. (2012). *Chvála pach(t)u*. Praha: Wolters Kluwer, ASPI ID LIT40426CZ.
- Hulmák, M. (2014). *Občanský zákoník: komentář*. 1. ed. Praha: C.H. Beck. ISBN 978-80-7400-535-0.

- Jouza, L. (2014). *Co musíte udělat při pachtu či prodeji závodu?* [online]. Praha: IHNED.cz, 14.02.2014, [cit. 2014-05-31]. Available from: <http://pravnicaradce.ihned.cz/c1-61700670-co-musite-udelat-pri-pachtu-ci-prodeji-zavodu>.
- Kabelková, E. (2013). *Nájem a pacht v novém občanském zákoníku: komentář : [§ 2201-2357]*. 1. ed V Praze: C.H. Beck. ISBN 978-80-7400-524-4.
- Kuklík, J. (2009). *Vývoj československého práva 1945 - 1989*. Praha : Linde. ISBN 978-80-7201-741-6.
- Lazar, J., et al. (2010). *Občianske právo hmotné I*. Bratislava: IURA EDITION s.r.o.. ISBN 978-80-8078-346-4.
- Melzer, R., & Tegl, P., et al. (2014). *Občanský zákoník – velký komentář. Svazek III. § 419 – § 654*. Praha: Leges.
- Pekárek, M., & Průchová, I. (1996). *Pozemkové právo*. 1 ed. Brno: Masarykova univerzita. ISBN 80-210-1349-4.
- Vaněček, V. (1945). *Dějiny státu a práva v Československu do roku 1945*. Praha: Orbis.
- Vyhláška Českého úřadu zeměměřičského a katastrálního č. 358/2013 Sb., o poskytování údajů z katastru nemovitostí
- Weinhold, D. (2014). *S pachtem se ještě napachtíme* [online]. Praha: IHNED.cz, 28.01.2014, [cit. 2014- 05-01]. Available from: <http://weinhold.blog.ihned.cz/c1-61625790-s-pachtem-se-jestenapachtime>.
- Zákon č. 126/1946 Sb., o úpravě zemědělských pachtovních poměrů.
- Zákon č. 141/1950 Sb., občanský zákoník.
- Zákon č. 256/2013 Sb., o katastru nemovitostí (katastrální zákon).
- Zákon č. 40/1964 Sb., občanský zákoník.
- Zákon č. 89/2012 Sb., občanský zákoník.
- Zákon č. 946/1811 Sb.z.s., obecný zákoník občanský.
- Zákon č. 95/1871 ř.z., o zavedení obecného zákona o pozemkových knihách.

Transformation of an Association into an Institute

Zuzana Frantíková

Abstract: *The paper focuses on the changes in the area of legal persons brought by the new Czech Civil Code. The new Civil Code recognizes three types of legal persons: corporations, foundations, and institutes. The process of transformation is aimed at the societies that were founded according to Act No. 83/1990 Coll., on association of citizens, as amended, and which became associations by the Civil Code since its effectiveness, i. e. on January 1, 2014⁶⁴. Associations founded according to the New Civil Code cannot be transformed into institutes. The form of an institute is suitable for associations where no member basis is present or ones where its members are at the same time also its employees. With regards to the association, the law recognizes two types of transformation, that is – voluntary, and obligatory. The obligatory transformation was done by the Civil Code when societies became associations, however, the voluntary transformation can be done sustaining on the decision of the supreme body. The society could be turned into an institute or into a social cooperative. The transformation process does not have any support in the legal regulation – that is why there are so many questions to be answered and interpreted.*

Key words: Institutes · Transformation of Legal Form Association · Association Law

JEL Classification: K1· K13

1 Introduction: Association (former Society) and Institute

The association is defined by the Czech Civil Code as a corporation that is formed at least by three persons either natural or juridical led by a common interest which is important to them. The range of the associations in the Czech Republic is quite broad, on one hand there are many associations founded by three members, and on the other hand there are societies with many members. The legal regulation of societies used to be ruled by Act No. 83/1990 Coll., on association of citizens, as amended. This act was annulled by the new Civil Code. Legal persons of private law in general are regulated by the Czech Civil Code. Societies from the beginning of their existence have always dedicated their activity in order not only to support their members' interest, but also to support the public life. In order to support the public life, many societies provide services to the public in the area of social, health care and educational services. The basic features of a society are membership and operative association self-government. This means that the society has to have a member base, which is able to actively decide on the operation and activities of the association and it is not bound by dependent relations typical of employment law. Members, in order to preserve the essence of the association self-government, cannot simultaneously be employees of the society. According to the New Civil Code, an association may actually develop the main and a secondary activity. The main activity represents the means to realize the common interests or social activities. The biggest debate arises precisely in defining secondary activity. The secondary activity may be of business character, nevertheless, it should not reach such a level that it can be considered comparable to the business, i. e. the association has not operated primarily for the purpose of profit.

Unlike associations, institutes are legal entities that are not based on membership – on the contrary, the employment contracts prevail. Contrasting foundations, they are not created in order to provide donations to the public, which is why their capital can be consumed, but to provide socially or economically useful activities. Pursuant to Section 402 of the New Civil Code "an institute is a legal person created for the purpose of pursuing socially or economically useful activities using its personal and property resources. An institute pursues activities which are equally available to everyone under predetermined conditions". Section 403 of the New Civil Code develops further the meaning of the secondary activity saying "if an institute operates a business enterprise or another secondary activity, its operation must not be to the detriment of the quality, scope, and availability of the services provided as the primary activity of the institute. An institute may only use its profit to support the activities for which it was formed, and to pay the costs of its own administration". Both associations and institutes are legal entities of private law that are not founded in order to do business, but, on the contrary, to provide services that are publicly beneficent (Lavický, P, et al, 2014). Nevertheless, associations are based on membership, which could be not found in institutes.

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⁶⁴Section 3045 par. 1 of the New Civil Code: Societies (in Czech: „sružení“) under Act No. 83/1990 Coll., on associations of citizens, as amended, are considered to be associations (in Czech: „Spolky“) under this Act. A society has the right to change its legal form to an institute or social cooperative under another statute.

2 Methods

In this paper there is an emphasis put on analytical method of logical deduction and on method of legal comparison. The purpose of this paper is to achieve by means of interpretation and scientific methods a reliable description of transformation of an association into an institute with respect to the New Civil Code and the possibility provided in Section 3045 thereof.

3 Results

Transformation Itself and the Problems Connected to the Process

The transformation of a legal person is regulated in Sections 174 – 184 of the New Civil Code. Pursuant to Section 175 a legal person may change its legal form only where provided by a statute. The change of a legal form is one type of a transformation of a legal entity and it is a process where the inner legal relations are changed by preserving the existence of the legal entity, also with regards to its identification number. The change in a legal form does not lead to the dissolution or termination of a legal person whose legal form changes, but merely to a change in its legal situation and, in the case of a corporation, also the legal status of its members.

During the process of the transformation five statutes such as Act No. 89/2012 Coll., the Civil Code, Act No. 563/1991 Coll., on accounting, Act No. 90/2012 Coll., on business corporations, and Act No. 125/2008 Coll., on transformation of corporations, can be used, nevertheless, finally, only Act No. 89/2012 Coll., and maybe the Act No. 563/1991 Coll. on accounting, regarding some specific problems narrowly connected to the accounting, can be used. The law is interpreted by the interpreting rules, and analogy or subsidiarity represent some of them. The transformation of associations into institutes is not expressively regulated in the law but there are provisions regulating transformations of business corporations and these norms that are most similar to those that are targeted can be applied also on the transformation of an association into an institute. Analogy in law is a legal norm helping to fill gaps in law. In any case, the analogous application of law is admissible only if there is no legal interpretation leading to an acceptable solution (Gerloch, A., 2009). As it has been already said before, the transformation process of an association into an institute is not regulated in any acts, that is why we should use by analogy the act on transformations of business corporations and draft a project including the formation deed. The project is then published for thirty days on an association's website approved by a supreme body, usually by a member's meeting in a public form before a notary. This practice is confirmed by a quick look into a collection of documents administrated by regional courts. A question whether the supreme body should decide on the change in a public form before a notary, or not, remains. In my opinion, no member's meeting in a public form before a notary is needed.

Another problem may arise relating to Section 176 of the New Civil Code in the sense of whether the change of a legal form is included under this Section and whether the decisive date has to be stated or not. I do not agree that the Section on decisive date shall relate to the change of a legal form despite the fact that the change of a legal form forms a part of a transformation according to Section 174. According to Section 183 par. 2 “if the date on which a draft contract or decision to change the legal form was prepared is not the date of preparation of balance sheet under a special legal regulation, a legal person shall prepare interim financial statements as of that date. The information used to prepare the financial statements as at the date on which the document changing the legal form is prepared may not precede the date of the legal person's decision to change its legal form by more than three months”. In the case of a change of a legal form no draft contract is prepared so there has to be an interim financial statement together with the project which is lately approved by the member's meeting, however within three months.

Subsidiarity of Foundations embodied in Section 418 of the New Civil Code and Its Problems

Section 418 of the New Civil Code says “that in other respects, the provisions on foundations apply, by analogy, to the legal relations of an institute; however, the provisions on endowment principal and endowment capital do not apply”. This section embodies the rule of subsidiarity. The Czech term for the application of subsidiary legislation may be supportive or ancillary use. Supporting application of the law within a certain sector of legal relations assumes that there is a law that contains primarily applicable legal framework of these relations. The use of the supporting standards is triggered when an applicable standard preferably contains no custom solutions to specific situations. Relationship subsidiarity can therefore be defined as well as through the mutual relationship between specific and general regulation. The above described subsidiarity may cause some interpretative problems because there is a tendency to interpret also the provisions explicitly saying the regulation regarding the institutes in the light of the regulation regarding the foundations (Gerloch, A., 2009).

Formation of an Institute – Formation Deed

Section 405 par. 1 of the New Civil Code says that an institute is formed by a formation deed or disposition mortis causa. The forming juridical act shall at least specify the name of the institute, registered office, purpose of the institute by defining its objects of activities, or, where applicable, its objects of business, indication of the amount of contribution, or non-pecuniary contribution, the number of members of the board of trustees and the names and places of residence of its first members, and details of the internal organisation if the institute, unless reserved for the by-laws of the institute. If the forming juridical act establishes a supervisory board, it specifies the number of supervisory board members and the names and places of residence of its first members. Those are the requirements regulated in Section 405 par. 1 of the New Civil Code. Pursuant to this section there is no requirement regarding the form unlike the regulation of foundations where in Section 309 par. 4 the notarial deed is needed. There were many uncertainties on this matter until a court decision appeared. In private law, generally, the principle that everyone has the right to choose any form of legal act is applied, unless an agreement between parties or a law provides otherwise (Section 559 of the New Civil Code). This principle also applies to the establishment of a legal entity. The provision of Section 418 of the Civil Code refers to the legal relationships of the institute and under this "legal relationships of an institute cannot be subsumed to the form of the founding legal actions – therefore no notary deed is needed for the form".⁶⁵ In my opinion there is a special section regulating the formation deed therefore there is no necessity to use Section 309 par. 4. In general, Section 123 par. 2 says that the writing form is needed for a formation document.

Remuneration of Members of Elected Bodies: Director as a Statutory Body, Board of Trustees, and Supervisory Board or Inspector

High responsibility of members of elected organs for the rightful operation of legal persons entitled them to be remunerated for their functions. Similarly, this regulation applies to the supervisory board or to the inspector, if either of the controlling body was established. The possibility and methods of providing rewards to members of the board of trustees, supervisory board and the director is regulated by the founder in the formation deed, otherwise Section 414 of the New Civil Code shall be applied saying "unless the formation deed provides that the members of the institute's bodies are entitled to remuneration for the discharge of their office and how it is to be determined, the director is conclusively presumed to be entitled to a usual remuneration; the offices of the members of other bodies are presumed to be honorary. In such a case, the board of trustees determines the amount of the remuneration of the director or the manner of its determination". The law does not *expressis verbis* say that the function of a director can be honorary. However, with respect to the main principles, on which the New Civil Code is based, by the *argumentum a maiori ad minus* it can be deduced that the honorary function of a director can be regulated in the formation deed. If the formation deed does not say anything then the function has to be remunerated and the director is entitled to a usual remuneration determined by the board of trustees (Lavický, et al, 2014).

Director

The director is the governing statutory body of an institute. Pursuant to the law it is a monocratic body. Unlike associations the statutory organ of an institute cannot be collective, at least the law is silent regarding this problem. Can the formation deed or by-laws state that the statutory body is collective? In my opinion, by *argumentum ad minori ad maius*, it can be deduced that the function of a director does not have to be only monocratic, however, the formation deed may regulate a collective statutory organ. The by-laws may provide another name for this body, provided that it is not misleading as to its nature. The director may not be a member of the board of trustees, and a member of the supervisory board or another body of a similar nature, if established. The board of trustees elects and removes the director except for the first director who is appointed by the founder in the formation deed in accordance to Section 123 par. 1. of the New Civil Code. I strongly disagree with the polemics on that fact written in the article (Duva, J., & Šveřepová, K. 2015).

Board of Trustees

Board of Trustees is regulated in Sections 409 – 412 of the New Civil Code. The members are appointed and removed by the founder. If it is not possible, the members of the board of trustees are elected and removed by the supervisory board, if established; otherwise, the board of trustees elects and removes its members on its own. The term of a member of the board of trustees is three years. The members can be elected repeatedly. The membership on the board of trustees is incompatible with the membership in the supervisory board. The law in the above-mentioned provisions does not *expressis verbis* say that the members of the board of trustees cannot simultaneously be employees, unlike Section 363 of the New Civil Code saying "unless the foundation charter provides additional restrictions, the persons not eligible to be members of the foundation board shall include any person who: a) is a member of the supervisory board of the foundation, b) is employed by the foundation, or c) has a criminal record related to the purpose of the foundation".

⁶⁵Vrchní soud v Praze, 7 Cmo 295/2015, [PR 11/2016 p. 416]

The rule of subsidiarity cannot be used here, in my opinion, because Sections 409 – 412 of the New Civil Code are special to Section 363 of the New Civil Code. The commentary to the Civil Code by Lavický is silent regarding to this fact, as well. Nevertheless, with respect to the competences of board of trustees it is obvious that they cannot perform their office if they are in an employment relation.

Controlling body: Supervisory Board or Inspector as an Obligatory or Facultative Body

Section 418 of the New Civil Code refers to the provisions regulating foundations where an establishment of a supervisory body is obligatory. Therefrom it could be deduced that the supervisory board or the inspector is an obligatory body of an institute. However, Section 409 par. 3 “where supervisory board has been established”, Section 405 par. 2 saying “if the forming juridical act establishes a supervisory board”, and Section 408 par. 2 “member of the supervisory board or another body of a similar nature, if established”, prompt to be facultative. The institute can establish either supervisory board or inspector as a controlling body, which would be convenient in case of the drawing off donations.

4 Conclusions

The above-mentioned new regulation brought a common general regulation of legal persons of private law which could be regarded as a progress, resp. as a good step forward. However, there are some uncertainties that shall be solved by practising and applying the law consisting in which kind of law shall be applied to the process of transformation when a legal form is changed. The choice of law is relevant with respect to the possibility of the necessity of a notary either regarding the form of formation deed or the decision of the supreme body approving the change of a legal form. One has to realize that this kind of transformation is final, there are no other provisions on that associations can be transformed into institutes and vice versa. This possibility has been given only to societies which were obligatorily transformed into associations by the efficiency of the New Civil Code since 2014. However, this obligatory change did not affect the legal form as such, it was rather a terminology and systematic change in order to make the associations more transparent. The voluntary transformation of an association into an institute based on Section 3045 par. 1 of the Civil Code shows many uncertainties regarding the interpretation of the law mainly with respect to the formation deed and elected bodies due to the interpretation laws as analogy, subsidiarity or *lex specialis derogat legi generali*.

References

- Duba, J., & Šveřepová, K. (2015). Ústav – nedostatky právní úpravy v praxi. *Bulletin advokacie*, 2015(10), 53.
- Gerloch, A. (2009). *Teorie práva*. Plzeň: Aleš Čeněk, 147-148.
- Lavický, P., et al. (2014). *Občanský zákoník I. Obecná část (§ 1–654)*. 1st edition Praha: C.H. Beck, 1570–1573.
- Svejkovský, J., & Deverová, L. et al. (2013). *Právnícké osoby v novém občanském zákoníku. Komentář*. Praha: C.H. Beck, 453.
- Ronovská, K. (2013). Nadační fond po rekonstrukci soukromého práva. Subsidiarita, či analogie uvnitř nadačního práva? *Právní rozhledy*, 2013(13-14), 494.
- Svejkovský, Deverová, et al. (2013). *Právnícké osoby v novém občanském zákoníku*. 1st edition, 448-449.
- Svejkovský, J., Kabelková, E., Vychopeň, M. et al. (2014). *Vzory smluv, petičů a základních listin dle nového občanského zákoníku* 1st edition Praha: C.H. Beck, 96.
- Švestka, J., Dvořák, J. Fiala, J., et al. (2014). *Občanský zákoník. Komentář, Svazek I*. Praha: Wolters Kluwer, 922.
- Act No. 89/2012 Coll., the Civil Code.
- Act No. 125/2008, Coll., on transformations of commercial companies and cooperatives (on business corporations).
- Act No. 563/1991 Coll., on accounting.
- Act. No. 83/1990 Coll., on associations of citizens, as amended.
- Vrchní soud v Praze, 7 Cmo 295/2015, [PR 11/2016 p. 416].

Liability of Corporations after Legislative Changes in the Private Law

Martin Slobodník

Abstract: *The author of the propounded contribution is dealing with a controversial issue of liability of legal entities (especially in the field of criminal law) in the light of a comprehensive recodification of substantive private law. Special attention is dedicated to the legal theories about the nature of legal entities, which were significantly changed after adoption of a new civil code, i.e. act no. 89/2012 coll. Original "organic" theory, in accordance with the idea of own will of legal entity, was replaced by the "fiction" theory. Under the replacing theory are legal entities legally incompetent, so they cannot act alone without their representatives. Legal actions of the representatives are imputable to legal entities. The author focuses on the issues of capacity of legal entities to act illegally, especially when they don't have own will.*

Key words: Liability of Corporations · The Legal Consequences of the Infringement · Imputability · Legal Entities

JEL Classification: K1

1 Introduction

Legal entity is one of the two types of entities recognized by law and which are distinguished by the doctrine of legal theory. These are artificial legal structures that have legal capacity, which is to some extent adequate to natural persons. There are two basic groups of theories of legal entities, which in principle prevailed in legal theory. They are referred to as a theory of fiction and an organic theory. The theory of fiction considers the natural persons (individuals, people) as the only real and existing person in the legal sense, since only physical, corporal, respectively biocorporal existence allows recognition of a person in a legal sense (Hendrych, D, 2009). Legal persons do not have a will in this case and as their willingness is considered the will of their representatives. In contrast, organic theory is based on the view that a legal entity is regarded as the "spiritual body", which we admit its own self-will, which is different from the people who form a legal entity (Beran, K, 2014). In this case, it is spoken about the theory of identification, or rather the organic theory.

It is obvious and appropriate that legal persons should be qualified to legal activities as well as illegal activities, and it is possible to hold them liable in legal relationships. Legal persons thus may act in accordance with the law, but they may also commit the infringement, as it is quite common, especially in the field of civil or administrative law (Bohuslav, L. in Jelinek, J. et al, 2013). Legal entities cannot only gain benefits, mainly the rights granted by the Czech law, but these benefits must be balanced by certain obligations and responsibilities on the other side.

Particularly in the 20th century we were witnesses of the detection of still growing real power of legal entities different from individuals. These entities existed in certain forms already in the oldest Roman law⁶⁷ more than two thousand years ago or also in the middle ages⁶⁸, however, the origin of the actual legal person is seen rather in the context of business development during the industrial revolution, when most of the traders looked for tools to reduce the risk of losing their property in case of their business failure in large projects (Eliš, K., et al, 2013).

Liability of legal persons is considerably older in private law cases than the responsibility inferred by the legal sources of public law. The oldest extant sources related to the criminal liability of legal persons come from the 16th century, but they are noticed in the field of Anglo-American type of legal culture; this type of legal culture is considered as a "cradle" of this form of liability (Fenyk, J, 2003). But these sources reject the possibility of penalizing corporations (Perkins, M. R., 1969). Later in 1821 Hazlitt spoke out in favour of the possibility of criminal sanctions, when he stated

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⁶⁷ In Roman law, there are certain kinds of legal entities called *universitates personarum* that could be holders of rights and obligations, and which could own property. They were completely independent from its founders, however they could not have their own will and therefore could not even commit a criminal act in accordance with the principle of *societas delinquere non potest*.

⁶⁸ In the Middle Ages various entities were founded especially because of governance of hansa, religious or university matters. These entities were often created to guard against the encroachments of the sovereign, but in these cases, we cannot speak about legal personality in the true sense of the institute.

that legal persons are much more debauched and corrupt than individuals (Hanzlitt, W, 2000). Since 1840, the criminal liability of legal persons has become common practice in England and hence is no longer questioned.

It was the development of modern industrial society, modern globalization and integration processes, intensifying of real impact of legal persons and their increasingly frequent and severe defective infringements that have led to the initial theoretical discussions. In the last quarter of the twentieth century we were the witnesses of the inception of increasing efforts of international forums to discuss the possibility of punishing the infringements of legal entities with effective and proportionate sanctions (Huberová, B., 2000).

This work has resulted in the adoption of a series of international, political or scientific documents, which are very important with regard to this issue and many of them are legally binding. Here I put forward some of them, especially those approved by the European union:

- Second Protocol to the Convention on the protection of EU financial interests of the European Communities on 19 June 1997 (97 / C221 / 02);
- Joint Action EU of 24 February 1997 on combating trafficking in human beings and sexual exploitation of children (97,154 / JI No L 063);
- EU Joint Action of 21 December 1998 on the criminalization of participation in a criminal organization in the EU Member States (98/733 / JI No L 351);
- EU Joint Action of 22 December 1998 on corruption in the private sector (98/742 / JI No L 358);
- EU Council Framework Decision of 28 May 2001 on combating fraud and counterfeiting of non-cash means of payment (2001/413 / JHA);
- EU Council Framework Decision of 13 June 2002 on combating terrorism (2002/475 / JHA);
- EU Council Framework Decision of 27 January 2003 on the criminal protection of the environment (2003/80 / JHA);
- EU Council Framework Decision of 19 July 2002 on combating trafficking in human beings (2002/629 / JHA);
- EU Council Framework Decision of 28 November 2002 on the strengthening of the penal framework to prevent the facilitation of unauthorized entry, transit and residence (2002/946 / JHA);
- EU Council Framework Decision of 22 December 2003 on combating the sexual exploitation of children and child pornography (2004/68 / JHA);
- EU Council Framework Decision of 25 October 2004 laying down minimum provisions on the constituent elements of criminal acts and penalties in the field of illicit drug trafficking (2004/757 / JHA);
- EU Council Framework Decision of 12 July 2005 to strengthen the criminal law framework to combat pollution from ships (2005/667 / JHA);
- Council Framework Decision EC of 22 July 2003 on combating corruption in the private sector (2003/568 / JHA)
- Council Framework Decision of 25 October 2004 laying down minimum provisions on the constituent elements of criminal acts and penalties in the field of illicit drug trafficking (2004/757 / JHA);
- Council Framework Decision of 24 October 2008 on the fight against organized crime (2008/841 / JHA);
- Directive of the European Parliament and of the Council of 19 November 2008 on criminal-law protection of the environment (2008/99 / EC);
- Council Framework Decision of 28 November 2008 on combating certain forms and expressions of racism and xenophobia by means of criminal law (2008/913 / JHA);
- European Parliament and Council Directive 2009/52 / EC of 18 June 2009 on minimum standards on sanctions and measures against employers of illegally staying third-country nationals;
- Directive of the European Parliament and Council Directive 2009/123 / EC of 21 October 2009 amending Directive 2005/35 / EC on ship-source pollution and on the introduction of penalties for infringements;
- European Parliament and Council Directive 2011/36 / EU of 5 April 2011 on preventing trafficking, combating and protecting victims, and replacing Council Framework Decision 2002/629 / JHA;
- European Parliament and Council Directive 2011/92 / EU of 13 December 2011 on combating the sexual abuse and sexual exploitation of children and child pornography, and replacing Council Framework Decision 2004/68 / JHA;
- Directive of the European Parliament and Council Directive 2013/40 / EU of 12 August 2013 on attacks against information systems, replacing Council Framework Decision 2005/222 / JHA (OJ EU L 218, 14 August 2013);
- Directive of the European Parliament and Council Directive 2014/62 / EU of 15 May 2014 on criminal law protection of the euro and other currencies against counterfeiting, and replacing Council Framework Decision 2000/383 / JHA (EU OJ L 151, 05.21.2014).

Since the late 70s of the twentieth century, these documents were created and produced especially in the Council of Europe, European Parliament, European Communities, the European Union, but many of them were created in the UN, OECD, as well as in major scientific forums (Jelínek, J., 2007). It is necessary to realise that the obligation of the Czech republic and other European states to criminalize certain forms of antisocial behaviour does not emerge only from binding legislation of the European union, but it follows also from the contracts prepared in a number of the above-mentioned international organizations, e.g.:

- Recommendation (77) 28 on the role of criminal law to protect the environment;
- Recommendation (81) 12 on economic crime;
- Recommendation (82) 15 on the role of law in protecting consumers;
- Recommendation (88) 17 of the Committee of Ministers (the European Council) member states on CSR, with legal personality for offenses committed in the exercise of their activities.

Legal nature of accepted documents is very different. It is possible to encounter rules in the form of binding international treaties, which oblige all participating States to implement tort liability of legal persons in their national law⁶⁹ and also the documents with the nature of recommendations, as well as those without legal nature (Šámal, P., 2002).

2 Results - Changes after the recodification

Most of the above cited documents are still applicable and those of the legal character are binding the Czech republic. All of these documents left the definition of the legal persons for national legislators. There are usually only very general definitions and we have to look carefully in the national legislation.

Together with the adoption of law no. 89/2012 coll., civil code, there has changed among a number of private law institutes also the concept of legal persons. While under the previously existing regulations⁷⁰, executive director or other legal person's statutory representatives acted on behalf of the legal entity, under the new legislation these representatives will represent the legal persons pursuant the delegation of authority. With regard to this concept, the legal entity itself cannot have the legal capacity to act. Under this concept these subjects are considered as incompetent. This adjustment brings undoubtedly certain advantages, e.g. when executive director represents a legal entity, we must subsidiary apply the general provisions on representation enshrined in the civil code, which results for instance in possibility where executive director can be deputized by anyone else with legal capacity (individual or even another legal person) when acting for a legal entity. In addition to certain indisputable advantages of this arrangement it is a doctrinal shift that may seem problematic with regard to cohesion of private law and public law.

A very important example is act no. 418/2011 coll., on criminal liability of legal persons and proceedings against them, dated on 27th October 2011, which was adopted during the effectiveness of previous Civil Code from 1964. This Act leaves the definition of a legal person to the private law with regard to the considerations contained in the explanatory report. For this reason, it is important to examine how the new Civil Code conceptually modified concept of a legal person. According to the new legislative rules is a legal person perceived from the theory of fiction.

But this is the part of public law that was drafted and approved during the period of the previous Civil Code of 1964, which was based on the organic theory. Organic theory perceives a legal entity as an organized group whose structure is made up of organs that make and outwardly express the intention of the group. Gierke in his analysis of this theory refers primarily to the structure of the state, which he considers a "human social organism" composed of various institutions, which are unified under general will and the organized power, and because of these reasons the State has a separate personality (Hurdík, J., 2000). Practical consequence of this theory is that organs of a legal entity like executive manager or another person or a group of persons authorized to represent the legal person externally, are acting on behalf of the legal person. This means that we do not speak about the imputability of the legal acts of persons authorized to represent the legal person externally, but such acting is perceived as acting of the legal person. In that case, it is much more easy to understand, that this person has a qualification to enter into legal acts. And from the opposite view, it is logical that on the other hand, this person has also a qualification to enter into illegal acts. When this person acts with legal consequences, it can be the act approved by law or contrary to law.

⁶⁹ E.g. Convention on criminal-law protection of the environment (Strasbourg, 4 November 1998, ETS no. 172) - binding international treaty is open for signature by all States, the Czech Republic has not yet ratified it, or the Criminal Law Convention on Corruption (Strasbourg, 27 January 1999, ETS no. 173) - binding international treaty is open for signature by all States (Czech Republic ratified the deposit of the instrument of ratification on 8 September 2000). Communication from the Ministry of Foreign Affairs no. 70/2002 Coll. m. s., as amended by Communication Ministry of Foreign Affairs no. 43/2009 Coll. m. p.

⁷⁰ Law no. 40/1964 coll., civil code.

However, according to the new legislation represented by the new civil code, *in concreto* § 20 (1) of the Civil Code 2012, is "legal entity an organized structure, about which the law states that it has a legal personality or whose legal personality is recognized by law. Legal persons may without regard to purpose clause of their activities have rights and obligations, which are possible to combine with their legal nature." This clause specifies that the legal entity has a legal personality, i.e. the capacity to possess rights and obligations, but unlike the individuals they do not have a legal capacity to act. This legislation does not mention the legal capacity of legal persons, so they are in the light of such legislation legally incapable. The fact that the legal person does not have this capacity, does not derive only from the actuality that in § 20 of the Civil Code the legal capacity is not granted. It especially stems from § 151 (1) of the Civil Code according to which "the law or founding contracts of legal persons determines how and to what extent are person or a group of persons authorized to represent the legal person externally, making the decisions of legal persons and replace its will." Unless the legal entity doesn't have a will, it can barely have a legal capacity, i.e. make separate legal acts. Therefore, the legal entity is designed in the new Civil Code in a way that it doesn't act alone, but that under § 164 of the Civil Code it is a member of the statutory body or person or a group of persons authorized to represent the legal person externally, who act and these acts are imputable to the legal person.

The first paragraph of § 8 TOPO provides that "a crime committed by legal person is an unlawful act committed (...)". The first, we have to note, that the law does not say e.g. "the legal person is responsible for illegal acts of" or "an offense of a legal person shall be deemed as unlawful act committed by..", but directly that "the crime committed by a legal person is (...)" (Beran, K., 2014). This linguistic expression is not random and it has its own importance in terms of how the law on criminal liability of legal persons conceptually defines a legal person. It can therefore be reasonably assumed that the law on criminal liability of legal persons is linked to theoretical basis of the previously existing Civil Code of 1964, which was based on organic theory. The very basic idea of this legislation was the possibility of legal person to act, either legally or illegally.

3 Conclusion

In conclusion, we can state that every even a slight interference in the legal system must be carefully prepared, particularly with regard to the interdependence of standards not only within the private law or in the context of public law, but also with regard to the interconnection of the legal system as a whole and preserving its cohesive character.

List of abbreviations

Sb.	Collection of Laws
Sb. m. s.	Collection of International Treaties
NOZ	Law no. 89/2012 Coll., Civil Code
ObčZ	Law no. 40/1964 Coll., Civil Code
ZOK	Law no. 90/2012 Coll., the Commercial Companies Cooperatives (Business Corporations Act)
TOPO	Act no. 418/2011 Coll., the law on criminal liability of legal persons and proceedings against them
TZ	Law no. 40/2009 Coll., Criminal Code Act
TŘ	Act no. 141/1961 Coll., The Law on Criminal Procedure (Criminal Procedure Code)

References

- Beran, K. (2014). Trestní odpovědnost právnických osob z pohledu nového občanského zákoníku, *Trestněprávní revue*, 2014(7-8), 179.
- Bohuslav, L. (2013). Přičitatelnost trestného činu právnické osobě. In Jelínek, J. et al. *Trestní odpovědnost právnických osob – bilance a perspektivy*. Praha: Leges.
- Eliáš, K. et al. (2013). *Občanské právo pro každého: Pohledem (nejen) tvůrců nového občanského zákoníku*. 1. ed. Praha: Wolters Kluwer ČR. 113.
- Fenyk, J. (2003). Vývoj trestní odpovědnosti právnických osob a český návrh zákona o trestním soudnictví nad právnickými osobami. *Státní zastupitelství*, 2003(2-3), 2-2.
- Hazlitt, W. (1901). *Table Talk*. World Classics, first publ. 359.
- Huber, B. (2000). Trestní odpovědnost korporací. Požadavky v rámci mezinárodních konvencí a jejich aplikace v evropských zemích. *Trestní právo*, 2000(9), 2-2.
- Hendrych, D. (2009). *Právní slovník*. 3. ed.. Praha: C.H. Beck.
- Huberová, B. (2000). Trestní odpovědnost korporací. Požadavky v rámci mezinárodních konvencí a jejich aplikace v evropských zemích. *Trestní právo*, 2000(9), 2-2.
- Hurdik, J. (2000). *Právní osoby (Obecná právní charakteristika)*. Brno : MU v Brně. 71.
- Jelínek, J. et al. (2013). *Trestní právo hmotné. Obecná část. Zvláštní část*. 3. ed. Praha: Leges.
- Jelínek, J. (2007). *Trestní odpovědnost právnických osob*. Praha: Linde.

- Jelínek, J. Herczeg, J. (2012). *Zákon o trestní odpovědnosti právnických osob a řízení proti nim: komentář s judikaturou*. 1. Ed. Praha: Leges.
- Jelínek, J. (2009). Trestní odpovědnost právnických osob v České republice – stále otevřený problém. In *Trestná zodpovednosť právnických osôb*. In *Zborník príspevkov z medzinarodnej konferencie konanej dňa 12. novembra 2009*. Bratislava: Eurokódex.
- Jelínek, J. (2008). Trestní odpovědnost právnických osob jako předmět zkoumání. *MVČR*, 008(1).
- Jelínek, J. (2016). Nad koncepcí trestní odpovědnosti právnických osob. *Kriminalistika*, 2016(1).
- Šámal, P. (2002). K úvodním ustanovením připravované rekodifikace trestního zákona. *Trestněprávní revue* 2002(12). 354.
- Šámal, P., et al. (2012). *Trestní odpovědnost právnických osob. Komentář*. 1. ed. Praha: C. H. Beck.
- Tichý, L. et al. (1999). *Dokumenty ke studiu evropského práva*. Praha.
- Vantuch, P. (2003). K návrhu zákona o trestní odpovědnosti právnických osob. *Trestní právo*, 2003(10). ISSN 1211-2860.
- Vidrna, J., & Dolanský, P. (2014). *Trestní odpovědnost obchodních společností a územních samosprávných celků*. Praha: C. H. Beck.

Title: Proceedings of the 10th International Scientific Conference INPROFORUM
„Threatened Europe? Socio-Economic and Environmental Changes“

Publisher/ ed.: University of South Bohemia in České Budějovice, Faculty of Economics

Print: Nová Forma s.r.o.

ISBN: 978-80-7394-607-4

Online ISSN: 2336-6788

Copies 150

Pages 296

First edition

ISBN 978-80-7394-607-4

