The Link between Firm-Level Productivity and Decisions to Export – the Case of Lodz Voivodeship

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SUMMARY

The aim of this article is to test whether there are differences in productivity between exporters and non-exporters among manufacturing firms from Lodz Voivodeship. Not only do we look for a correlation, but also we verify two main hypotheses about the causality of the postulated relation: self-selection and learning-by-exporting (LBE). We use microeconomic data from the Central Statistical Office of Poland and the Olley-Pakes algorithm to estimate the total factor productivity (TFP) of firms. Then we apply that data to probit and logit estimations of export status and examine TFP increments of new exporters. We did not find sound evidence for self-selection among firms in Lodz Voivodeship. We managed, however, to prove the existence of an LBE effect, though this effect seems to be weak and restricted to certain sectors with comparative advantages. One should keep in mind that our research was limited by data availability and further studies are required. However, this study is a rare example of a regional analysis of international trade and deals with main New New Trade Theory postulates in a complex manner.
Keywords: productivity, internationalisation, export, Lodz Voivodeship
Journal of Economic Literature (JEL) code: F14, F23

INTRODUCTION

Since the establishment of the New Trade Theory (NTT) it has been acknowledged that monopolistic competition under internal scale economies and consumers' love for variety can be seen as the environment within which international trade occurs (Krugman 1979, 1980; Helpman & Krugman 1985). However, NTT models were based on the assumption of a representative (typical) firm, which led to conclusion that if such a firm exports, then empirically one should see that all firms within the same narrowly defined industry do so. Casual observation violates that theoretical conclusion, raising question about characteristics distinguishing exporters from firms operating only domestically.

The new theoretical revolution, giving rise to the so-called New New Trade Theory (NNTT), started in the early 2000s. Melitz (2003) proved that firm-level productivity is the most crucial factor affecting the decision of whether to export or not. Only the most productive firms are competitive enough (due to low marginal costs) to make such high revenue from exporting that they can cover the sunk fixed costs of exporting (arising, for example, from the formation of distribution channels or promotion activities). Specifically, in every industry there exists a productivity threshold of exporting – if a firm's efficiency is below that value, then it is unable to start or continue exporting. Similar results were obtained in other theoretical models (Bernard et al. 2003; Melitz & Ottaviano 2008).

The phenomenon in which firm-level productivity influences the decision of exporting is called self-selection. This hypothesis is based on an empirically found correlation between firms' efficiency and their export status. However, correlation does not indicate causality, hence another direction of the link between productivity and exporting has been proposed. In the so-called Learning-by-exporting (LBE) hypothesis, engagement in international trade boosts a firm's efficiency[1]. Yeaple (2005) showed that in order to export, firms must adopt better technology and more skilled workers – the ultimate result being an increase in firm-level productivity. In a similar model Verhoogen (2008) demonstrated that foreign customers' preferences for high quality forces exporting firms to hire more skilled workers. Bernard et al. (2010) built a model in which engagement in export leads to concentration on the firm's core competence. The LBE hypothesis has also been tested in numerous empirical papers with mixed results (see Wagner 2005).

[1] *See De Loecker (2013) on empirical issues connected with detecting the LBE effect.*

The empirical literature shows that self-selection is a more common phenomenon than LBE. For instance, using simple VAR models Hagemejer (2006) found no evidence of LBE but at the same time proved the existence of self-selection among Polish manufacturing firms. In probit regression he also found that firm-level productivity affects the probability of exporting.

In this article we present the results of our research on the impact of productivity on the exporting activities of firms from Lodz Voivodeship. The choice of that voivodeship is motivated by the fact that it is a representative region with average economic power and sophistication compared to other regions of Poland. In the next section we compare the distributions of exporters' and non-exporter's productivity. Then we verify the self-selection and LBE hypotheses. The last section states our conclusions.

EXPORTERS AND NON-EXPORTERS – MAIN DIFFERENCES IN DISTRIBUTION OF PRODUCTIVITY

Productivity in general is a feature that describes how well a given company performs or, in other words, how efficiently it uses its resources in order to maximise its product. Particularly, the Total Factor Productivity (TFP) is a measure of how effectively all inputs on production components are converted into economic outcomes[2]. However, technically it can be difficult to estimate TFP, as simple measures often suffer from serious biases which make conclusions based on them far from real.

Olley and Pakes (1996) proposed a semi-parametric method of estimating TFP, which we incorporated in our research. Their method is suitable for estimation of firm-level productivity as it resolves two main problems arising when dealing with panels of firm-level data: simultaneity and selection bias (Yasar et al. 2008, p. 221). The former refers to the fact that observed inputs, such as labour or capital, may be correlated with unobserved inputs or productivity shocks, such as quality of materials, management skills, technical wear of capital, etc. The latter refers to the problem of subjects falling out from the data set. Moreover, these endogenous exits are often correlated with other variables, most often with size (Aguirregabiria 2009, p. 2). The Olley-Pakes algorithm (OPA) copes with these issues by employing investment as a proxy for the unobserved, time-varying productivity shocks and using estimates of survival probability (Yasar et al. 2008, p. 222).

In our research we measured firm-level productivity (using OPA on Central Statistical Office data) of companies from Lodz Voivodeship (Poland), dividing them into two groups: exporters and non-exporters. We repeated our calculations for the years 2005 (the aftermath of Polish EU accession), 2008 (the verge of the subprime crisis) and 2011 (latest available data, global crisis entering its fadeout). We expected to obtain higher productivity measures for exporters in all the research periods. Table 1 contains the results.

Table 1
Results of TFP estimations

TFP estimates	Number of companies					
	Exporters			Non-exporters		
	2005	2008	2011	2005	2008	2011
(0.0 - 5.5]	17	21	26	59	52	58
(5.5 - 6.0]	140	97	96	162	148	134
(6.0 - 6.5]	170	165	163	173	180	143
(6.5 - 7.0]	120	108	107	80	78	66
(7.0 - 7.5]	56	58	85	17	28	23
(7.5 - 8.0]	34	46	33	4	11	15
(8.0 - 8.5]	7	13	17	1	4	3
(8.5 - 9.0]	6	4	6	0	0	1
(9.0 - 9.5]	0	0	1	0	0	0
9.5 <	0	1	4	0	1	1
Total number (% of all comp.)	550 (53%)	513 (51%)	538 (55%)	496 (47%)	502 (49%)	444 (45%)
Avg. TFP	6.45	6.53	6.59	6.09	6.18	6.18
St. deviation	0.66	0.72	0.78	0.51	0.59	0.65

Source: own calculations based on Central Statistical Office data

The most important observation is the fact that the average productivity of exporters was higher than that of non-exporters in all years of calculation. It is worth stressing that our calculation was based on a set of information about all production companies from Lodz region, so our averages are in fact expected values of complete discrete distributions given in Table 1. That is why there is no necessity for testing the significance of differences in averages if we wish to provide conclusions referring only to Lodz Voivodeship. Should we, however, wish to widen our inference, we could treat our sets as subsets of productivity distribution among exporters and non-exporters in general (or at least in Poland) and our averages as estimates of expected values. In that case one would also find, based on simple statistical testing, that these differences are significant at $\alpha=0.01$.

When referring to dynamics of average productivity, two pieces of information seem to be crucial. Firstly, exporters' TFP was growing in the entire period, whereas non-exporters' productivity grew in 2008 in comparison to 2005, but in 2011 the average TFP was exactly the same as in 2008. Secondly, although the crisis at its beginning brought a drop in the number of both exporters and non-exporters, leading even to an increase of the non-exporters' share in the amount of all companies, in 2011 the number of exporters began to rise again, while more and more non-exporters dropped out of the market. That is why it is safe to point out that when the first shock of global crisis had passed, it was the group of exporters that managed to recover more efficiently.

[2] *The basic idea of TFP is to present the relation of output value to sum of all costs of inputs incurred during the production process. TFP over 1 means that the value of enterprise's production (usually – sold production) exceeds its costs. In general, the higher TFP, the better, as it indicates more effective performance.*

Since all averages belong to the (6.0 – 7.0) range, let us fix 7.0 as the threshold for extraordinarily high productivity and 6.0 as the threshold for extraordinarily low productivity. For non-exporters, the shares of companies with low productivity were 45%, 40% and 43% for 2005, 2008 and 2011, respectively, and the share of companies with high productivity was 4%, 9% and 10%. As for exporters, the share of companies with low TFP (for 2005, 2008 and 2011, respectively) was 29%, 23% and 23% again, while the shares of exporters with high productivity were 19%, 24% and 27% respectively. This again shows that the productivity gap between the group of exporters and non-exporters is increasing with time.

THE SELF-SELECTION HYPOTHESIS

According to standard NNTT models (Bernard et al. 2003; Melitz 2003) exporters are more productive than non-exporters[3]. That view has been proved by numerous empirical studies (e.g. Bernard & Jensen 2004, Mayer & Ottaviano 2007, to name but a few). Hagemejer (2006) investigated the case of Poland. He found that self-selection characterises Polish manufacturing firms – more productive firms are more likely to become exporters. Bearing that result in mind, we tried to find whether such a phenomenon is present among firms from Lodz Voivodeship.

Our research was based on logit and probit estimations with export status (1 for exporter, 0 for non-exporter) playing the role of dependent variable. The sample consists of 5,373 observations. Table 2 enumerates independent variables used in the estimations.

Table 2
List of independent variables

Symbol	Description
ht	Olley-Pakes estimation of firm-level TFP (ratio)
lt	log of i-th firm workforce (people)
at	log of i-th firm age (years)
st	dummy for Treasury in ownership structure
jt	dummy for local government in ownership structure
zt	dummy for foreign capital in ownership structure
pt1	dummy for PKD (Polish Business Classification) divisions 10, 11 or 12
pt2	dummy for PKD divisions 13, 14 or 15
pt3	dummy for PKD divisions 16, 17 or 31
pt4	dummy for PKD divisions 18, 26 or 32
pt5	dummy for PKD divisions 19, 22 or 23
pt6	dummy for PKD divisions 20 or 21
pt7	dummy for PKD divisions 24 or 25
pt8	dummy for PKD divisions 27, 28 or 33
pt9	dummy for PKD divisions 29 or 30
mt	dummy for being an importer of capital goods
bt	dummy for investing abroad in the form of FDI

Source: own elaboration based on Central Statistical Office data

Both logit and probit estimations lead to the same qualitative conclusions (see Table 3). Surprisingly, we find no evidence of self-selection. Not only is the marginal effect of change in productivity negligible, but also firm-level efficiency appears in estimated equations with negative coefficients. That result can be interpreted as proof that the competitive edge of firms from Lodz Voivodeship is based on characteristics other than productivity (intuitively, high quality or uniqueness of products, high financial liquidity and access to vast networks of contacts can be seen as these traits). Low values of R-squared (McFadden R-squared or adjusted R-squared) indicate that factors other than productivity play a key role when firms decide whether to enter foreign markets through export.

The lack of self-selection is of paramount importance from policymakers' point of view. Without such a phenomenon there are no intra-industry reallocations in the direction of the most productive firms. Those reallocations are seen as a serious contributor to aggregate productivity gains (Pavcnik 2002; Melitz 2003). It seems that in Lodz Voivodeship the only productivity-connected effect of exporting resulting from the behaviour of individual firms may be LBE.

The results of logit and probit estimations also indicate that the probability of exporting increases with firm size (proxied by workforce) and age. It seems that the bigger the firm is, the more human resources it can devote to conducting international operations. The result for age can be seen in two different ways. Firstly, according to sequential internationalisation theories (like the Uppsala model) only firms successful enough on the domestic market can start international activities. Gaining such success requires time, hence older firms are more likely to become exporters. Secondly, there is probability of the so-called hysteresis effect – firm actively exporting in previous periods remain exporters. In such a situation age can be seen as a proxy for past exporter status.

Apart from that, the results show that ownership is another important aspect of firm-level decisions on international operations. Treasury-owned or local-government-owned firms are less prone to engage in exporting. At the same time foreign ownership increases the probability of exporting. What is more, if the firm is an importer of capital goods or invests abroad (FDI), then it is also more likely to enter foreign markets via export. The effects of foreign ownership and engagement in other forms of internationalisation lead to the conclusion that firms belonging to international production networks are more likely to be exporters.

Our results also indicate that the industry in which the firm operates has an effect. Having divided the industries into nine categories, we used eight of them in estimations (we skipped one to avoid the problem of collinearity). However, each of the coefficients was negative, meaning that belonging to the non-included (ninth) sector

[3] *Self-selection can be found in importing as well. See also Bernard et al. (2013) with two-sided firm heterogeneity.*

increases the probability of exporting. In general, that industry is connected with production of vehicles. It seems this is where the (static) comparative advantage of Lodz Voivodeship lies.

Table 3
Results of probability estimations

Var.	Logit estimation				Probit estimation			
	Coef.	Stand. error	z	Marg. effect	Coef.	Stand. error	z	Marg. effect
const.	-1.816	0.458	-3.96	---	-1,016	0,256	-3,97	---
ht	-0.012	0.076	-0.16	-0.003	-0,023	0,044	-0,54	-0,009
lt	0.469	0.045	10.51	0.112	0,278	0,026	10,65	0,108
at	0.116	0.045	2.61	0.028	0,065	0,026	2,48	0,025
st	-0.176	0.186	-0.95	-0.042	-0,093	0,109	-0,86	-0,036
jt	-1.632	0.983	-1.66	-0.390	-1,014	0,573	-1,77	-0,393
zt	1.323	0.102	12.92	0.316	0,761	0,057	13,24	0,295
pt1	-1.517	0.241	-6.31	-0.362	-0,864	0,133	-6,50	-0,334
pt2	-0.562	0.236	-2.38	-0.137	-0,297	0,130	-2,29	-0,116
pt3	-0.864	0.251	-3.44	-0.212	-0,468	0,140	-3,34	-0,185
pt4	-1.248	0.259	-4.83	-0.301	-0,708	0,144	-4,92	-0,276
pt5	-0.929	0.243	-3.82	-0.228	-0,527	0,134	-3,94	-0,208
pt6	-1.304	0.264	-4.94	-0.313	-0,732	0,148	-4,93	-0,285
pt7	-0.847	0.248	-3.42	-0.208	-0,476	0,137	-3,47	-0,188
pt8	-0.921	0.245	-3.76	-0.226	-0,512	0,136	-3,77	-0,202
bt	0.627	0.287	2.18	0.137	0,821	0,043	19,26	0,314
mt	1.337	0.071	18.84	0.315	0,364	0,156	2,33	0,133
Stat.	Dependent var. – mean			0.571	Dependent var. – mean			0.571
	Dependent var. – SD			0.495	Dependent var. – SD			0.495
	McFadden R-squared			0.226	McFadden R-squared			0.226
	Adjusted R-squared			0.222	Adjusted R-squared			0.222
	Log likelihood			-2842.8	Log likelihood			-2844.7
	Akaike crit.			5719.6	Akaike crit.			5723.4
	Schwarz crit.			5831.7	Schwarz crit.			5835.4
	Hannan-Quinn crit.			5758.8	Hannan-Quinn crit.			5762.5

Source: own calculations based on Central Statistical Office data

THE LEARNING-BY-EXPORTING HYPOTHESIS

The LBE hypothesis is one of the views referring to a link between productivity and engagement in international trade, according to which, companies that enter foreign markets by exporting manage to benefit from it not only due to increases in sales, but also thanks to being exposed to new technologies, more demanding customers, higher competition, different management styles and operational standards, etc. as well as through joining production chains and networks. This may enable them to specialise either in a narrower range of goods or in just a part of production process, leading to investment in more advanced and specialised human resources and equipment and benefiting from economy of scale (see Redding 2010). All of this helps them to develop and thus become more productive. In other words, supporters of the LBE hypothesis claim that TFP productivity shift is a result of establishing contacts with foreign markets and international partners.

Whether the LBE effect is an existing real phenomenon or just a theoretical construct remains uncertain. Some results support its existence (see i.e. Isgut 2001 or Maggioni 2010), others stand against it (see i.e. Bernard 1995; Delgado et al. 2002; Wagner 2002). As for research on the LBE effect in Poland, the situation is very similar. Out of three main research projects on that issue, one showed the existence of LBE (Hagemejer & Kolasa 2008), one found that export was insignificant for productivity changes, so there is no LBE (Bukowski et al. 2006), and one was inconclusive (Hagemejer 2006).

In our research we tried to find out if firms entering foreign markets (new exporters) note any productivity increases during the first three years of their international activities. We analysed increments of the variable ht – the OPA productivity estimator (see Table 4).

Table 4
Productivity gains in the first three years after engaging in exports

	Productivity (ht) gain after		
	1 year	2 years	3 years
Mean	0.019	0.029	0.032
St. deviation	0.085	0.101	0.121
25th percentile	-0.018	-0.025	-0.037
50th percentile	-0.003	0.005	0.014
75th percentile	0.037	0.066	0.087

Source: own calculations based on Central Statistical Office data

Firstly, the average increases in productivity are positive and growing with time, though with falling

dynamics. However, they are also very small. With an average of ht about 6.5, the gain of more or less 0.03 is only about 0.5%, which is not much. Moreover, in the first year half of new exporters suffered from a negative productivity change and in the following years at least 25% maintained that condition. To make matters worse, the standard deviation is almost four times the mean, which only proves that effects of becoming an exporter (in terms of TFP changes) were soundly heterogeneous. However, though it would be hard to treat these results as strong arguments in favour of the LBE hypothesis, one should also consider that our research period, 2005-2011, mostly coincided with a crisis, which strongly increases volatility and negative production dynamics.

LBE effects are also not equal in all sectors. Table 5 shows our results for average productivity gains with sectoral filtration imposed.

Table 5
Sectoral differences in averages of the productivity gains within the first three years of exporting

	Avg. productivity (ht) gain after		
Sector	1 year	2 years	3 years
pt1	0.018	0.035	0.043
pt2	0.012	0.025	0.018
pt3	0.026	0.017	0.014
pt4	0.026	0.022	0.013
pt5	0.040	0.055	0.072
pt6	0.028	0.027	0.039
pt7	0.006	0.006	0.001
pt8	0.001	0.012	0.014
pt9	0.019	0.058	0.077

Source: own calculations based on Central Statistical Office data

As appears from gathered data, the strongest learning benefits were observed in two general sectors. The first one, marked as pt5, stands for production of non-metallic raw materials, especially oil refining products, gums and plastics. The second, marked as pt9, is the production of vehicles and other transportation equipment. This sector was already identified as the sector in which the exporting probability – in the sense of self-selection for reaching and maintaining positive exporting status – is the highest. Now it is also clear that the LBE effect is the strongest in that industry. Again it would seem, then, that it should be one of the most strategic sectors for Lodz Voivodeship.

What is more, a traditionally and historically important sector for the Lodz region, the textile industry (pt2), turned out to place among the least promising in terms of productivity stimulation via export. Moreover, one of the strategic ideas of the local government to boost development of the region was to encourage business process outsourcing (BPO) services in Lodz. However, production of IT technology, marked as pt4, which is complements the BPO services production industry, was also one of the sectors with the lowest LBE effects. The very lowest learning benefits from exports were noted for the production of metallic raw materials, marked as pt7. Based on our results, these sectors should not be backed by local business support institutions.

CONCLUSIONS

According to the new theoretical models regarding international trade there is a strong link between firm-level productivity and export status. The results of our research contrast with that view. We found that there is no self-selection characterising the exporting behaviour of firms from Lodz Voivodeship (at least not favouring the most productive establishments). At the same time the results proved that the extent of learning-by-exporting (LBE) in the region is highly limited. Those results are of great importance. It seems that the only export-related mechanism causing total factor productivity (TFP) growth within sectors is LBE (though the strength of that mechanism may be rather scant), and not self-selection.

Probably the most important conclusion refers to the sectoral aspect of the link between efficiency and the export status of firms. It seems that firms operating in the transport vehicle industry are not only more likely to engage in trade but also benefit the most in terms of increases in productivity. Bearing that in mind, rational policymakers should be able to save scarce resources by limiting trade promotion to that sector. By supporting firms from that industry (in which Lodz Voivodeship apparently has a comparative advantage) the region would enhance its growth potential.

One must be also aware of the limitations of our research. Especially, introduction of access to the credit market or proxies for quality of goods in the logit regression could shed light on other determinants of firm's decision to export. Due to lack of data we were unable to do so, hence we recommend it for future research on the topic.

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Entrepreneurship in Relation to the Competitive Potential and Position of Economies – a Regional Approach Based on Polish Provinces

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SUMMARY

The aim of this study was to determine the influence of entrepreneurship on the competitiveness of regional economies, in particular on the competitive potential and position of regions. In order to do this, an empirical study of the Polish provinces was conducted. In order to achieve the aim of the study, regression function parameters were estimated by means of three methods: the classic method of least squares, the panel method with fixed effects and the panel method with random effects. Empirical confirmation was obtained for the first hypothesis, which assumed a positive impact of entrepreneurship on the competitive potential of a region. In particular, the findings lend support to the two related secondary hypotheses, which indicated a positive impact of the enterprise start-up rate (Hypothesis 1A) and enterprise density rate (Hypothesis 1B) on the competitive potential of a region. The issue of the impact of entrepreneurship on the competitive position of a region is less clear. One of the secondary hypotheses, which assumed a positive impact of the enterprise density rate on the competitive position (Hypothesis 2B) was confirmed by the findings. However, the enterprise start-up rate was found to have an adverse influence on the competitive position of regions, thus Hypothesis 2A has to be rejected.

Keywords: entrepreneurship, regional competitiveness, Poland
Journal of Economic Literature (JEL) code: L26, O40

INTRODUCTION

This article examines the determinants of regional competitiveness. Because in the vast majority of cases companies begin their business operations in a local market and later expand their activities to other markets, an analysis of local economic conditions seems to be extremely important.

Among the different factors that have an impact on regional competitiveness, the analysis concentrates on entrepreneurship understood in its narrow meaning as the process of creating and running a business enterprise. This issue is relatively rarely discussed, although according to the literature the relationship between entrepreneurship and competitiveness can be bidirectional (Audretsch & Pena-Legazkue 2012) and the findings of earlier research do not provide definitive answers regarding the direction and strength of those dependencies. Some studies indicate that entrepreneurial opportunities appear in the environment, whereas others argue that it is entrepreneurs who shape the environment (Edelman & Yli-Renko 2010).

To address this research problem, the article differentiates between competitive potential and competitive position. Entrepreneurial capital is an important regional asset (Audretsch & Pena-Legazkue 2012) and it can be considered as a factor which affects the competitive potential of a region. At the same time, a properly conducted entrepreneurial process influences a region's competitive position.

The article is divided into four sections. The first section explains the essence and meaning of competitiveness. The second contains a theoretical discussion of the role of entrepreneurship in shaping the competitive position and potential of a region. The third part presents the adopted research assumptions, including the research hypotheses and methods of empirical analysis. The final section includes the findings of the research, followed by concluding remarks.

THE ESSENCE AND MEANING OF COMPETITIVENESS

Competitiveness is a multifaceted concept, which can be discussed on a national level or on an industry, enterprise or product level (Buckley et al. 1988; Flanagan et al. 2007), and each of those levels is significantly different from the others (Flanagan et al. 2007).

The multidimensionality of competitiveness means that many different definitions of it can be found in the literature, none of which having been universally accepted (Flanagan et al. 2007; Balkyte & Tvaronaviciene 2010). Some prominent global institutions adopt the following definitions (Fischer & Schornberg 2007):

- The OECD defines competitiveness as the ability of companies, industries, regions, nations or supra-regional economies to generate relatively high factor income and employment levels on a sustainable basis while being exposed to international competition,
- In the definition of the European Commission, competitiveness is the ability of an economy to provide a sustained rise in the standards of living for all the people who are willing to work,
- According to the definition adopted in the Global Competitiveness Report prepared by the World Economic Forum, competitiveness is a set of institutions, policies and factors which affect the level of productivity of a country (World Economic Forum 2011-2012, p. 4).

Competitiveness is also understood as a dynamic comparison between enterprises, industries or sectors in which the goods or services they produce can complement or compete with each other at certain points in order to achieve specific commercial or financial objectives. This comparison is continuous and dynamic, and it shows the evolution in the advantages of enterprises, industries or sectors over their competitors (Lombana 2011).

In another approach competitiveness is defined in the following ways, depending on the level of analysis (Buckley et al. 1988; Balkyte & Tvaronaviciene 2010):

- Competitiveness at the company level – a company is competitive if it is able to provide products or services of high quality and at lower prices than its national and international competitors,
- Competitiveness at the regional level – the ability of a region to use its competitive potential in order to achieve and maintain a competitive position over other regions,
- Competitiveness at the national level – the ability of a country to generate the resources necessary for fulfilling its national needs.

A particular form of national competitiveness is the international competitiveness of a country, traditionally explained on the basis of the theory of international trade (Balkyte & Tvaronaviciene 2010), or in a narrow sense as export competitiveness (Gorynia et al 2007b).

The concept of competitiveness is used to try and explain why some countries develop faster than others (Vares et al. 2011). The primary role of a nation is to create local conditions for the operation of companies. In the initial stages of existence, companies are usually dependent on local economic conditions, which shape their identity and determine access to resources (Grant 1991).

National competitiveness can be considered in two meanings (Thompson 2004):

- A narrow meaning, relating to cost conditions as determined by the exchange rate,
- A broader meaning, comprising the institutional and systemic circumstances of a business environment, for example the legal or political factors which influence business activities.

Another dimension of competitiveness is regional economies. The competitiveness of companies and the competitiveness of regions are interdependent concepts (Huggins 2003). The competitiveness of a region, both at the local and the regional level, is the ability of a specific sub-national economy to attract and retain companies which have a stable and/or growing market share, and to sustain a stable or growing standard of living for the population of the region (Huggins 2003). Regional competitiveness should also indicate the relative position of the companies from a given region in external markets, as well as the productivity and utilisation of local resources (Turok 2004). Additionally, regional competitiveness relates to how successfully regions compete against one another in order to win a share of the national or international markets (Kitson et al. 2004).

It is assumed that the foundations of regional competitiveness, measured by regional productivity, employment and the standard of living, comprise the manufacturing capital, human capital, social and institutional capital, cultural capital, infrastructure and knowledge (Kitson et al. 2004). The concept of competitiveness involves both efficiency, understood as the ability to achieve goals; and effectiveness, which means that goals are achieved at the lowest possible cost (O'Farrell et al. 1993).

There are several approaches and models for explaining competitiveness. The models derived from the works of Porter are considered to be mainstream models in the study of competitiveness although their critics point to some limitations such as a restricted possibility of widening the spectrum of analysis, focusing on the domestic sphere or the role of the government (Lombana 2011). Michael Porter's Five Forces model assumes that competitiveness is influenced by five forces and that basic competitive strategies exist (Porter 2006, pp. 31 and subsequent). On the other hand, Porter's National Diamond model enumerates the following pillars of competitiveness: factor conditions, demand conditions,

related and supporting industries as well as company strategy, structure and rivalry (Prasad 2011; Balkyte & Tvaronaviciene 2010; Ozgen 2011).

Other models of competitiveness are presented in the work of Ormanighi and Stringa (2008). The Structure-Conduct-Performance SCP) model assumes the impact of the structure of an industry on the conditions of conducting business, which affects the performance of companies. From the perspective of game theory, competitors are engaged in a specific game. The resource-based approach suggests that the efficiency of companies varies due to their different access to resources. And market process economics indicates that competitive advantage stems from a subjective assessment of profit potential, the creation and use of uncertainty as well as the coordination of learning and knowledge.

Another model of competitiveness, the 3P model, assumes the existence of three dimensions of competitiveness (Taggart & Taggart 1998):

- potential competitiveness – describes the inputs that can be made,
- process competitiveness – includes all the aspects of business operations through which competitive potential can change into competitive position,
- performance competitiveness – indicates the results of competitiveness.

With the introduction of aspects related to potential, process and position, competitiveness has become a coherent concept which can be integrated with management studies, economics or operations research (Flanagan et al. 2007).

The three dimensions of competitiveness interact with one another. Competitive potential influences the competitive position by making it permanent, and it influences the competitive process through generating resources which are necessary for management. Competitive process influences the position through managing the competitive potential, and it influences the potential through managing the decisions which determine the competitive potential. Finally, competitive position makes it possible to improve the competitive potential and the competitive process (Buckley et al. 1990). Competitive potential is connected with the inputs and competitive position is connected with the outputs (O'Farrell et al. 1993). Another study (Gorynia et al. 2007a) distinguishes between competitive potential and competitive position, just as in the 3P model, but the term competitive process is replaced by competitive strategy.

In the literature various measures are suggested to describe the dimensions of competitiveness as described by the 3P model; for example, the following measures can be used (Taggart & Taggart 1998; Buckley et al. 1990):

- potential competitiveness – labour costs, productivity, prices, research and development expenditure, commercialisation of research and development activities,
- process competitiveness – involvement in international business, marketing skills, economies of scale, internal and external relations,
- performance competitiveness – market share, share in exports market, dependence on exports, increase in exports, profitability.

Research findings also indicate that some measures of competitiveness seem to have values which are specific for given sectors, such as, for example, the volume and value of sales, sales growth, profitability and time- and cost-effectiveness as measures of competitive position; the quality of a product as a measure of competitive potential; and international orientation, management content or market orientation as measures of process competitiveness. Other measures may have a more universal nature, for instance employee's skills or relationships in key markets as measures of competitive potential, and the organisational structure, management styles and systems as measures of process competitiveness (Coviello et al. 1998). For a company to achieve a stable and balanced competitive situation it should be competitive in all the aspects of the 3P model (Taggart & Taggart 1998).

THE ROLE OF ENTREPRENEURSHIP IN SHAPING THE COMPETITIVENESS OF A REGION – A THEORETICAL APPROACH

The present study focuses on the competitiveness of a regional economy. This dimension has been adopted because of the importance of local conditions for the operations of business enterprises. Typically, companies start to operate in local markets and only later do some of them begin the process of internationalisation (Grant 1991). Therefore, regional competitiveness is a phenomenon which is important in terms of both theory and practice.

One of the key dimensions of effective regional competitiveness is sustainable growth in employment. A key factor in achieving sustainable growth is maintaining a critical number of firms, measured by the saturation of an economy with enterprises, which helps generate new entrepreneurs and innovators in emerging sectors and markets as well as creating new jobs (Huggins, 2003).

There are two perspectives of regional competitiveness. The first is a microeconomic perspective, which involves the companies operating in a given region and their ability to produce goods in a stable and profitable manner, making it possible to meet the demand in an open economy. The second perspective is the result of macroeconomic competitiveness (Dimian & Danciv 2011).

This article assumes that entrepreneurship is a factor which influences regional competitiveness. Entrepreneurship, just like competitiveness, is a multi-faceted concept which remains outside the mainstream of neoclassical economics. Although research into entrepreneurship has been conducted for over half a century, there is still no single universally accepted definition or theory of this concept (Bygrave & Hofer 1991; Campbell 1992; Zachary & Mishra 2010); however, entrepreneurship is becoming an increasingly legitimate area of research (Hoskisson et al. 2011).

One problem of entrepreneurship studies is thought to be that fact that there is no clear conceptual basis; instead, research is based on various concepts derived from neoclassical equilibrium, psychology, and the Austrian school, as well as economic, cultural and socio-political schools (Murphy 2011). Entrepreneurship is analysed in historical, time, institutional, spatial and social contexts (Welter 2011). There are three principal research trends, in which entrepreneurship is understood as innovativeness (Schumpeter 1960; Hoskisson et al. 2011), risk-taking (Emmett 1999), or noticing and exploiting market opportunities (Kirzner 1997; Douhan et al. 2007). In the literature, entrepreneurship is equated with starting a business, innovation, seeking business opportunities, taking risks, seeking profit, making a new use of resources, obtaining and managing resources, creating value, company existence, taking initiatives, ownership, as well as the strategic development of an enterprise (Morris et al. 1994; Hoskisson et al. 2011). In a narrow sense, entrepreneurship is connected with the creation and development of an enterprise (Griffiths et al. 2012), whereas in a broad sense it is connected with its attributes and resources (Bridge et al. 2009, pp. 39-44].

This article has adopted a narrow definition of entrepreneurship, being the process of creating and running a company. Creating a new business is a complex process that involves a range of activities, such as identifying market opportunities, preparing a plan of action, and obtaining resources, as well as formalising the company and its further development through successive stages of growth (Gorzelany-Dziadkowiec & Gorzelany, 2007). In the course of the entrepreneurial process an idea is transformed into an operating company (Bratnicki 2008).

The relationships between entrepreneurship and regional competitiveness are not often analysed in the literature and they require further study (Audretsch & Pena-Legazkue 2012). Studies which examine the relationships between entrepreneurship and the environment present two opposing views: some claim that entrepreneurial opportunities emerge in the environment, whereas others argue that entrepreneurs shape the environment (Edelman &Yli-Renko 2010); sometimes it is said that a two-way relationship exists between these two categories (Audretsch & Pena-Legazkue 2012). Previous study has looked for a relationship between the location of new enterprises, the place of an entrepreneur's operations and entrepreneurship support policies (Trettin & Welter 2011). Moreover, it is indicated that the characteristics related to the location of businesses, especially access to local resources, affect their ability to implement innovation (Karlsen et al. 2011).

This study assumes that the level of entrepreneurship in a given region affects regional competitiveness, so entrepreneurial activity influences the environment. Adopting such an assumption stems from the observation that entrepreneurship is embedded in the social structure, and enterprises are part of a larger system consisting of other enterprises as well as society as a whole. A local community can be regarded as an important basis for developing entrepreneurial activity. Entrepreneurs are agents of change and organisers of the community development process (Spilling 2011). Entrepreneurial capital is a significant regional asset which can accelerate the transformation of a local economy through increased competition and regional productivity (Audretsch & Pena-Legazkue 2012). A region's greater capability of generating new knowledge and creating new enterprises are positively correlated with its level of competitiveness (Gonzalez-Pernia et al. 2012).

Market entries of new enterprises and the activity of the existing ones can influence the level of regional competitiveness through several channels. The appearance of new market entrants increases competition between companies and creates demand for skilled workers (Kitson et al. 2004), which has a positive impact on the competitiveness of the region. This positive impact can be attributed to two causes. The first one is a selection mechanism which prevents inefficient companies from surviving on the market, thus enabling new companies to enter. The second mechanism indicates that competition between enterprises forces existing companies to improve technologies or the organisation of their operations (Turok 2004). Thus, possible entries of new firms increase the efficiency of existing companies, which raises the competitive potential of a region.

Such a relationship can also be linked to the type of technological regime in a region, which affects the ways of introducing innovation to the market. There are two types of regimes: an entrepreneurial regime and a routinised regime. An entrepreneurial regime is characterised by a high number of new enterprises that introduce innovation into the market. In routinised regimes the start-up rate is relatively low, and innovation is implemented by existing companies (Audretsch & Fritsch 2002; Lin & Huang 2008; Peneder 2008). In an entrepreneurial regime there is creative destruction, which means that new companies enter the market and replace existing businesses; and in a routinised regime there is creative accumulation, which is characterised by a relatively stable number of companies. It is easier for new businesses to enter entrepreneurial regime markets because of lower entry barriers (Lin & Huang, 2008). It is believed that entrepreneurial regimes are characterised by

a greater increase in value added and in employment; however, labour productivity is lower than in routinised regimes (Peneder 2008).

The saturation of an economy with enterprises, which promotes the generation of new entrepreneurs and innovators, is considered to be one of the key factors for achieving effective regional competitiveness (Huggins 2003).

THE IMPACT OF ENTREPRENEURSHIP ON THE POTENTIAL AND THE COMPETITIVE POSITION OF A REGION – RESEARCH ASSUMPTIONS

In view of what has been said above, the business environment can be regarded as one of the elements of the economic system of a region. Taking into account the bi-directionality of the possible interactions between entrepreneurship and competitiveness, it has been assumed that the entrepreneurial process connected with the appearance of new market entrants and the growth of existing firms affects the potential and the competitive position of economies at a regional level.

To justify this one can refer to the assumptions of neoclassical economics, especially the processes which shape the long-term situation in perfect competition (Mankiew & Taylor, 2009 pp. 386-388; Czarny & Nojszewska 2000, pp. 129-132; Varian 2001, p. 408 and subsequent). The more companies operate in a market and the lower their concentration, the easier it is for new companies to enter the market. This is because such a market more closely resembles the structure of perfect competition and consequently entry barriers are lower, there are better conditions for companies to make their mark, and the regional market is more open to new business enterprises. New market entrants affect the form of the supply function, which in the long term leads to the decline in prices to a level where profit is reduced to zero. Simultaneously, such a situation prompts companies to implement new solutions and look for the most efficient methods of utilising their resources in the search for profit. Competition between existing enterprises and the threat of new entries can thus affect the competitive potential and competitive position of a region.

Existing and newly created companies help improve the competitive potential of the region in which they operate through their influence on the inputs that can be made and utilised in the region's economy. On the one hand, enterprises obtain the factors of production which are necessary for their operations; on the other hand, they decide how to use them. It can therefore be assumed that the more developed entrepreneurship is in a region, the higher the region's competitive potential. The above dependencies lead to formulating the first research hypothesis.

Hypothesis 1: Entrepreneurship has a positive impact on the competitive potential of a region.

Existing and emerging businesses influence the competitive position; that is, the results that a region achieves in comparison to other regions. Through managing their resources, companies generate economic benefits both for themselves and for cooperating groups of stakeholders. This is reflected in the overall economic performance of the region. The greater the number of efficient companies which operate in a region, the better the region's economic performance. The above observations lead to formulating the second research hypothesis.

Hypothesis 2: Entrepreneurship has a positive impact on the competitive position of a region.

An empirical study was conducted in order to verify the research hypotheses relating to the positive impact of entrepreneurship on the competitive potential and position of regional economies. The study analysed the economies of 16 Polish regions. Based on data availability, for each of the economies the course of the variables was examined for the years 2003-2009 in yearly data. This means that for each region a time series of seven years was analysed. Altogether, 112 observations were used for each of the variables .

The impact of entrepreneurship on the competitive potential and position of economies was determined on the basis of the estimated parameters of regression function. It was assumed that the regression function is represented by the following regression equation

$$K = a_0 + a_1 MP_1 + \ldots + a_n MP_n \qquad (1)$$

where:

K – measures of competitiveness, including measures of both competitive potential and competitive position,

$MP_1 \ldots MP_n$ – measures of entrepreneurship from 1 to n,

$a_0, a_1 \ldots a_n$ – regression function parameters.

Because this study has adopted the narrow meaning of entrepreneurship as a process of enterprise creation and development, appropriate measures were applied which illustrate these processes. Initially, four measures of entrepreneurship were adopted:

- enterprise start-up rate (SR) – calculated as the percentage of newly registered enterprises in a given year in the total number of enterprises in each region,
- enterprise closure rate (CR) – measured as a percentage of deregistered companies in a given

- year in the total number of enterprises in each region,
- enterprise net rate (NR) – calculated as a percentage of the difference between new and deregistered companies in a given year in the total number of enterprises in each region,
- enterprise density rate (DR) – calculated as the number of enterprises per 1,000 inhabitants in each region.

In the absence of consensus with regard to competitiveness measures, this study refers to entrepreneurship studies which use the indicator approach. These include the Global Competitiveness Report produced by the World Economic Forum (Fischer & Schornberg 2007).

The Global Competitivness Report includes the Global Competitivness Index (GCI), which is influenced by 12 pillars, each indicating the determinants of competitiveness. These pillars depict such aspects of competitiveness as institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market sophistication, technological readiness, market size, business sophistication, and innovation (Global Competitiveness Report 2011-2012). Although the GCI is a comprehensive measure for competitiveness assessment, it presents an international perspective and there is no data relating to individual regions of a country. That is why the GCI could not be used for the purposes of this study.

It can be noted that the measures of entrepreneurship adopted in this study can be linked to the sixth pillar of competitiveness – the efficiency of the goods and services market. In the GCI one of the components of this pillar is domestic competition, which includes the number of new manufacturing enterprises and the time required to start a business. The measures of entrepreneurship adopted in this study (enterprise start-up rate, closure rate, net rate and density rate), although not entirely corresponding to the components used in the GCI, can be considered to present a broader picture of competition between enterprises.

Although Porter's five forces model evaluates the profitability of an industry and not of a region (Porter 2006, pp. 31 and subsequent; Prasad 2011), it can be seen that the adopted measures of entrepreneurship as determinants of competitiveness are associated with the threat of new market entries, which is one of the forces analysed in the model. Additionally, with regard to Porter's diamond of national advantage, the determinants adopted in this study relate to the part of the diamond which comprises the strategy of companies, their structure and rivalry (Balkyte & Tvaronaviciene 2010; Prasad, 2011).

To determine the competitive potential of individual regions, which involves the resources that can be utilised, the present study used the potential measures proposed in the 3P model (Taggart & Taggart 1998; Buckley et al. 1990). In particular, the following three measures were taken into account:

- Labour costs in PLN per one inhabitant (LC),
- Price dynamics, where the previous year is considered to be 100 (PD),
- Research and development expenditure in PLN per inhabitant (RDE).

Competitive position, in turn, which indicates the performance competitiveness of regions, was measured by means of two parameters: GDP per capita and disposable income. In the literature, net national income per capita, measured by purchasing power, is considered to be the most synthetic indicator of economic performance (Kowalski & Pietrzykowski 2010, pp. 30-31); however, in the Polish economy the differences in price levels are not very significant so correcting GDP with purchasing power is not necessary. GDP per capita is often used in studies as a measure of regional competitiveness (e.g. Dimian & Danciv 2011) which indicates the results and thus the competitive position of regions.

In the case of competitiveness measures this study took into account the ranking of regions' effectiveness, that is the relationship of GDP per capita and disposable income in a region to the level of these values in Poland, with the average value for Poland being 100. Thus, the following two measures for the competitive position of regions were adopted:

- A percentage deviation of GDP per capita in a given region from GDP per capita in Poland (GDP per capita, Poland = 100) (GDP)
- A percentage deviation of disposable income in a given region from disposable income in Poland (Disposable income, Poland = 100), (DI).

The denominator for most of the adopted indicators describing the competitive potential and position (LC, RDE, GDP, DI) is the population of a given province. This stems from the desire to obtain a common denominator for competitiveness measures and the enterprise density indicator (DR).

Because one of the adopted variables, the enterprise net rate (NR), can have both positive and negative values, it cannot be converted to natural logarithms. Therefore, to achieve the comparability of variables at this stage of the study, the decision was taken to keep the raw data; if only linear dependencies were to be analysed when creating regression functions, all the variables should be converted to natural logarithms.

In order to eliminate the collinearity of independent variables, correlations between the variables were examined (see Table 1).

Table 1
The correlation coefficient between variables

	GDP	DI	LC	PD	RDE	SR	CR	NR	DR
GDP		0.954	0.808	-0.021	0.807	-0.134	-0.185	0.155	0.732
DI	0.954		0.766	-0.027	0.707	-0.126	-0.137	0.098	0.757
LC	0.808	0.808		0.333	0.830	0.281	0.152	-0.022	0.605
PD	-0.021	-0.027	0.333		0.127	0.206	0.296	-0.252	0.043
RDE	0.807	0.707	0.830	0.127		0.076	-0.018	0.070	0.459
SR	-0.134	-0.126	0.281	0.206	0.076		0.643	-0.209	0.053
CR	-0.185	-0.137	0.152	0.296	-0.018	0.643		-0.883	-0.117
NR	0.155	0.098	-0.022	-0.252	0.070	-0.209	-0.883		0.182
DR	0.732	0.757	0.605	0.043	0.459	0.053	-0.117	0.182	

Source: own compilation

From the point of view of estimating the regression function parameters, it is important to exclude those variables which have a high correlation. Out of the four independent variables adopted (SR, CR, NR, DR), there is a high positive correlation between the start-up rate (SR) and the closure rate (CR) (0.643). Therefore, enterprise closure rate (CR) was discarded as an independent variable and only three measures of entrepreneurship were used in further research procedures: enterprise start-up rate (SR), enterprise net rate (NR) and enterprise density rate (DR).

THE IMPACT OF ENTREPRENEURSHIP ON THE COMPETITIVENESS OF REGIONS – RESEARCH FINDINGS

The next research step, following the correlation analysis (see Table 1), was the estimation of regression function parameters according to Equation (1). The dependent variables were the measures of competitive potential and competitive position, and the independent variables were the measures of entrepreneurship. First, the classic method of least squares was used to estimate the level of significance (p value) for each of the parameters (see Table 2).

Out of the 5 regression functions (see Table 2) estimated during the second research step, in 4 cases the parameters for the independent variable enterprise net rate (NR) turned out to be not statistically significant (for the dependent variables GDP, DI, LC and RDE), and for the fifth function (dependent variable PD) this parameter was again significant with a lower level of significance than the level adopted in this study (the threshold of significance adopted in this study is at the value of $p<0.01$, whereas in the analysed case the value was $p=0.016$). Therefore it was concluded that there is no basis for adopting the enterprise net rate as an independent variable influencing competitiveness, and this variable was excluded from further analysis.

Table 2
Regression function parameters calculated by means of the classic method of least squares using raw data

Dependent variable	Independent variables	Parameter value	Standard error	t-distribution	p value
GDP	Constant	24.805	11.794	2.103	0.038
	SR	-3.163	1.169	-2.706	0.008
	NR	-0.191	0.728	-0.262	0.794
	DR	0.991	0.086	11.480	0.000
DI	Constant	52.712	6.799	7.753	0.000
	SR	-2.002	0.674	-2.972	0.004
	NR	-0.549	0.419	-1.309	0.193
	DR	0.631	0.050	12.67	0.000
LC	Constant	-4439.980	1743.390	-2.547	0.012
	SR	538.332	172.754	3.116	0.002
	NR	-120.471	107.549	-1.120	0.265
	DR	105.030	12.764	8.228	0.000
PD	Constant	100.802	1.020	98.780	0.000
	SR	0.164	0.101	1.626	0.107
	NR	-0.154	0.063	-2.446	0.016
	DR	0.006	0.007	0.830	0.409
RDE	Constant	-245.301	90.850	-2.700	0.008
	SR	5.324	9.002	0.591	0.556
	NR	-0.172	5.604	-0.031	0.976
	DR	3.484	0.665	5.238	0.000

Source: own compilation

On completion of the second research stage, two variables were finally adopted as independent variables, the enterprise start-up rate (SR) and the enterprise density rate (DR). This allows us to analyse the influence of entrepreneurship both from the point of view of entrepreneurial potential, measured by the start-up rate (SR), and from the point of view of entrepreneurial results, measured by enterprise density (DR).

Adopting these two dependent variables makes it possible to refine the research hypotheses. Hypothesis 1, which concerns the positive impact of entrepreneurship on the competitive potential of a region, has been modified by adding two specific hypotheses.

Hypothesis 1A: Enterprise start-up rate has a positive impact on the competitive potential of a region.

Hypothesis 1B: Enterprise density rate has a positive impact on the competitive potential of a region.

By analogy, the second research hypothesis, which concerns the positive impact of entrepreneurship on the competitive position of a region, has been modified by formulating two specific hypotheses.

Hypothesis 2A: Enterprise start-up rate has a positive impact on the competitive position of a region.

Hypothesis 2B: Enterprise density rate has a positive impact on the competitive position of a region.

After enterprise closure rate and enterprise net rate had been excluded from the set of analysed variables, it was possible to convert all the remaining variables to natural logarithms. When this had been done, the parameters of the regression function were estimated according to the initial form of Equation (1) by means of three consecutive methods: the classic method of least squares, the panel method with fixed effects, and the panel method with random effects.

Table 3
Regression function parameters for GDP per capita as a dependent variable

Independent variables	Parameter value	Standard error	t-distribution	p value
Classic method of least squares				
Constant	0.671	0.337	1.988	0.049
SR	-0.221	0.078	-2.817	0.006
DR	0.947	0.067	14.040	0.000
Panel method with fixed effects				
Constant	4.025	0.317	12.700	0.000
SR	-0.050	0.016	-3.148	0.002
DR	0.127	0.073	1.744	0.084
Panel method with random effects				
Constant	3.559	0.319	11.170	0.000
SR	-0.060	0.017	-3.582	0.001
DR	0.235	0.073	3.230	0.002

Source: own compilation

When analysing the results of estimating the parameters of the regression function for GDP per capita as a dependent variable by the use of three methods, it can be observed that irrespective of the method of estimation, the enterprise start-up rate (SR) is inversely proportional and the enterprise density rate is directly proportional to GDP. In all the methods of estimation, both the independent variables have a statistically significant impact on the dependent variable (see Table 3).

Comparing the absolute values of the estimated parameters, it can be assumed that the enterprise density rate of an economy has a greater impact on GDP per capita than the start-up rate.

Table 4
Regression function parameters for disposable income (DI) as a dependent variable

Independent variables	Parameter value	Standard error	t-distribution	p value
Classic method of least squares				
Constant	2.097	0.216	9.717	0.000
SR	-0.126	0.050	-2.507	0.014
DR	0.599	0.043	13.880	0.000
Panel method with fixed effects				
Constant	3.823	0.187	20.500	0.000
SR	-0.030	0.009	-3.175	0.002
DR	0.173	0.043	4.038	0.000
Panel method with random effects				
Constant	3.618	0.185	19.540	0.000
SR	-0.034	0.010	-3.536	0.001
DR	0.221	0.042	5.226	0.000

Source: own compilation

Another dependence which was examined, using the same three methods of estimating regression function parameters, was the influence of entrepreneurship on the disposable income of the population (see Table 4). In all three cases it was found that the start-up rate (SR) inversely influences and the density rate (DR) directly influences the disposable income of the population. The DR variable turned out to be statistically significant in all the analysed cases with the adopted level of significance ($p<0.01$). The ST variable is statistically significant at the adopted level of significance ($p<0.01$) in the case of the panel method with random and fixed effects; however, in the case of the classic method of least squares this variable is significant at a lower threshold of significance ($p=0.014$).

The absolute values of the estimated parameters indicate that the enterprise density rate is a factor which has a greater influence on the disposable income of the population than the business start-up rate.

Next, the influence of entrepreneurship on labour costs per capita (see Table 5) was analysed using the three methods of estimating the parameters of the regression function. Both measures of entrepreneurship, enterprise start-up rate (SR) and enterprise density rate (DR), in the case of all the regression functions, turned

out to have a directly proportional and statistically significant influence on labour costs.

Table 5
Regression function parameters for labour costs per capita (LC) as a dependent variable

Independent variables	Parameter value	Standard error	t-distribution	p value
Classic method of least squares				
Constant	3.889	0.516	7.537	0.000
SR	0.549	0.120	4.586	0.000
DR	0.907	0.103	8.797	0.000
Panel method with fixed effects				
Constant	-1.463	1.237	-1.183	0.240
SR	0.925	0.062	14.840	0.000
DR	1.921	0.284	6.759	0.000
Panel method with random effects				
Constant	1.280	0.834	1.535	0.128
SR	0.960	0.063	15.34	0.000
DR	1.298	0.190	6.833	0.000

Source: own compilation

A comparison of the absolute values of the estimated parameters indicates that, similarly to the previous regression functions, business density rate is a factor which exerts a greater influence on labour costs than does the business start-up rate.

Table 6
Regression function parameters for price dynamics (PD) as a dependent variable

Independent variables	Parameter value	Standard error	t-distribution	p value
Classic method of least squares				
Constant	4.588	0.034	135.200	0.000
SR	0.015	0.008	1.946	0.054
DR	0.002	0.007	0.324	0.747
Panel method with fixed effects				
Constant	4.054	0.213	19.020	0.000
SR	0.016	0.011	1.448	0.151
DR	0.120	0.049	2.459	0.016
Panel method with random effects				
Constant	4.588	0.034	135.200	0.000
SR	0.015	0.008	1.946	0.054
DR	0.002	0.007	0.324	0.747

Source: own compilation

The next research step was to determine the influence of entrepreneurship on the price dynamics in each region (see Table 6). However, in none of the three methods for estimating the parameters of the regression function did the parameters of both measures of entrepreneurship, enterprise start-up rate (SR) and enterprise density rate (DR), reach the adopted level of significance ($p<0.01$). Thus there are no grounds for confirming the influence of entrepreneurship on price dynamics.

The final stage of the research was to examine the impact of entrepreneurship on research and development expenditure per inhabitant (see Table 7) using the three adopted methods of estimating regression function parameters. All the regression functions showed that both measures of entrepreneurship – the start-up rate (SR) and the density rate (DR) – have a directly proportional influence on research and development expenditure. However, the statistical significance of this relationship is unclear. In half of the cases (three out of six) the assumed significance threshold was reached, in two other cases the p values marginally exceeded the target level ($p=0.019$; $p=0.018$), and in the last case the significance level was at the value of $p=0.059$. This means that if a lower level of significance ($p=0.1$) is accepted, all the variables can be considered significant, but with the assumed threshold in half the cases the variables did not reach the target level.

Table 7
Regression function parameters for research and development expenditure (RDE) as a dependent variable

Independent variables	Parameter value	Standard error	t-distribution	p value
Classic method of least squares				
Constant	-5.822	2.136	-2.725	0.008
SR	1.183	0.496	2.386	0.019
DR	1.731	0.427	4.052	0.000
Panel method with fixed effects				
Constant	-7.697	4.363	-1.764	0.081
SR	1.683	0.220	7.654	0.000
DR	1.918	1.003	1.913	0.059
Panel method with random effects				
Constant	-7.345	3.313	-2.217	0.029
SR	1.679	0.210	8.006	0.000
DR	1.842	0.757	2.432	0.017

Source: own compilation

Similarly, as in the case of the dependencies which were analysed earlier, on the basis of the absolute values of the estimated parameters it can be stated that the impact of enterprise density on research and development expenditure is greater than the impact of start-up rate. This time, however, the difference in the strength of the impact is smaller than it was in the previous instances.

In conclusion, it is evident that the results of the analyses have confirmed the impact of the two measures of entrepreneurship, enterprise start-up rate and enterprise density rate, on both the potential and the competitive position of regions.

Both the adopted measures of entrepreneurship exert a positive influence on the competitive potential of regions. The start-up rate, which depicts the scale of new businesses entering the market, has a directly proportional influence on labour costs and on prices, as well on as research and development expenditure. A greater number of new market entrants increases competition for resources, including human capital. This produces an increase in labour costs, resulting from salary-based forms of attracting new employees, as well as an increase in price dynamics. At the same time, a higher start-up rate forces all the market operators to look for innovative solutions, which leads to an increase in research and development expenditure.

The rate of enterprise density also has a favourable influence on the competitive potential of a region. The

greater the enterprise density in a given economy, that is the greater the number of businesses per 1,000 inhabitants, the more intense the competition between them for the factors of production, including human capital. This results in higher labour costs and greater price dynamics. At the same time, a greater density of enterprises prompts them to look for new solutions, which increases the level of research and development expenditure.

It is worth noting that the adopted measures of entrepreneurship exert the strongest influence on research and development expenditure and the weakest on price dynamics.

Consequently, the findings of this part of the research provide confirmation for the first research hypothesis, which assumed a positive impact of entrepreneurship on the competitive potential of a region. The findings also provide support for accepting the two specific hypotheses, which assumed a positive impact of enterprise start-up rate (Hypothesis 1A) and enterprise density rate (Hypothesis 1B) on the competitive potential of a region.

The situation is somewhat different as regards the influence of entrepreneurship on the competitive position of regional economies. It was discovered that during the analysed period one of the measures of entrepreneurship, the enterprise start-up rate, had an adverse effect on the competitive position, whereas the second measure, the enterprise density rate, had a positive effect on the competitive position of regions.

The enterprise start-up rate depicts the scale of new market entries. Thus it is a form of human, especially entrepreneurial, and financial capital investment in new business activity. However, not all new companies are able to survive in the market, and enterprise closure rates (see Table 1) show what proportion of new business enterprises fail. In the short term a large scale of new entries can be a burden on the economy of a region and can lead to a deterioration in its competitive position, and only the activity of businesses that manage to survive in the market – depicted in the form of the enterprise density rate – has a positive impact on the competitive position of a regional economy.

The above findings do not provide sufficient grounds for accepting in its entirety the second hypothesis, which assumed a positive impact of entrepreneurship on the competitive position of a regional economy. As regards the secondary hypotheses, there are no grounds for accepting Hypothesis 2A, which assumed a positive impact of the enterprise start-up rate on the competitive position of a region. However, empirical findings provide confirmation for Hypothesis 2B, which assumed a positive impact of the enterprise density rate on the competitive position of a region.

CONCLUSIONS

The aim of this study was to determine the influence of entrepreneurship on the competitiveness of regional economies, in particular on the competitive potential and position of regions. In order to do this, an empirical study of the Polish provinces was conducted. The study used yearly data pertaining to the subject of the research for the years 2003-2009. Panel data were created, which showed the value of the adopted indicators for 16 regions over the period of 7 years, which produced 112 observations for each of the variables. In order to achieve the aim of the study, regression function parameters were estimated by means of three methods: the classic method of least squares, the panel method with fixed effects and the panel method with random effects.

The findings of the research were then related to the research hypotheses. Empirical confirmation was obtained for the first hypothesis, which assumed a positive impact of entrepreneurship on the competitive potential of a region. In particular, the findings lend support to the two related secondary hypotheses, which indicated a positive impact of the enterprise start-up rate (Hypothesis 1A) and enterprise density rate (Hypothesis 1B) on the competitive potential of a region.

The issue of the impact of entrepreneurship on the competitive position of a region is less clear. One of the secondary hypotheses, which assumed a positive impact of the enterprise density rate on the competitive position (Hypothesis 2B) was confirmed by the findings. However, the enterprise start-up rate was found to have an adverse influence on the competitive position of regions, thus Hypothesis 2A has to be rejected.

The above findings provide a basis for further research. It seems essential to verify the findings obtained in this study with regard to the regional economies of other countries. An important aspect for future research also seems to be the issue of a time delay in the impact of entrepreneurship on regional competitiveness, particularly on the competitive position. It seems possible that entrepreneurship, especially as expressed through new firm creation, affects the competitive position of a region with a certain time lag, resulting from the fact that new businesses need time before they are able to produce economic results.

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Fisher's Rate and Aggregate Capital Needs in Investment Decisions

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SUMMARY

Fisher's rate means the interest rate where the net present values of two mutually exclusive projects become equal. The paper examines the background and the circumstances of conformation of Fisher's rate in connection with the aggregate capital needs. Aggregate capital needs is a new conception and gives a new viewpoint to investment project decisions. The paper defines the special content of aggregate capital needs, and compiles an index number for it. The analysis widens knowledge regarding the content of net present value, and highlights the importance of taking the aggregate capital needs into consideration. Fisher's rate only means useful information in practice if the ranking is made based on the net present value. However, this principle of ranking is in contradiction with the concept of long-term profit maximization. The transformed net present value, which is free of distorting effects (and assuming equal required rates of return,) gives the same ranking list as the internal rate of return. Therefore, Fisher's rate has no importance in business decisions.

Keywords: aggregate capital needs; investment project decisions; net present value; internal rate of return; ranking; Fisher's rate
Journal of Economic Literature (JEL) code: M21

INTRODUCTION

Fisher's rate (or intersection) is nowadays an often quoted and illustrated category in financial books. This rate shows the interest rate that would provide the same net present value for two mutually exclusive projects. The relating intersection is that point where the two net present value curves drawn according to the series of interest rate intersect each other. The illustration covers a range of rates from zero interest rate to a rate slightly higher than the internal rate of return of the two projects. The value of the intersection on the x axis gives the rate; on the y axis it shows the same net present value of the two projects. In the range of interest rates where the interest rate is smaller than the Fisher's rate, the ranking based on the net present value differs from the ranking based on the internal rate of return. After the intersection the ranking of net present values changes, and the rankings based on the net present value and on the internal rate of return become equal. The literature mainly deals with the demonstration and ranking-changing role of this rate; (to my best knowledge) there has been no substantive mapping of the background of these relationships yet.

The financial literature recommends net present value as a tool of ranking. Since the middle of the 20th century, financial recommendations say that the ranking of investment alternatives must support the maximization of shareholder wealth, which means the realization of projects with the highest net present value. The authors usually refer to the work of Fisher. Illés (2012b) gives a brief literary overview on this topic.

If net present value (NPV) is used as a ranking indicator, the intersection can mean important decision-making information, as this is the point where the net present value based ranking of the two projects changes order. However, net present value is not suitable for ranking. After removing distorting effects from the net present value method (and assuming equal required rate of return) this ranking list leads to the same ranking as the internal rate of return (IRR). Illés (2012a) proves this relationship. Based on this article doubt is cast upon several statements of the literature, including the role of Fisher's rate in the process of investment project decisions.

The main objectives of this paper are:

1. To discover the causality relationships between net present value and required rate of return from a business economics perspective.
2. To define and analyze the concept of aggregate capital needs.
3. To compile an index number of aggregate capital needs.
4. To discover and explain the mechanism and internal coherences of the formation of Fisher's rate and Fisher's intersection.

5. To discover the causality-based pre-conditions of appearance of this rate and intersection.
6. To highlight that this rate should not be treated as substantive information in investment project decisions.

The paper analyzes the net present value and its internal relationships by using an economic detour approach. The analysis applies in principle a business economics view and system of conditions that makes it fundamentally different from any financial analyses. Illés (2012b) works out the most significant differences between the financial and the business economics approach.

One of the basic categories of examinations is the yield, which means the difference between the total revenues and total expenditures of a year. (In the literature yield is used in different contexts and so can mean different things. In this paper the yield always means the difference of the total revenues and total expenditures of a year.)

In this paper investment decisions concern investment projects with orthodox cash flow patterns. (The well-known criteria of orthodox cash flow patterns are: a series of the difference of annual revenues and expenditures starts with negative amount or amounts and the sign of these differences changes only once. That is, from a point in time where this difference first turns into positive, this positive sign does not change.)

In order to be clear, the paper only calculates with the usage of equity capital and defines profit as pre-tax profit and at project level. (At company level a loss-reducing investment does not give profit, therefore at this level it is not taxable.)

THE ORIGINAL NAME OF THE RATE

The name Fisher's rate refers to the work 'The Theory of Interest' of Irving Fisher published in 1930. This study was issued more than eight decades ago. Its significance is indisputable. Besides its financial hypotheses, another significant benefit of this work is that it is one of the establishers of the methodology of dynamic profitability calculations. The terminology has changed with time. For example, the expression 'net present value' is not mentioned in Fisher's book.

Fisher actually examines the interest rate according to which the income streams of two mutually exclusive projects will be equal. "That is, this equalizing rate is such that the present values of the two options would be equal" (Fisher 1930:155). This equality has an implicit assumption that the two projects have equal initial investments.

The author names the interest rate where the present values of two projects are equal 'the rate of return over cost'. This expression is used altogether 77 times in the book. The denomination does not refer to the real content. Scientific articles and studies of the last century refer to the category according to Fisher's denomination (for instance: Alchian 1955; Renshaw 1957; Dudley 1972; Keane 1975; Meyer 1979; Hirst & Ma 1983). The economic content of the rate would be slightly better described by the expression "equalizing rate", also used by the author; however, this expression is only mentioned three times in his book.

There are several misunderstandings in the contemporary literature due to the novelty of Fisher's topic and to the rather specific denomination of the category. One of the biggest and most often referred to misunderstandings can be found in the work of Keynes (1936). Several authors quote and analyze this oversight (for instance Alchian 1955; Carlson et al. 1974; Keane 1975). The substance of this is that (in today's terminology) Keynes defines in his work the internal rate of return that he has drawn up as equal to "the rate of return over cost" developed by Fisher. Although considering Fisher's denomination this misunderstanding is not surprising, it is still remarkable because besides the significant differences in content – with some simplification – two projects are necessary to calculate Fisher's rate, while for the internal rate of return only one project is needed (Alchian 1955).

It should be noted, however, that in some cases a different interpretation of the rate of return over cost is also possible. For instance: "In general, the rate of return over cost has to be derived by more complicated methods. As already indicated, the rate of return over cost is always that rate which, employed in computing the present worth of all the costs and the present worth of all the returns, will make these two equal. Or, as a mathematician would prefer to put it, the rate which, employed in computing the present worth of the whole series of differences between the two income streams (some differences being positive and others negative) will make the total zero." (Fisher 1930:168-169.) The second sentence of the quote is a clear explanation of the type of misunderstanding seen in Keynes.

Dudley (1972), as well as Hirst & Ma (1983), finds it important to highlight that according to Fisher's examples the initial investment of the two projects (implicitly) is the same. In fact, this fisherian solution can be the reason that in the related examples of financial literature, the initial investment of the two examined projects is always the same. The equality of the initial investment in the examples is basically uninteresting; the information about the aggregate capital needs would be relevant. Fisher gave preference to the project, from the mutually exclusive projects, with the highest present value, because he thought that this could make the highest contribution to the growth of shareholders' wealth. This view of Fisher that prefers (net) present value even in case of ranking is referred to in the recommendations of the mainstream of today's financial studies.

Furthermore, according to Fisher's approach it is worth mentioning the explanation of the rate at the

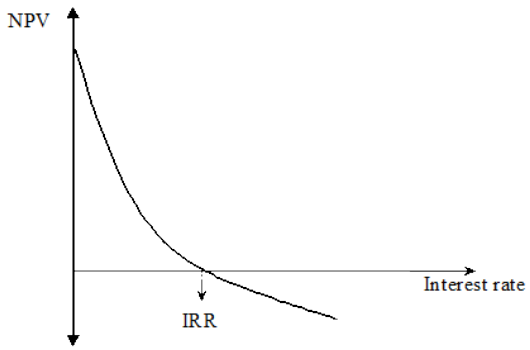
intersection as the relevant re-investment rate (Dudley1972; etc., critical analyses: Keane 1975; orthodox micro-economic approach: Meyer 1979).

Today in most cases only the name of the rate and of the intersection refers to the scientist. Besides these general references there is usually no concrete literature reference (for instance Van Horne & Wachowicz 2008; Baker & Powell 2009). In business economics publications it is mostly typical that the categories related to the intersection of the net present value curves do not use his name, not even in their denomination (e.g., Adelberg et al. 1986; Arnold & Hope 1990). Among the financial publications there are also some where neither the denomination of the intersection nor the name of the related rate refers back to Fisher (for instance Brealey & Myers 1988, or Firer & Gilbert 2004).

THE BACKGROUND OF THE NET PRESENT VALUE CURVE

The plotting of the curve of the net present value is a regularly appearing topic within the related literature. (This curve is illustrated by Figure 1.) The authors consider this figure well-known and widely used in this form; therefore do not use any professional reference. The figures and related explanations can be introduced from different perspectives: once a general theoretical relationship (Arnold & Hope 1990:254), another time as a solution of an exercise or an introduction of a problem through an example (Brealy & Myers 1988:79; Van Horne & Wachowicz 2008:329).

The literature usually illustrates that the higher the interest rate is, the smaller the net present value. As a result of increasing interest rate, this decrease first reaches the zero net present value, then further increasing results in higher and higher negative net present values. The interest rate that is at the intersection of axis x and that results in zero net present value is, as we all know, the internal rate of return. I am aware of no literature sources on the pre-conditions and detailed content background of the illustrated relationship.



Source: Widely–used illustrations of the relationship

Figure 1 The sum of the net present value in the function of interest rate

In order to specify the problem it must be laid down that the curve in Figure 1 is valid for most but not all projects in question. The relationship is only valid for profitable projects with orthodox cash flow pattern. The illustrated relationship can also be applied for protracted investments. In this case, at the beginning of the duration the initial investment contains the compound interest as well. Hereinafter, in order to simplify modeling, that sort of model will be examined where the payment of initial investment occurs at the same time as operation is started. This is date zero. The first revenues will occur one year later, by this time the annual revenues exceed the annual expenditures.

The survey starts from the content background of economic correspondence. In this way the causality relationships may come to be evident. Related topics:

- to discover the process of the yield requirements formation,
- to analyze the changing content structure of the yield in function of interest rate,
- to show that when the yield requirements are fulfilled then all of the further yields become surplus profit, the discounted sum of which is the net present value.

The net present value method is applied to orthodox cash flow pattern projects, where the initial investment occurring at the zero point of time is the following:

$$NPV = \sum_{t=1}^{n}(B_t - K_t)\frac{1}{(1+i)^t} - E_0 \qquad | B_t - K_t > 0 \qquad (1)$$

where
B_t = revenues in year t,
K_t = expenditures in year t,
E_0 = initial investment,
i = required rate of return,
t = serial number of years (t > 0),
n = duration of the project.

The illustrated net present value curve starts from zero percent interest rate. When the required rate of return is zero, then the net present value is calculated as follows:

$$NPV = \sum_{t=1}^{n} B_t - \sum_{t=1}^{n} K_t - E_0 = M \qquad | i = 0 \qquad (2)$$

M= Total accounting profit that is the difference of the nominal value of total revenues and total expenditures including initial investment arising during the whole duration of the project.

As Equation (2) shows, at zero percent interest rate the net present value is the difference between the nominal value of total revenues and total expenditures including initial investment. This difference can also be considered as an accounting profit summed up in nominal value for the total duration of the project. This gives the conclusion that if no profit is gained at nominal value, the starting point of net present value curve cannot be in a

positive range. Because of this the figure is not valid for projects that do not generate accounting profit

In this calculation, which considers the nominal value and the whole duration of the project, the problem caused by accounting not defining the profit as a difference between revenues and expenditures but as annual differences between revenues and total costs disappears. (Nevertheless, the profit of a project only means profit at the company level when the company itself is not in an accounting loss.)

The profit calculated at nominal value for the whole duration means the coverage of the profit requirements according to the required rate of return. In fact, the content mechanism of net present value method subtracts the amount of profit requirements – that can be calculated for the not yet returned investment using compound interest calculation – from this nominal profit sum. If the profit requirements are smaller than the sum of all accounting profits, the mechanism of the calculation discounts and summarizes the surpluses for the years concerned. This content mechanism is difficult to recognize because of the calculation is made on the basis of yields.

In case of an interest rate of 1 percent, in the first year this method calculates 1 percent interest-like profit requirements for the initial investment. The yield in the first year first of all covers the profit requirements and the remainder part of the yield covers a part of the initial investment. In the following years, the 1 percent profit requirements will be calculated for the sum of the not yet returned capital. (This way compound interest will be realized.) When all of initial investment and profit requirement is returned then all of the further yields become surplus profit. The higher the interest rate used in the calculation, the smaller surplus will remain from the total accounting profit, and then, when this does not provide coverage for the requirements any more, a yield lack arises. Discounting the surplus profit (or the lack of yield) for the date zero gives the net present value.

In the case of investment projects with orthodox cash flow patterns the net present value shows the sum of the surplus yield above the required one (or lack of that), discounted for present value. (The definition is in Illés 1990 and its mathematical proof can be found in Illés 2012a.) Consequently, increasing the rate of interest continuously decreases the surplus sum of accounting profit, then, after equality, it gradually increases the yield lack compared to the requirements.

The capital recovery process is not illustrated in Figure 1. In order to identify the relationships, it is practical to clarify that the annual difference of revenues and expenditures, that is, the annual yields of examined investment project, first of all are expected to cover the profit requirements according to the required rate of return and the possible part of not yet returned capital. The yearly profit requirements are calculated by multiplying of the not-returned capital and the interest rate.

Considering that the return of capital and profit requirements must be covered by the annual yields, and furthermore that the return of the nominal value of the initial investment and the profit requirements are not differentiated, the essence of the method does not become clear. The essence is that the profit requirements calculated with compound interest should be returned from the sum of the total accounting profit. This latter part of the relationship is illustrated by the amount of net present value at zero percent interest rate. (The details will come later.)

Assuming otherwise constant conditions, the higher the interest rate is, the higher the amount that needs to be returned. The interest rate of which the required profit sum is just covered by the sum of all accounting profit is the factual profit rate of the time-varying tied- up capital. At this interest rate there is no surplus profit or lack of yield (and this interest rate is named as internal rate of return). A profit requirement that is higher than the factual profit rate cannot be fulfilled according to the project's database, thus the calculation will show lack of yield. In such cases, the value of the yield lack at the end of the period after discounting will be the net present value with negative sign.

Of course, net present value can be defined as a difference between the present value of future yields and the initial investment. From the aspect of management process, this seems to be only a theoretical approach; it does not give sufficient information about the content background.

CALCULATION OF THE PROFIT REQUIREMENTS ACCORDING TO THE NOT RETURNED PART OF CAPITAL

The profit requirements calculated for the duration of the project are the following:

In the first year: $$M_{s1} = E_0 i \quad (3)$$

In the second year:

$$M_{s2} = E_1 i \; ; \text{ where } E_1 = |H_1 - E_0\, i - E_0| \quad (4)$$

In the third year:

$$M_{s3} = E_2 i \; ; \text{ where } E_2 = |H_2 - E_1 i - E_1| \quad (5)$$

For the $t > 1$ year, where the payback period (in years) is not smaller than the duration of the project:

$$M_{st} = E_{t-1} i; \text{ where } E_{t-1} = |H_{t-1} - E_{t-2} i - E_{t-2}| \; ; \; 1 < t \leq z \quad (6)$$

H_t = the yields (that is the difference of revenues and expenditures) in year *t,* where the value of H_t is always

positive for years $0 < t \leq n$ by the terms of orthodox cash flow pattern projects, and the initial investment occurring at the zero point of time,

E_t = the not returned part of capital at the end of year *t,*

M_{st} = the profit requirement in year *t* according to the not returned part of capital and required rate of return,

z = the number of years of the dynamic payback period.

In order to show the content relationships, in Equation (6) the following mathematical merger of the components is not included: $H_{t-1} - E_{t-2}\, i - E_{t-2} = H_{t-1} - E_{t-2}(1+i)$

Between the first and the z-1-th years the yield has two content components. These are profit requirement and certain capital return (provided that the yield is greater than the profit requirement). If the yearly profit requirement is larger than the current year's yield, then the difference is added to the capital still to be returned. In the *z*-th year the yield has a third content component as well, provided that the return cannot be met at the end of the year. This third component is a surplus profit.

The total profit requirements that arise during the lifespan of the project (as an accounting approach) can be defined as follows:

$$\sum_{t=1}^{n} M_{st} = \sum_{t=1}^{n} E_{t-1}\, i \quad | n \leq z\,; \tag{7}$$

where

$$E_{t-1} = \left| H_{t-1} - E_{t-2}\, i - E_{t-2} \right|\,; \qquad | \; t > 1$$

If the payback period is not shorter than the project duration in years, then the present value of surplus profit is the net present value itself:

$$NPV = \left\lfloor M - \sum_{t=1}^{n} M_{st} \right\rfloor \frac{1}{(1+i)^n} \quad | n \leq z \tag{8}$$

If the payback period is shorter than the project duration in years, there will be some years without capital and profit requirements. In this case the yields of the additional years are surplus profits as well. (The number of these years is *n-z*.) According to the continuance of the conformity with net present value method, these surplus profits can be compounded to the end of the duration. The amount of nascent quasi interest will disappear when discounting. (See Table 2 and the following calculation.)

EXAMPLE FOR CALCULATING INTEREST RATE DEPENDENT PROFIT REQUIREMENTS

The above statements are illustrated by a simple example. The basic data of a project – let us call it Project S – are the following: at date zero, 240 units of expenditure arise (as an initial investment), and then for 4 years a100-unit yield (revenues minus expenditures) is gained annually.

According to the database, during the total lifespan of Project S an accounting profit of the nominal value of 160 units is gained. (400-240=160) This amount can be divided between the return based on profit requirements and surplus profit, or in case of higher profit requirements, the difference means a lack of yields.

The relevant data are summarized in Table 1. The detailed and explaining calculations can be found in Tables 2 to 4. For the better identification of relationships, the results of these calculations are presented as rounded numbers.

Table 1
The total profit requirements and surplus profits according to different interest rates of Project S

Measurement unit: unit

Interest rate as a required rate of return	0 %	8 %	20 %	24 %	30 %
Nominal value of the total profit requirements	0	38	121	160	219
Surplus profit /lack of yield at the end of Year 4	160	124*	39	0	- 59
NPV (present value of the surplus profit /lack of yield at the end of Year 4)	160	91	19	0	-21

*This amount contains 2 units of technical (quasi) surplus profit. See details in Table 2.

In Table 1, the sum of profit requirements and the nominal value of surplus profit always add up to 160 units as the sum of all of accounting profits. (In case of yield lack, the difference of profit requirements and yield lack gives the accounting profit of 160 units.) The 24 percent is at the same time the internal rate of return as well. In this case there is no surplus profit or yield lack. The sum of the profit requirements is 160 units. (This is the whole accounting profit of the project.)

As is visible in Table 2, the annual amounts of profit requirements are accounted by multiplying the amounts of the not yet returned capital and the required rate of return. The annual yield of 100 units on the one hand covers the profit requirements of the current year, then, on the other hand its remaining part decreases the not yet returned capital until the total amount of capital is returned. In the payback year, the yield that remains over the profit requirements and not yet returned capital is the surplus profit. The yields in the following years mean clear surplus profit.

Table 2
Details of the economic calculation in the case of 8 percent required rate of return

Measurement unit: unit

Year	Capital to be returned at the beginning of the year	Amount of profit requirements (8 %)	The structure of 100 units annual yield		Capital still to be returned (-)/ surplus profit at the end of the year (+)
			Profit requirements	For capital return	
1.	240	19	19	81	- 240 + 81 = - 159
2.	159	13	13	87	- 159 + 87 = - 72
3.	72	6	6	94	- 72 + 94 = + 22
4.	surplus profit 22	2*	Surplus profit in the current year 100 + 2*		+22 + 102 = +124

*In order to ensure the consistency of the net present value method, the surplus profits gained before the end of the duration need to be compounded to the end of it. $(22 \times 0.08 = 2)$ This is only a technical solution and only concerns those cases where the payback period in years is shorter than the duration of the project. The calculated quasi-surplus profit disappears when compounded surplus profit will discounted to date zero.

Below is a control calculation of net present value where the required rate of return is 8 per cent: $-240 + \frac{100}{0.30192} = -240 + 331 = 91$, and $124 \times 0.73503 = 91$

Table 3
Details of the economic calculation in the case of 20 percent required rate of return

Measurement unit: unit

Year	Capital to be returned at the beginning of the year	Amount of profit requirements (20 %)	The structure of 100 units annual yield		Capital still to be returned (-)/ surplus profit at the end of the year (+)
			Profit requirements	For capital return	
1.	240	48	48	52	- 240 + 52 = -188
2.	188	38	38	62	- 188 + 62 = -126
3.	126	25	25	75	- 126 + 75 = - 51
4.	51	10	10	90	- 51 + 90 = + 39

Table 4
Details of the economic calculation in the case of 24 percent required rate of return

Measurement unit: unit

Year	Capital to be returned at the beginning of the year	Amount of profit requirements (24 %)	The structure of 100 units annual yield		Capital still to be returned (-)/ surplus profit at the end of the year (+)
			Profit requirements	For capital return	
1.	240	58	58	42	- 240 + 42 = -198
2.	198	48	48	52	- 198 + 52 = -146
3.	146	35	35	65	- 146 + 65 = - 81
4.	81	19	19	81	- 81 + 81 = 0

THE AGGREGATE CAPITAL NEEDS

The method of net present value only considers the amount and period of capital investment up to the level of required rate of return in a correct way. Any surplus profit over this level is simply being discounted and summed up. The amount remaining as a surplus profit is not affected by the capital-focused corporate efforts that are what was the average tied-up capital and how long it was needed to gain a certain surplus profit. In practice, from an economic viewpoint, this means the main deficiency of the information content of this category and this is the main reason that net present values cannot be compared on the merits.

A net present value with positive sign has the following message for the decision-maker: the profit requirements according to the required rate of return will be fulfilled and in present value a surplus profit of a certain amount will also be gained. If the question is whether the profit requirements are fulfilled, this answer is satisfactory. But it is not easy to tell what advantage this amount exactly means. A quite ordinary example: for an individual who is fixing 300,000 euro in a bank for one year, it is more meaningful to do so at an interest rate of 4.5% than to be told that he will get 3% interest on his deposit plus 4,500 euro more. This special sort of deposit is more difficult to see through with a long-term commitment (Illés 2012b).

The literature that deals with net present value is not concerned about the aggregate capital needs. However, it is absolutely evident that if a higher capital sum is needed for a longer time, then the aggregate capital needs will be higher. Knowledge of the aggregate capital needs can help in the comparison of net present values. In the clarification process it can be considered as a step forward when the aggregate capital needs may help us to see that the net present values (with their original

content), and the net present values divided by initial investment or multiplied by the loan repayment factor cannot be compared. These recommendations can be found in various literary sources. (On the latter in more detail see Illés 2012a.)

The project's aggregate capital needs means the amount of capital needed for the operation of the project during its full duration. For investments with an orthodox cash flow pattern, the capital needs are basically determined by three factors: the amount of initial investment, the duration of the project and the rapidity of capital payback. The latter depend on the required rate of return as well. As illustrated in the example of Project S, the higher the required rate of return is, the larger the part of the annual yield that is used to cover the profit requirements and the less remains to cover the not yet returned capital. By increasing the interest rate, the return of nominal value of the capital will be delayed, and the aggregate capital needs of the project increase.

The exact calculation of aggregate capital needs for investment projects is not a simple task. This issue has not arisen; no correct method of calculation has been discovered yet. As mentioned above, there are three reasons for the differences in aggregate capital needs of the project variants: different initial investment, different duration of the project and the different rapidity of capital payback. According to this, main manifestations of the higher aggregate capital needs – higher initial investment, longer time of return, lower rapidity of return – and different combinations of these. In the case of one-way differences, it might be obvious which variant has the higher aggregate capital needs. However, in reality, these three factors can appear in different combinations and at the same time can have effects in different directions. For example, one variant has a higher initial investment that will return in a shorter time but at with slower capital payback, etc.

The series of annual tied-up capital are built up in the Equations (3)-(6). According to these, the not yet returned capital concerning the payback period of the project can be calculated as the following:

In the first year of operation, the full amount of initial investment tied up in the projects is: E_0

In the second year, the amount of the tied-up capital is decreased by the capital returned as the result of the first year's operation: $E_1 = \left|H_1 - E_0\, i - E_0\right|$

In the third year, the tied-up capital is decreased by the capital returned during the second year's operation: $E_2 = \left|H_2 - E_1\, i - E_1\right|$

During $1 < t \leq z$ years the amount of tied-up capital is:

$$E_{t-1} = \left|H_{t-1} - E_{t-2}\, i - E_{t-2}\right| \; ; \quad \left| \; 1 < t \leq z \right. \tag{9}$$

The index number of the aggregate capital needs should be worked out on the basis of yearly tied-up capital and the duration of the project. Tied-up capital is a state indicator, and therefore the tied-up capital of different years cannot be summed up from this aspect. However, in consideration the income-producing potential needs to take into account simultaneously the tied-up capital and tied-up time. The solution is to sum up the yearly tied-up capital, that is, the not-returned parts of the capital for each year. To do this correctly as a measurement unit may be one unit tied-up capital for one year. According to the calculation method used above a three-year tie up of one capital unit is equal to three capital units tied up for one year. This solution is considered to be correct because the tied-up capital is computed with a database where the profit requirements are subtracted from the yields. (In the general case a three-year tie up of one unit of capital would be more burdensome than a one-year tie up of three units. This is because of using the compound interest method.)

Based on all these, the index number of aggregate capital needs (E_{ACN}) is as follows:

$$E_{ACN} = \sum_{t=1}^{n} E_{t-1} \tag{10}$$

This index number reflects the effect of initial investment, the duration and the rapidity of capital payback in the aggregate capital needs rather well, but concerning the content it means a capital amount which is tied up for one year.

In case of equal lifetimes the index number of annual average capital needs ($E_{average}$) can also provide useful information.

$$E_{average} = \frac{\sum_{t=1}^{n} E_{t-1}}{n} \tag{11}$$

The average tied-up capital shows how much tied-up capital is used in average during the lifetime of the project. This average index number is comparable only if the projects' duration is the same. (The rapidity of capital payback is taken into account as well.)

The category of the aggregate capital needs has a significant opinion-forming role in the sphere of using the net present value method. For the evaluation of the relative amount of surplus profit this index number is also necessary. When using the internal rate of return, the aggregate capital needs are important information as well; because of this the index number shows the real comparable capital amount which results in this profitability.

As was mentioned above, the required rate of return can also have a great effect on the aggregate capital needs. The higher the required rates of return, the smaller the part of the annual yields for capital return. Consequently, when the required rate of return is higher the return of the capital takes longer and the index number of the aggregate capital needs will be higher. This is illustrated through the calculations related to

Project S (see Tables 2-4). In regard to the fact that when calculating the annual tied-up capital, the profit requirements were already considered, the examination concerns the nominal value of capital to be returned. The results of the calculations related to the capital needs are summarized in Table 5.

Table 5
The effect of interest rate on the capital needs for Project S

Measurement unit: unit

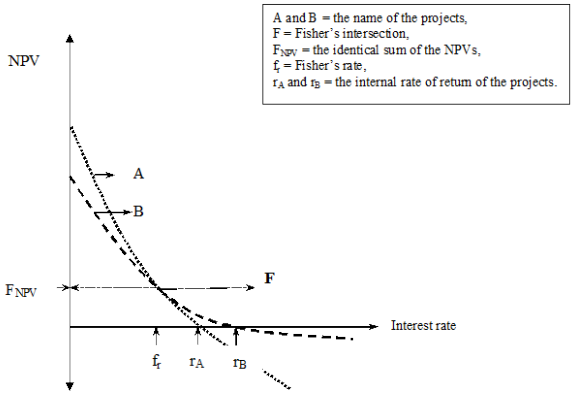
Year	Yearly capital needs depending on the interest rate				
	0 %	8 %	20 %	24 %	30 %
1	240	240	240	240	240
2	140	159	188	198	212
3	40	72	126	146	176
4	-	-	51	81	99
Aggregate capital needs					
Aggregated	420	471	605	665	727
Annual average capital needs calculated for the duration of the project					
Average	105	118	151	166	182

The analysis of Table 5 refers to Project S, where the duration is 4 years. This is the relevant information for calculating the annual average capital needs. In the case when the average calculation refers to the real tie-up period of the capital instead of the whole duration of the project, the index number does not show comparable information. (As Table 5 shows applied interest rates of 0 and 8 percent, the tied-up capital only lasts 3 years, while at 10 and 24 percent this would be 4 years. In case of an interest rate of 30 percent the profit requirements are not covered.)

THE RATE AND THE INTERSECTION

As was mentioned above, the finance literature usually calls the interest rate Fisher's rate when the net present values of the two investment projects are equal. The intersection of the net present value curves of the two projects is called the Fisher's intersection. The intersection and the rate are illustrated by Figure 2. The names of the projects are: Project A and Project B. The rate that belongs to the intersection on the x axis is the Fisher's rate, while the intersection reflected on the z axis gives the same net present value of the two projects.

In Figure 2, the net present value of Project A considering zero percent interest rate (i.e. the accounting profit of the whole duration of the project) is significantly higher than that of Project B. The aggregate capital needs of Project A must be significantly higher so that the gradually increasing profit requirements according to the rate of interest will use up higher amounts of the accounting profit than in the case of Project B. Under certain capital and profit conditions, the intersection comes into being as a result of the differently decreasing surplus profits. At the interest rate that belongs to the intersection, the net present values of the two projects are equal.



Source: Edition by the author, based on commonly used figures in the related literature (For instance, Keane 1975:22; Adelberg et al. 1986:708; Brealey & Myers 1988:83; Arnold & Hope 1990:257; Firer & Gilbert 2004:42; Van Horne & Wachowicz 2008:332; Crundwell 2008:189; and Baker & Powell 2009:259)

Figure 2 The intersection of NPV curves and the related Fisher's rate

At interest rates over the intersection, the project variant with lower capital needs will have the higher net present value. Where the surplus profit disappears, there is the internal rate of return. The surplus profit of the variant with lower capital needs lasts up to higher interest rates, which shows higher profitability of capital. The profit requirements of the variant with higher aggregate capital needs 'uses up' the total surplus profit faster, thus the internal rate of return will be lower. (The capital invested in this variant will have a lower average profitability.) This is the main reason that above the intersection the rankings based on the net present value and the internal rate of return are the same.

But it cannot be a question whether in terms of equal net present values the two projects can be considered economically equal. The aggregate capital needs are significantly higher for Project A. By investing the difference into another project, further net present values could be gained. We cannot leave out of consideration whether the same surplus profit can be gained with lower aggregate capital needs. This relationship can only be disregarded in case of unlimited capital resources and under other special conditions (Illés 2012b).

THE CAUSALITY BASED PRE-CONDITIONS FOR EMERGENCE OF INTERSECTION

Keane (1975) highlights that the existence of Fisher's rate is not necessary, furthermore when illustrating two net present value curves, even more intersections can emerge. The latter means that the net present values of two projects can be equal at several interest rates.

Keane (1975:23) cites the findings of Mao (1969) about the conditions that are necessary for existence of the Fisher's rate:

"There will be no Fisher intersection in the interval (0, rm) where rm = the smaller of the two rates of return, if

(1) a) A's NPV > B's NPV at zero discount rate, and
    b) A's NPV decreases at a greater rate than B's, in response to a given increase in k
    c) A's IRR > B's IRR.

(2) a) A's NPV > B's NPV at zero discount rate, and
    b) A's NPV decreases at a lesser rate than B's in response to a given increase in k.

There will be a unique intersection between the two NPV functions where:

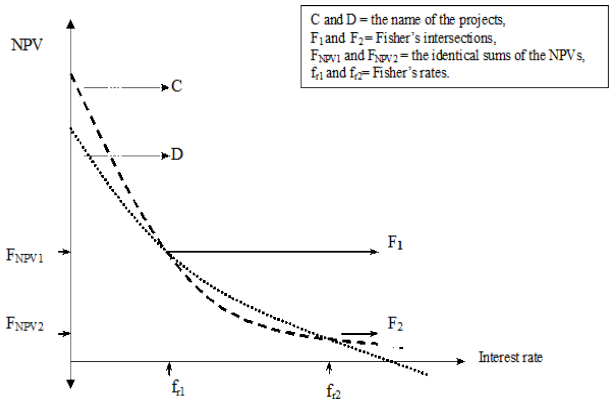
a) A's NPV > B's NPV at zero discount rate, and
b) A's IRR < B's IRR
c) A's NPV decreases at a greater rate than B's in response to a given increase in k."

In their study Hirst & Ma (1983) look for the explanation of the emergence of Fisher's intersection. They built upon the fact that Fisher (implicitly) used equal initial investments in his calculations; therefore this can be excluded as a possible reason. Further root causes can be the duration of a project and the rapidity of capital payback. In order to consider the common effect of the two factors, the authors introduced the category of weighted duration, which can be used as an explanation for the intersection. They say that the net present value of the variant with higher weighted duration is more sensitive to changes in interest rate. (According to the terminology of the current study the reasons for the longer weighted duration are the longer duration and/or the slower rapidity of capital payback.) For the calculation of weighted duration Hirst & Ma (based on the works of other authors) use the present values of annual yields as weights. (In the numerator of the fraction there is a sum that is calculated by multiplying the ordinal numbers of operating years with the annual discounted yields. The denominator contains the sum of all discounted yields. The authors also analyze the effect of applied interest rate on the weighted duration.) Hirst & Ma (1983) show some interesting examples in the field of intersections in context of weighted duration. It must be emphasized that this weighted duration can only be accepted as a root cause if the initial investment is the same in both projects.

According to the related thesis of Descartes (1596–1650), the maximum number of internal rate of return of an investment project is determined by the number of sign changes in the yield series. The project may have as many internal rates of return as the number of yield series sign changes. A lower number of internal rates of return than this are possible, but no more. In our days this basic relationship can be considered as generally known. Having more than one internal rate of return is the characteristic of unorthodox cash flow pattern projects only. The number of internal rates of return means how many times the net present value function intersects the x axis.

The Fisher's rate – from this aspect – is the interest rate that makes the series of yield differences of the two projects zero. The internal rate of return of the series of annual yield differences will be equal to the same interest rate where the net present value of the two projects becomes equal. So at the Fisher's intersection the present value of the yield differences of the two projects becomes zero. Consequently the Fisher's rate is the internal rate of return of yield differences as well.

If the criterion of an orthodox cash flow pattern is fulfilled for both variants and the sign change of the yield differences occurs only once, there can be no more than one point of intersection. However, several occurrences of intersections of two projects with orthodox cash flow patterns are possible as well when the sign of yield-differences changes on several occasions. This is illustrated in Figure 3.



Source: This sort of illustration can be found in the study of Hirst & Ma (1983:169) according to another conception. Illustration in this context is the author's work.

Figure 3 The possible occurrence of Fisher's rates and intersections of two projects with orthodox cash flow patterns where the yield differences changed sign twice

The several sign changes in the yield difference series do not necessarily mean several intersections. If intersections of the net present value curves of arbitrary type investment projects (e.g. with unorthodox cash flow patterns) are examined, then general quantifying of these intersections may become very complicated.

The classical Fisher's rate defines only one intersection. The majority of recent (English) financial books do not deal with the possibility of more than one intersection, either. A causality-based comprehensive background of this is not analyzed in the literature.

The simultaneous fulfillment of the following six conditions is necessary to have one and only one intersection:

1. The criterion of orthodox cash flow pattern must be fulfilled in case of both variants.
2. The sign change of the difference of the two series of yields occurs only once.
3. Both projects must have an accounting profit.
4. The sum of all accounting profits and the aggregate capital needs must be different for the two projects.

5. The variant with the higher sum of all accounting profits must have higher aggregate capital needs.
6. The variant with lower capital needs must have a higher internal rate of return.

The illustration of net present values of the two project variants starts with a discounting by zero percent interest rate (Figure 2). If the accounting profit sums differ, the starting points on the y axis will also be different, thus one requirement of the intersection is already fulfilled.

The variant with higher sum of all accounting profits must have higher aggregate capital needs, so that by increasing the interest rate, the net present value of this variant would decrease faster. The different rapidity of decrease is also a requirement of the intersection.

In addition, to have equality besides a positive net present value, it is also necessary that the variant with lower capital needs must have a higher internal rate of return. (The first and second conditions are necessary so that only one internal rate of return of yield differences may come into being.)

THE IMPORTANCE OF THE INTERNAL RATE OF RETURN OF YIELD DIFFERENCES

In his quoted work, Fisher deals a great deal with the question of internal rate of return of the series of annual yield differences of the two projects. He attaches very great importance to it.

As mentioned in detail above, the internal rate of return of the yield differences means exactly the same interest rate where the net present values of the two projects are equal. This is obvious, as this interest rate has made the differences of yield series disappear.

According to my current knowledge, this is only a technical feature, it has no substantive significance. The literature on modern corporate finances uses the internal rate of return of the yield differences as a rather simple way of calculating the Fisher's rate. This method of Fisher's rate calculation is much simpler than calculating the net present values of the two projects starting from zero percent interest rate to higher percentages until the two net present values become equal (or this interest rate will determined in approaching from two sides).

ILLUSTRATION AND EXPLANATION OF THE INTERSECTION THROUGH AN EXAMPLE

The purpose of the example below is to illustrate and explain the Fisher's rate and the Fisher's intersection through numerical relationships. The most important data of the two mutually exclusive project variants are summarized in Table 6.

Table 6
Revenues, expenditures and yields of the two project variants
(assuming equal initial investment, equal duration, but different aggregate capital needs)

Measurement unit: unit

Date	Project A_1			Project B_1			The difference of the two series of yields $A_1 - B_1$
	Expenditures	Revenues	Yields	Expenditures	Revenues	Yields	
0	350	0	-350	350	0	-350	0
1	552	557	5	771	1171	400	– 395.000
2	691	696	5	1017	1022	5	0
3	352	852	500	861.488	866	4.512	495.488

According to the database the main economic characteristics of the projects are the following. The initial investment and the duration of the two projects are equal but the rapidity of capital payback is significantly different. In case of Project B_1, the nominal value of the 350-unit initial investment is exceeded by the yield of 400 units already at the end of the first year. In the following two years – despite the fact that the sales revenues only decreased by 8-12 percent – only 4.5-5 units of yield are gained. In the same time, in the case of Project A_1, the yields of the first two years only support the return of capital needs and profit requirements with a rather small amount of yield, 5 units; 98% (500 units) of the yield is only gained at the end of the third year. At an interest rate of zero percent the total accounting profit of variant A_1 is 160 units, while of variant B_1 it is only 59.5 units.

Considering the fact that the two series of yields are orthodox cash flow patterns, the internal rate of return shows the average profitability of the projects. The aggregate tied-up capital shows how much capital operates with this profitability rate.

The internal rate of return for Project A_1: ~13.5 %, aggregate tied-up capital: 1182 units.

The internal rate of return for Project B_1: ~16.5 %, aggregate tied-up capital: 362 units.

Variant B_1 with its significantly lower capital sum results in the internal rate of return of 16.5 percent.

Variant A_1 with higher aggregate tied-up capital provides a capital profitability of 13.5 percent. For making a good choice between the two projects, it is practical to examine the profitability possibilities of re-investing the yield difference of 395 units for two years, and then compare this with the critical profitability rate of the re-investment. (Details are shown in Illés 2012a.) Table 7 contains the data necessary for the illustration of Fisher's rate and Fisher's intersection.

Table 7
The net present values of two project variants with different interest rates

Measurement unit: unit

Project	0 %	4 %	6 %	8%	10 %	12 %	15 %	20 %
A_1	160.0	103.9	79.0	55.8	34.3	14.3	-13.1	-53.0
B_1	59.5	43.3	35.6	28.2	21.2	14.3	4.6	-11.6

The net present values of the project variants can differ due to the different interest rates as well. When increasing the interest rate, due to the higher aggregate capital needs, the net present values of Project A_1 are decreasing more rapidly than those of Project B_1. The equality of net present values occurs at the interest rate of 12 %. The significant points calculated from the data of the above example are illustrated in Figure 4.

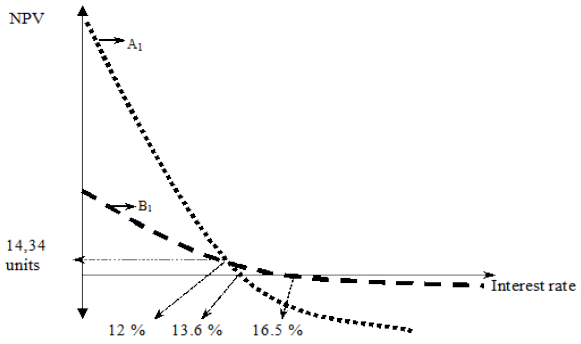


Figure 4 The Fisher's rate and the Fisher's intersection calculated from the data of the above example

Calculating the internal rate of return (r) from the differences of the yield series of the two projects can help to estimate the Fisher's rate:

Basic relationship: $-395\ \frac{1}{1+r} + 495{,}488\ \frac{1}{(1+r)^3} = 0$

After rearrangement: $\frac{495{,}488}{395} = (1+r)^2$

After executing the calculation: (1+r)2 = 1.2544; where r = 0.12

The internal rate of return calculated from the data series of yield differences is 12 %, which is equal to the Fisher's rate. As we can see, this rate of 12 % is irrelevant in the economic evaluation of projects.

SUMMARY

According to the approaches and recommendations of finance, the net present value has a primary importance in supporting investment decisions. Therefore the existence of Fisher's rate and the rate itself are significant business information in finance. The literature calls attention to the fact that conformation of the intersection is not necessary. This study works out the causal relationships that are necessary for existence of the intersection, in order to gain a better understanding of internal relationships of the net present value method.

The net present values of different projects cannot be compared in general; therefore the net present value is not suitable as a ranking indicator. Factors that cannot be disregarded are how much initial investment, for how long and how much tied-up capital is needed to gain a certain net present value. After eliminating the three main distorting factors, the net present value will be a sort of rate that gives the difference between the internal and the required rate of return (corrected by a calculation error factor). Thus this corrected net present value rate is approximately equal to the surplus profitability that exceeds the required rate of return (Illés 2012a).

If the risks of the projects are equal or risk management of the projects has been done in advance (e.g. decreasing the series of revenues or increasing the series of expenditures and so on), the ranking based on the net present value rate that is free of distorting effects and the ranking based on the internal rate of return will be the same. The surplus profitability over the required rate of return will be the highest for the project where the internal rate of return is the highest. Thus the same projects will gain the first, second, etc. place in both rankings. No change of ranking is possible with Fisher's rate.

In theory, the company can reach the best growth if the projects with the highest internal rate of return are carried out. (Provided, that is, that the required rate of return is equal.) Based on the rates of critical profitability and the real profit opportunities of the difference of initial investment and other capital need differences, the expedience of choice can prefer solutions that differ slightly from the ranking based on the internal rate of return. (This topic is showing in detail by work of Illés 2012a.) But even in these cases the decision criterion is still not the net present value. The relationship that in case of limited capital-investment opportunities at a certain risk level, the highest profitability can lead to the highest profit is still valid.

From this aspect, ranking based on the simple net present value is not relevant as well. The interest rate that would provide the same net present value for two projects is also irrelevant. In most cases when the net present values are equal, the aggregate capital needs are different.

The paper also defines the special content of aggregate capital needs, and elaborates an index number for this content. The project's aggregate capital needs means the amount of capital needed for the operation of the project during its full duration. It considers the income-producing potential necessary to take into account simultaneously the tied-up capital and tied-up time. The measurement unit is one unit tied-up capital for one year. The solution is to sum up the yearly tied-up capital that is the not-returned parts of the capital for each year. This solution considered to be correct because of the tied-up capital is computed with a database where the profit requirements are subtracted from the yields. The category of the aggregate capital needs has a significant opinion-forming role.

A highly important relationship is the following: profit requirements calculated with compound interest should be returned from the sum of the total accounting profit. The larger the aggregate capital needs of the project, the greater the profit requirement that arises.

Based on these conclusions, considering a real economic system of conditions and the purpose of long-term profit maximization (maximization of shareholder value), Fisher's rate and the Fisher's intersection can only have theoretical significance. Their analyses can give a better understanding of the content background of the net present value, but are irrelevant for making investment decisions.

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Complex Evaluation Model of Corporate Energy Management

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SUMMARY

With the ever increasing energy problems at the doorstep alongside with political, economic, social and environmental challenges, conscious energy management has become of increasing importance in corporate resource management. Rising energy costs, stricter environmental and climate regulations as well as considerable changes in the energy market require companies to rationalise their energy consumption and cut energy costs. This study presents a complex evaluation model of corporate energy management, which can be used for identifying corporate challenges resulting from global energy crises and for seeking possible answers to them as well as enabling companies to evaluate their current energy management practices and identify the level of their energy consciousness. This model enables companies to rethink their energy management tasks and identify the most acute problems of their energy management practices.

Keywords: energy management, corporate resource management, evaluation model
Journal of Economic Literature (JEL) code: M19, M21, Q49, L69

INTRODUCTION

From an operation perspective, it is of major importance for a company to ensure the resources required for its smooth operation at the lowest possible cost impact. An effective organisation of corporate resource management is a fundamental factor in terms of competitiveness. As for resources, apart from raw materials, assets, human resources and other resources, the energy used also plays an increasing role. The importance of conscious energy management is growing, since market processes pose challenges to companies. The rising energy prices and strict environmental and climate-protection requirements require companies to rationalise their energy consumption and decrease energy costs. The fact that companies assign different priorities to these issues should not be neglected. The efforts companies make for energy rationalisation depend on company size, the sector it is categorised in, energy intensity of the activities, and the proportion of energy costs compared with operating costs. Based on the information reviewed, it would be wise for companies to review their priority list in terms of energy rationalisation measures, evaluate their current energy management practices and level of their energy consciousness, set further tasks regarding their energy management and identify problem areas in their current practices. The complex evaluation model elaborated in this paper can provide assistance to companies in this endeavour.

THEORETICAL FRAMEWORK OF THE TOPIC

Before the complex evaluation model of corporate energy management was constructed, the available technical literature was thoroughly reviewed. The available literature on the topic of energy management has increased over the past few years. A number of sources deal with setting tasks in energy management, motivation factors and barriers of its application, and energy-management tools from different aspects and in various depths. (See among others: National Productivity Council, 2002; Zsebik & Czinege, 2003; Zsebik et al., 2003; Goebel, 2007; Diófási & Diófási, 2009; Carbon Trust, 2010, 2011a,b; Hirzel et al., 2011; Bihari, 2012; Thorpe, 2013). There have been several empirical studies on evaluating energy efficiency of particular sectors of economy (Önut & Soner, 2007; Pardo Martínez, 2009; Gordićat al., 2010; Sivill, 2011; Madlool et al., 2013). Apart from the above-listed studies, a number of other sources provided background for developing the approach used in this paper. As for the applied methodology, self-assessment models widely used in

current practices (energy management matrix (EMM)[1], Energy Management Assessment (EMA)[2], Ecomapping[3], Ecostar methodology) and self-assessment questionnaires (Virtual Power Plant Programme, Gvozdenak & Morvay, 2008) were thoroughly reviewed.

This paper presents two self-assessment models which are most frequently applied: the Energy Management Matrix and the Energy Management Assessment. The Energy Management Matrix (Brescu, 1993) is a simple and easy-to-use self-assessment method of energy management. It analyses energy management performance in six areas. The ascending rows, on the scale from 0 to 4, represent the increasingly sophisticated, mature and formalised nature of energy management activities, which indicate increasingly good practices. The organisational profile received after the levels have been marked indicates the areas where additional efforts are required to further promote energy management efficiency. The advantage of this method lies in its simplicity.

The matrix enables companies to assess the operation of energy management functional areas without involving external experts. If this assessment is repeated after a certain period of time, progress can be measured. The priority areas are apparent; however, I think their number and contents could be expanded. The disadvantage of this model is that it is subjective, like any other method based on self assessment. However, the subjectivity is slightly decreased since relatively concrete requirements are assigned to each level and clear and accurate statements provide bases for choosing the right level. Yet I think that – apart from the lowest and the highest levels – the statements are a bit constrained at other levels and do not always show realistic 'stair steps'. The application of only this single matrix highly simplifies, even over simplifies the assessment. Thus, it is advisable to collect background information related to particular areas and perform in-depth studies, which makes the choice of levels better grounded. (To this end, there are propositions formulated in 'Energy Efficiency Guide for Industry in Asia' (www.energyefficiencyasia.org). Unfortunately, the guide fails to list the cases and areas where a weaker performance can be considered acceptable.)

The Energy Management Assessment (EMA) provides a more detailed appraisal of energy management performance than the Energy Management Matrix. The Carbon Trust Guide (2011a, b) serves as a basis for introducing the method. The method distinguishes twelve key areas across five area groups and analyses each key area according to several criteria (with variable numbers). Particular criteria are weighed in different ways. Each key area is assigned a maximal reachable score and an actual reached score. After all the key areas are assessed, a summary table is compiled illustrating actual scores, maximal scores, and performance in percentage. The achieved results are illustrated in a cobweb diagram. The areas which require further improvement can be identified from the diagram (Carbon Trust 2011a, b). The advantage of the EMA is that it analyses several key areas according to several criteria. Since the criteria have different weight, the relevance of particular criteria can be distinguished. The disadvantage of the EMA is that the determination of the evaluation criteria and variables of particular areas results in superficial evaluation. Thus, the content lying behind the evaluation of particular areas requires further consideration. The EMA is not suitable for comparing companies.

After the secondary research was conducted, a comprehensive summary of the motivations, toolbars and main barriers of corporate energy management were prepared (Kádárné Horváth in Szakály (szerk.) 2012), which provided a basis for identifying the main directions of further research and compiling questions for a corporate questionnaire and the elements of an empirical model. The reviewed research studies were considered to be guidelines when the model was created. However, none of them was really suitable for performing the role of a complex evaluation method. When the complex evaluating model was elaborated, the methodological framework of the EMA self-assessment method was particularly inspiring. Its framework was mostly followed but its content was considerably changed when the complex model of corporate energy management evaluation was created.

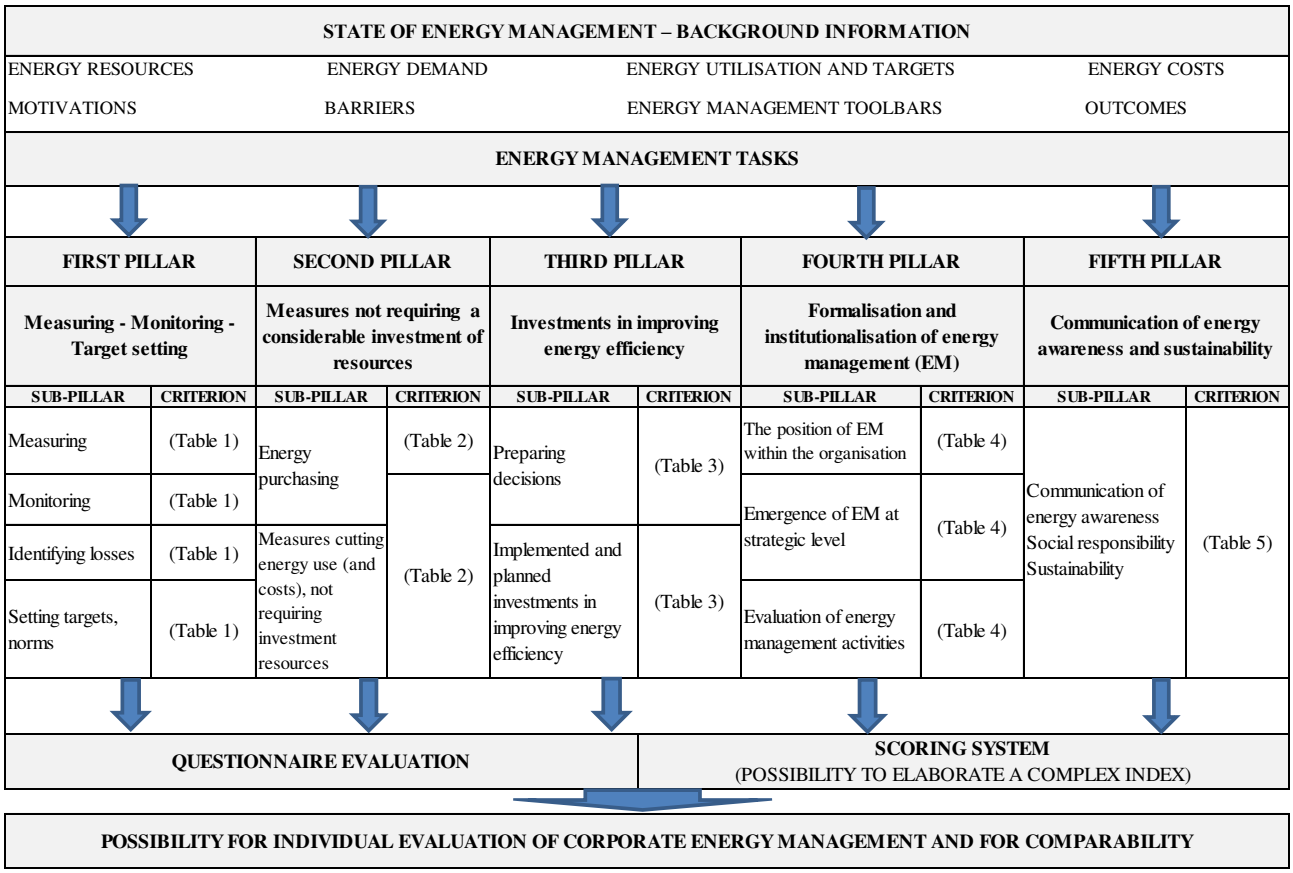
COMPLEX MODEL OF CORPORATE ENERGY MANAGEMENT EVALUATION

The starting point of the complex evaluation model was the most important task in corporate energy management, namely, to identify the corporate activities to be assessed. It was followed by grouping the identified tasks and establishing the pillars of the model. When the task groups making up the pillars of the model were determined, a principle of gradation was applied. On particular pillars, the energy management activities reflect tasks which require higher level and more corporate efforts and a more sophisticated and energy-conscious approach. The pillars (task groups) constitute main tasks of energy management (the sub-pillars) and main criteria for task evaluation. These criteria are assessed with a variable of different numbers.

The complexity of the model is experienced in several areas. First, the areas being evaluated cover almost all of the most important tasks, toolbars and motivating and

[1] *Copyright © Brescu 1993*
[2] *Carbon Trust 2011a,b*
[3] *Ecomapping © Heinz-Werner Engel, 1998*

hindering factors of energy management. Second, the model can be applied in several areas. Our aim was to construct a complex model with a double function which provides an informative evaluation of corporate energy management, mapping the areas for improvement and allows comparing companies. This double function can be fulfilled by the two evaluation tools applied in parallel in the model. The evaluation is performed on the basis of a detailed questionnaire in which there are questions related both to topics corresponding with the model elements and to background information in order to have a better insight into the issue. This method enables companies to identify the areas for improvement in their energy management, since companies have to think over what responses to give to the questions and utilise the opportunities provided by the individual evaluation of the responses. The scoring system developed on the basis of the model pillars makes individual assessment possible. This is the second tool for evaluation besides the questionnaire. Figure 1 shows the complex evaluation model.



Source: own elaboration

Figure 1 Complex evaluation model of corporate energy management

In the next part of the study the pillars of the model are introduced.

THE FIRST PILLAR: MEASURING – MONITORING – TARGET SETTING

The first pillar includes four tasks, which are measuring, monitoring, identifying energy losses, and setting norms and objectives (Table 1). They make up the first level of energy management tasks, where there is neither energy nor cost savings. However, these tasks are crucial from an efficient energy management perspective. Sustainable energy savings cannot be achieved without knowing where and with what purpose the energy is used, the amount of energy used, factors influencing it, where and at what points intervention is required, and what measures should be taken to achieve energy rationalisation. Major energy consumers, energy loss sources and the amount of lost energy are to be identified as well.

Without measuring, monitoring and controlling energy consumption, energy rationalisation measures cannot be accomplished. Identification of sources of energy losses and target setting are also important tasks. The assessment of the certain tasks should be carried out according to the following criteria:

- Measuring energy consumption. A company can estimate the amount of the energy used in several ways. One is to collect data from utility bills and suppliers' invoices. Another way is to read the utility meters. The latter provides more

accurate information. As for the measurements, the first evaluation criterion is to identify the presence of measurement conditions, namely, to map whether the company has enough utility meters and sub-meters and in what state of maintenance they are; and whether the company has energy supervision and information systems that are suitable for analysing and evaluating the collected data. The other evaluation criterion is to identify the levels where the accurate measurements of energy consumption are performed and to examine the frequency of these measurements.

- Monitoring. Monitoring and analysing the energy consumption and energy costs are of vital importance from an energy management perspective. As for evaluation criteria of activities, it is also critical to know at what levels the measurements are carried out and with what frequency they are performed. Apart from monitoring at the corporate level, performing monitoring at the site, category, plant, building, process, equipment and shift levels also provides useful information for analyses. Accurate measurement data and the data available on the utility bills, as well as different calculation methods, provide bases for information. Another important move is to analyse and monitor energy costs. Accurate and detailed analyses also allow reliable evaluation of activities. It is not sufficient to examine only the trends in energy usage and energy costs – the reasons lying behind these trends are also worth considering when energy consumption and energy costs are evaluated. This is because several factors have a considerable impact on energy consumption and energy costs. Thus, the identification of these factors and the analysis of each impact are essential. The savings resulting from energy rationalisation measures, should be distinguished from the savings that result from changes in the weather, in the production structure, in the organisational structure (organisational changes, changes in work schedules, outsourcing or insourcing activities), in the production volume, in costs, in purchasing strategies and in energy prices.
- Identifying energy losses. Energy losses can be experienced at several levels. Apart from shipping, distribution and transformation losses, there may be technological and overhead-nature losses (in technological process or in lighting, heating). It is of utmost importance whether companies identify the main sources of energy losses or quantify the losses in some way. The quantification of monetary losses makes companies sensitive to these losses and helps them overcome their vulnerability.
- Setting goals and norms. Taking into account the outcome of analyses, a company sets goals related to energy savings. The assessment of the suitability and elaboration precision of these goals may be another evaluation criterion. The goals should be clear, realistic, relevant to the specific features of the area under analysis, and measurable. An additional criterion of evaluation is the presence of concrete action plans including resource, cost and timescale analyses, a list of names of responsible persons with set deadlines, and evidence for goal implementation, feedbacks and regular reviews.

Table 1
Structure and evaluation criteria of the first pillar

THE FIRST PILLAR	
Measuring – Monitoring – Target setting	
SUB-PILLAR	EVALUATION CRITERIA
Measuring	Presence of measurement conditions
	Measurement levels, frequencies
Monitoring	Monitoring frequencies
	Precision, detailedness of analysis
Identifying energy losses	Identification of sources of energy losses
	Quantification of energy losses
Setting targets, defining norms	Conformance of targets
	Extent of objective elaboration

Source: own elaboration

THE SECOND PILLAR: MEASURES NOT REQUIRING A CONSIDERABLE INVESTMENT OF RESOURCES

Measures not requiring a considerable investment of resources constitute the second pillar of energy management tasks (Table 2).

Table 2
Structure and evaluation criteria of the first pillar

THE SECOND PILLAR	
Measures not requiring a considerable investment of resources	
SUB-PILLAR	EVALUATION CRITERIA
Energy purchasing	Bargaining power in the energy market
	Performing operative tasks
	Elaborating the energy purchasing strategy
Measures for reducing energy use without requiring a considerable investment of resources	Energy saving measures
	Energy efficiency measures

Source: own elaboration

The first task among the measures is energy purchase which is not accompanied by considerable additional costs. When the energy is purchased, there are no energy savings; however, considerable energy costs can be saved by adopting appropriate energy purchasing strategies. Apart from purchasing tasks, the second pillar encompasses company measures resulting in reducing energy use and not requiring a considerable investment of resources.

The assessment of the certain tasks should be carried out according to the following criteria:

- Energy purchasing. The role of energy purchasing in saving corporate energy costs has increased in the past few years, especially after the liberalisation process of energy markets. Different types of contracts have been concluded in the free market, which requires better preparedness and knowledge from energy management. Comparing tenders submitted by energy traders competing in the energy market is also a complicated process. Apart from the negotiated prices and the grid fees, there are several other contractual terms and conditions (tolerance bands, surcharges, penalties, currencies, exchange rates, payment deadlines and timeframes) that should be taken into account. It is by no means certain that the contract offering the lowest price is really that cheap. Energy can be purchased from different vendors and places in various ways (OTC markets, energy stock exchanges, energy tenders and grouped purchases). There are also several ways to rationalise energy costs while purchasing energy. Whilst evaluating the utilisation of the opportunities lying in purchasing energy, the company's bargaining power, the performance of such basic tasks as checking energy bills, and the presence of professional competences used for developing purchasing strategies are also worth considering.
- Measures reducing energy usage and not requiring a considerable investment of resources. Energy usage can be reduced in two ways: by introducing measures targeting energy savings and through increased energy efficiency. The fundamental difference between the two ways is that in the first case energy can be saved by placing consumers in a worse situation (providing heating at a lower temperature). In the latter case, energy consumption is reduced; however, the original degree of comfort remains. The available options arising from this should be examined. This idea involves such simple actions as turning off machinery and interrupting power, eliminating the standby mode, encouraging employees' conserving behaviour, setting appropriate lightning levels, or identifying and utilising natural lighting options.

THE THIRD PILLAR: INVESTMENTS IN IMPROVING ENERGY EFFICIENCY

The third pillar is a considerable jump in terms of corporate energy management. The tasks on this level have financial implications since decision making involves financial considerations. In order to implement investments, a financial basis is to be established. As for energy- efficient investments, two sub-tasks are worth giving priority (Table 3). First, it should be analysed how much caution and prudence was exercised when the decision about investing in energy project was made and processes were prepared. Second, it should be investigated whether the company has already performed any investment activities or planned investments aiming at improving energy efficiency.

Table 3
Structure and evaluation criteria of the third pillar

THE THIRD PILLAR	
Investments in improving energy efficiency	
SUB-PILLAR	EVALUATION CRITERIA
Preparing decisions on investments improving energy efficiency	Priority to energy investments
	Support of energy investments
	Decision-making methodology
	Ways of raising resources
Executed and planned energy efficiency investments	Energy investment in corporate processes
	Energy investment in building energetics
	Reduction of energy loss
	Incorporation of energy efficiency criteria into other investment processes

Source: own elaboration

The assessment of the certain tasks should be carried out according to the following criteria:

- Preparing decisions. It is essential to analyse priorities a company has given to energy investment projects from the perspective of implementing different energy investments and their support in a company. Its mapping is important because some companies lack solid justification of investment projects in energy and the conditions of their implementation. Another evaluation criteria can be to identify the applied decision-making methodology and to evaluate the calculations a company has made before deciding for or against investing in a project. It is also worth examining whether minimum criteria (for instance, the return on the investment) are set when evaluating a project and whether all investments in energy are given the same considerations or each investment project is evaluated according to seperate

criteria. The method of financing investment projects is also of great importance.

- Implemented and planned investments in improving energy efficiency. Mapping implemented and planned investments in improving energy efficiency is an important evaluation criterion. It is worth examining in what areas investments in energy efficiency were implemented and with what objectives, whether they targeted corporate main and support processes or building energetics or they were aimed at reducing losses. Another critical element is the presence of energy efficiency critera in other investment processes of a company (for instance, in purchasing office machines).

THE FOURTH PILLAR: FORMALISATION AND INSTITUTIONALISATION OF ENERGY MANAGEMENT

The fourth pillar analyses the level of formalisation and institutionalisation of energy management (Table 4). Formalisation and institutionalisation mean how energy management is addressed by a company, whether the company has an official framework for pursuing this activity and whether the functional area plays any role in corporate strategic visions. The fundamental tasks at this level are to identify the position of energy management within the organisation, to map its place at a strategic level and to evaluate corporate activities in energy management.

Table 4
Structure and evaluation criteria of the fourth pillar

THE FOURTH PILLAR	
Formalisation and institutionalisation of energy management	
SUB-PILLAR	EVALUATION CRITERIA
The position of energy management within the organisation	Emergence of energy management functional areas in the organisational structure
	The number of employees responsible for the energy management, their job duty areas and organisational position
	Harmonisation of competencies, powers of decision and responsibilities
Emergence of energy management at the strategic level	Emergence of energy management in the corporate strategy
	Energy strategy, energy policy
	Energy management system
Evaluation of energy management activities	Evaluation of outcomes of energy efficiency policy measures
	Identification of energy management tasks

Source: own elaboration

The assessment of the certain tasks should be carried out according to the following criteria:

- The position of energy management within the organisation. Energy management tasks can be positioned within the corporate hierarchy in a different way. Because of the character of energy management, it can be considered to be a border area between technical and economic areas, so its position in the organisation structure is not clearly defined. For this reason, the emergence of energy management functional areas in organisational structure is worth analysing. The focus should be laid on determining whether a company employs a person whose job duty areas are related solely to energy management; how many persons are responsible for performing energy management tasks; whether competencies, powers of decision and responsibilities are harmonised; whether the company has an Energy Management Department; whether the energy management tasks are present at middle and top management levels and the performance of this activity is indicated in the management's and other employees' payrolls; and whether energy efficiency is included in the performance evaluation as a criterion.
- Emergence of energy management at strategy level. Important evaluation criteria can be whether energy management issues are present in the corporate strategy within a formalised framework; whether the company has elaborated independent energy strategy and energy policy and whether they are in harmony with each other and with the corporate strategy; whether the company has implemented an energy management system certified by an international standard; and whether a regime of energy audits is introduced on a regular basis. The above-listed issues emerge at a more sophisticated level of a corporate energy management policy.
- Evaluation of energy management activities. It is worth examining whether a company performs a regular efficiency evaluation of energy management, strives to quantify the outcomes of energy efficiency policy measures, identifies the areas in energy management practices requiring improvement, and has professional competences to perform energy management tasks. The methods applied by the company when conducting the evaluation should also be examined.

THE FIFTH PILLAR: COMMUNICATION OF ENERGY AWARENESS AND SUSTAINABILITY

The fifth pillar is the most sophisticated level of performing energy management tasks (Table 5).

Table 5
Structure and evaluation criteria of the fifth pillar

THE FIFTH PILLAR	
Communication of energy awareness and sustainability	
SUB-PILLAR	EVALUATION CRITERA
Communication of energy awareness, emergence of sustainable energy management	Communication of energy awareness
	Participation in energy efficiency initiatives
	Further expansion of an energy-aware purchasing policy to materials, equipment and buildings
	Further expansion of energy-aware purchasing policy to the complete supply chain
	Emergence of energy efficiency criteria in product development
	Social and environmental responsibility
	Emergence of sustainable energy management

Source: own elaboration

The assessment of the certain tasks should be carried out according to the following criteria:

- Communication of energy awareness and emergence of sustainable energy management. Information about the following issues is to be collected at this level, namely whether the company communicates energy awareness inside and outside the company, is a participator or an active initiator of energy efficiency initiatives (for instance, the Virtual Power Plant Project), expands energy efficiency criteria to the whole purchasing process (including material, equipment and building purchases), expands energy aware purchasing concept to the complete supply chain, applies energy efficiency criteria in product development, undertakes social and environmental responsibility in corporate activities and includes sustainability and sustainable energy management in the corporate strategy.

OPERATION OF THE MODEL

As a result of the research work, a research questionnaire and the first draft of the scoring system have been created. Pre-testing has already been carried out. After pre-calculations are made a final version of the questionnaire will be developed.

According to the initial concept, the evaluation of the five pillars was performed along several sub-pillars on the basis of several (a variable number) evaluation criteria. Variables used for measuring particular elements were developed in every evaluation criterion. The set of variables used in the scoring system was compiled on the basis of the questions in the questionnaire. The questionnaire was made up of questions thematised by the elements of the introduced evaluation model. On the basis of the scoring system, an equal obtainable total score could be reached in each pillar. However, the sub-pillars making up the pillars were weighted differently, since sub-pillars were assigned a different maximal reachable score. The variables of the criteria selected to evaluate the sub-pillars were also weighted depending on how much relevance they have compared to each other. (The variables may include not only specific questions, closed questions, specific data and information but also scale-type questions, which involve some subjectivity.) There is a maximal reachable total score for each pillar and sub-pillar. After the evaluation is completed, the score reached by the company is established. As a quotient of the reached score and the maximal reachable total score, the percentage rate of the potential of a particular task group exploited by the company can be defined for each pillar.

The following concrete example presents the application of the model. As has already been mentioned above, the first draft of the research questionnaire and the scoring system built on it have been pilot tested. The responses given by 8 companies to the pilot questionnaire were evaluated and calculations related to eight companies were performed. On the basis of obtained results, the scoring system is currently under elaboration (clarification) and the circle of variables to be included in the scoring system is being worked on. Although only the results of the tentative calculations are available, they do not hinder the understanding of the theoretical operation of the model.

One of the concrete examples of test calculations illustrates the application and interpretation of the complex evaluation model. The information known about the company is as follows. The company's business activities belong to the sector of 'manufacture of wood and of products of wood and cork','manufacture of articles of straw and plaiting materials' and 'manufacture of furnitures'. As for the size, it is a small-sized company with five employees. It has been successfully operating as a family enterprise for 20 years. The business has been growing; its activities have expanded and changed. A new wood manufacturing company, a carpentry and wood machining plant, was founded to meet the increased consumer demand. The plant is involved in both trading and manufacturing activities and is a service provider, too. The plant has advanced machines (a wood drying machine, different types of circular saws, a milling machine, and a pressing machine) and technology, which enables the management to handle wood waste efficiently

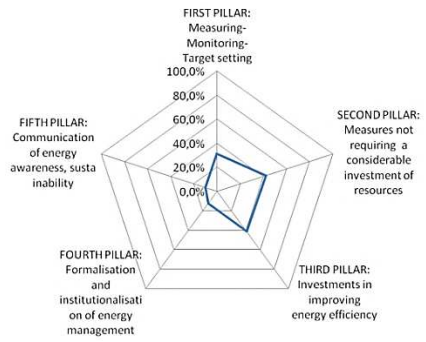
and use wood residues for further purposes. From an energy aspect, the purchasing of a biomass boiler was a major investment in enhancing the energy efficiency of the business. It is used for heating the workshop and burning wood waste and chips. The wood waste generated during production is made into useful briquettes, which are sold alongside with logs as a heating fuel. The company is thinking of further investments in modernising and expanding its machine park and plants to deploy solar panels with the objective of reducing and covering electricity demand. The return on these investments is estimated at 10-12 years. The management is not planning to hire an energy expert to perform energy management tasks. The company uses most of the purchased electricity for operating machines (60%), lighting (32%), and supporting processes (8%). They do not purchase any heating fuels for heating buildings or operating drying machines. The purchased biomass boiler, operating on logs and wood waste, is used for generating the required amount of heat. In addition, the company has two gas-powered forklifts. The proportion of energy costs in the revenue amounts only to 1.71% and together with fuel costs this figure accounts for 2.1%. The company is attempting to take an advantage of the liberalised electricity energy market and is planning to change its supplier. The management constantly strives to cut energy consumption. By rationalising the production processes, modernising lightning (using energy-efficient lamps), replacing old doors and windows and improving insulation, the company has saved a considerable amount of energy. The company lacked an explicit and written energy strategy and an energy management system. Their energy losses were assessed by an external expert. Nevertheless, the company adopted good energy management practices. On the basis of the new model and the results obtained from the tentative calculations, a summary table was elaborated (Table 6), which illustrates the points obtained, the maximal reachable score and the percentage performance.

Table 6
Summary table of the complex evaluation model (on a basis of a real company)

Evaluated areas	Reached scores	Maximal scores	Percent of points (%)
FIRST PILLAR: Measuring-Monitoring-Target setting	12.5	40	31.3
Measuring	0.25	8	3.1
Monitoring	6.75	16	42.2
Identifying losses	3.5	8	43.8
Setting targets, norms	2	8	25
SECOND PILLAR: Measures not requiring a considerable investment of resources	16.98	40	42.4
Energy purchasing	5.38	20	26.9
Measures cutting costs, not requiring investment resources	11.6	20	58
THIRD PILLAR: Investments in improving energy efficiency	16.48	40	41.2
Preparing decisions	1.48	10	14.8
Implemented and planned investments in improving energy efficiency	15	30	50
FOURTH PILLAR: Formalisation and institutionalisation of energy management	4.88	40	12.2
The position of energy management within the organisation	0.25	10	2.5
Emergence of energy management at strategy level	1	15	6.7
Evaluation of energy management activities	3.63	15	24.2
FIFTH PILLAR: Communication of energy awareness, sustainability	4	40	10
Energy awareness, communication, social responsibility, sustainability	4	40	10
Total:	**54.83**	**200**	**27.4**

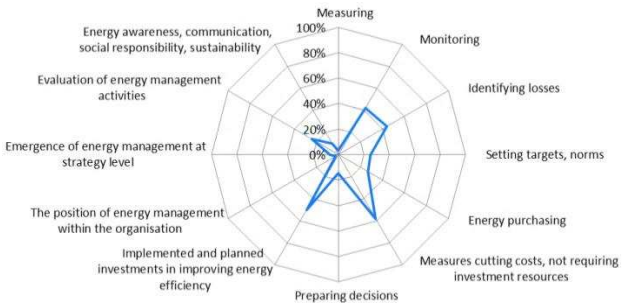
Source: own elaboration

The obtained results are shown in a cobweb plot (Figure 2 and Figure 3) where the areas which need improving can be easily identified.



Source: own elaboration

Figure 2 Implementation of pillars in the company



Source: own elaboration

Figure 3 Implementation of sub-pillars in the company

Although the obtained figures of the tentative calculations show that the company had some energy management areas where energy efficiency was low, it is

invalid to draw negative conclusions from the outcomes themselves. First, taking into consideration the sectoral and corporate characteristics, low and high values need to be determined. If the value is low, the company's specific features are to be considered and the reasons for low performance in specific areas should be identified. It should be noted that not every company needs to have high values in every area. It may happen that a lower value in one group of companies shows better performance than a slightly higher value in another company group. This depends on what an acceptable level in specific cases is considered to be. In the case of the company under evaluation, the circle of issues related to strategy, formalisation, communication of energy awareness and sustainability will not play a very important role. This expectation is justified by the outcome. Taking into account that the rate of energy costs was relatively low related to their revenues, it can be stated that a 50% and a 58% performance reached in the components of investments in improving energy efficiency and measures not requiring a considerable investment of resources, respectively, is quite good.

After giving a serious consideration to these criteria and identifying causes, areas for energy improvement can be determined. The presented model makes it possible to perform an energy management analysis for each company separately. However, the model cannot be considered suitable for comparing energy management practices of companies.

POSSIBILITIES FOR CREATING A COMPLEX EVALUATION INDICATOR

The complex evaluation model was constructed with the objective of performing specific and individual evaluations as well as comparing companies. There is a growing requirement for establishing comparability of countries and companies. In cases where the comparison is done not only for one factor, but considering complicated and complex correlations, factors influencing each other and requiring identification of complex impacts, comparison is considerably more difficult. As a compromise solution to individual cases, composite indices have widely been used in the past few years. Both at a macro level (see OECD 2008, Bartha et al. 2013 among others) and at a micro level (Sasvári, 2008) complex indices are applied (country and corporate competitiveness index, sustainability index and so on).

The comparison of corporate energy management practices and energy awareness is not possible along one single dimension. The analysis should be done according to several criteria. In addition, in order to create bases for comparison, it is important to recognise the distortions arising from unique features of sectors and companies. In this regard, an idea of constructing a composite indicator used for comparing energy management and energy awareness of companies may be raised which combines impacts of numerous factors that influence each other into a complex indicator.

Table 7

*Theoretical possibilities for taking into account unique features of sectors and companies**

		COMPANY GROUPS (based on sectoral energy intensity and/or company size, and/or rate of energy costs)							
		DIVERGENT WEIGHTING (decrease of weight rate of less relevant factors)		APPLICATION OF MULTIPLIERS (by multiplying scores of less relevant factors)		APPLICATION OF DIVERGENCE TOTAL SCORES (by deducting scores of less relevant factors)		APPLICATION OF DIVERGENCE THRESHOLD (defining good performance threshold)	
		GROUP 1*	GROUP 2**	GROUP 1*	GROUP 2**	GROUP 1*	GROUP 2**	GROUP 1*	GROUP 2**
1st PILLAR	Measuring-Monitoring- Target setting	20%	40%	1	1	40	40	75%	50%
2nd PILLAR	Measures not requiring a considerable investment of resources	20%	30%	1	1	40	40	90%	70%
3rd PILLAR	Investments in improving energy efficiency	20%	15%	1	1.3	40	25	70%	40%
4th PILLAR	Formalisation and institutionalisation of energy management	20%	10%	1	1.3	40	25	80%	25%
5th PILLAR	Communication of energy awareness and sustainability	20%	5%	1	1.4	40	20	70%	15%
	TOTAL:	100%	100%			200	150		

*Group 1: energy intensive sector/ large companies/high energy cost rate
** Group 2: not energy-intensive sector/ SMEs/low energy cost rate
*** Figures in Table 7 are used for demonstration purposes only and require further research

Source: own elaboration

The complex indicator can be made up of the weighted summary of the total scores reached on each pillar or a weighted summary of the percentage performance (it could be interpreted on sub-pillar levels as well). Identifying unique features of sectors and companies is more important when a comparison is done than when individual cases are analysed. The company size, what sector it is categorised in, how energy intensive its activities are, the proportion of its energy costs and the company's rank on the vertical value chain all make a considerable contribution to determining the energy management priority levels and the tasks which are less relevant to the energy management of a particular company. Numerous possible methods can be used for determining these issues, four of which are shown in Table 7. In each case, the starting point is that the criterion of grouping of companies should be chosen, by which the differences in the importance of energy management activities are reflected. Then companies are divided into groups. In each company group, the sub-pillars that play the most important role and the ones that are the least relevant to the company group are identified. Table 7 offers some theoretical possibilities for how to take into account less relevant factors. It is important to note that the weights and multipliers in the Table 7 are indicated for demonstration purposes only and require further research.

CONCLUSIONS

The complex evaluation model described in this paper offers a theoretical approach which provides possibilities for measuring the efficiency of corporate energy management after conducting an analysis based on several evaluation criteria listed in the sub-pillars and the scoring system that has been created. By applying this model, corporate areas requiring further energy improvement can also be identified. The set target of establishing specific individual evaluation possibilities has been met. Apart from individual evaluation, there is also a growing need for establishing the comparability of companies. In some cases when the comparison of corporate energy management practices and energy awareness is not possible along one single dimension, an idea of constructing a composite indicator is raised, which combines impacts of numerous factors that influence each other into a complex indicator. The constructing of the composite indicator could be based on the complex evaluation model shown in this article. The complex indicator can be made up of a weighted summary of the total scores for each pillar or a weighted summary of the percentage performance. Weighting is needed because of the prerequisite of comparison, which identifies distortions resulting from unique features of sectors and companies.

The reception of composite indicators and their application varies greatly among scholars in the academic community. Indicators are criticised for their limited applicability, subjectivity in their creation, and loss of information. Indicators used at a micro-level raise further problems, namely, they lack 'hard' information, statistical data, measurable information, or collections of factual data: these are outweighed by 'soft' variables. Although the raison d'être of criticism is indisputable, the bias can be decreased by adopting a prudent approach to creating the indicators. There are strict fundamental criteria for developing composite indicators (establishing a theoretical framework, choosing data selection methods, handling missing data, conducting a multivariable analysis, performing normalisation, weighting and aggregation, addressing robustness and sensitivity issues) and if they are followed, the validity and reliability of indicators can be considerably improved (OECD 2008). The widespread application of composite indicators highlights the fact that there is a need for developing complex indicators which help evaluate reality, which is typically affected by several factors, and such indicators can simplify multidimensional correlations into a single index.

In conclusion it can be said that the complex evaluation model presented in this paper is suitable for meeting two objectives, namely it offers an informative evaluation about corporate energy management and shows areas for further improvement. In addition, it makes comparison of companies possible. Furthermore, it serves as a basis for constructing a composite type of indicator. The concept underlines the importance of background information, separate analyses of specific areas, specific features of companies, and the parallel application of evaluation tools to reduce information loss as much as possible.

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Changing Role of Industry in the Economy in the V4 Countries – a Regional Approach

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SUMMARY

The theme of the article is the changing role of industry in the economy of the countries of the Visegrád Group, further referred to as V4. The goal of the research is to delimit the regularities in terms of changes of the importance of industrial activity in the economy of the region in the conditions of moving from the industrial to post-industrial to information phase of the development and building of a knowledge-based economy. The analysis is based on the NUTS-2 regions of the V4 countries against the general changes in the European Union states, based on selected measurements of industrial potential, i.e. employment and gross value added of industry, as well as indicators of spatial concentration, structure and dynamics in industrial activity, with a special focus on those related to the knowledge-based economy, such as employment in technology and knowledge-intensive sectors. The analysis is dynamic and refers to the years 2000-2012. The research is based on the following methods: comparative analysis, explanation, quantitative analysis and cartographic analysis, all with a regional approach.

The analysis indicates the diminishing role of industry in the V4 countries compared to the other EU states. However, the participation of employment in industry is relatively high in comparison with the rest of the EU states. Concentration of industry occurs in the earlier developed areas of concentration, i.e. industrial districts. As a result, there is a need for a new interpretation of the regional policy in the V4 states, where more attention should be paid to the role of industry in shaping the economic structure.

Keywords: industry, regional economy, the Visegrád Group, economic transformation
Journal of Economic Literature (JEL) code: E24, E25, J21, L60, R10, R11, R12

INTRODUCTION

Changes in the socio-economic system in the countries of Central and Eastern Europe, associated with the introduction of a market economy based on a competition mechanism, significantly affect the functioning of companies and different sectors of the economy. This also applies to industrial activities, which were growing in completely different conditions in the centrally controlled economy. As a result, a specific enterprise developed in which economic efficiency was not the main goal. The main aim of its operation was to serve the needs of the national economy and society, through the implementation of tasks planned and defined at the central level, not the company itself (Koźmiński 1998). In addition, these companies were usually characterised by excessive employment, large volume of production, mostly of not very modern products, unadjusted to the existing demand, outdated machinery equipment and the organisational structure adapted to the prescriptive-distributive system (Błaszkiewicz, 1994; Rachwał 2002; Rachwał 2006a). As a result, at the beginning of the economic transformation industrial enterprises found themselves in a difficult situation, which required them to undertake a restructuring process in order to increase their competitiveness on the domestic and international markets. Raising the competitiveness of these enterprises was carried out through means such as changes in the ownership structure, organisation and management structures, rationalisation of employment levels, adjusting the product portfolio to the expectations of buyers and the consequent modernisation of production assets, as well as the transformation of the sources of supply and, consequently, the sales structure (Rachwał 2002; Rachwał 2006a; Rachwał 2006b).

Today, in the era of the knowledge-based economy, improving competitiveness manifests itself primarily in the implementation of organisational, technological and product innovation: increased capital expenditures on fixed assets and innovative activities as well as intensive research and development (Kilar 2008). These changes reflect the participation of national industrial enterprises in the global economic processes and integration of industries of the countries of Central and Eastern Europe with the global industry, particularly through organisational, capital, technological, information and market links (Kilar 2010; Rachwał 2006a). They lead to the liquidation of the structural gap that occurred in connection with the implementation of fundamentally

different models of industrialisation in the countries of Central and Eastern Europe and the countries of Western Europe, where the functioning of the national economy has been based on market rules. Corporate restructuring processes also affect the change in the role of industry in the national and regional economy.

OBJECTIVES, METHODS AND SOURCES OF STATISTICAL DATA

In the light of the above premises, the theme of the article is the changing role of industry in the economy of the Visegrád Group countries referred to as the V4. The aim of the study is to determine the regularity in terms of changes in the importance of industrial activities in the regional economy, in the conditions of transition from the industrial to post-industrial to information phase of the development and building a knowledge-based economy. The analysis is conducted in the system of the NUTS-2 regions of the V4 countries compared to the general trend of change in the European Union, based on the selected measures of industrial capacity, i.e. employment and gross value added (GAV) of industry, as well as indicators of spatial concentration, structure and dynamics relating to the industrial activities, with particular emphasis on those related to the knowledge-based economy, such as employment in technology- and knowledge-intensive sectors.

Achieving and maintaining a competitive position on the domestic and foreign markets requires considering – in the strategies of the industrial enterprises – the growing role of education and science, research and development and innovation, that is, everything that is the key to achieving a competitive advantage in the knowledge-based economy. Particular attention has been paid to the spatial variability of the phenomena; for this purpose the cartographic method of presentation of the phenomena was used. The analysis is conducted in a dynamic way and covers the period 2000-2012. In these years there was a change in the classification of activities from NACE 1.1 to NACE 2.0. It was considered, however, that due to the extent of aggregation this does not affect significantly the conclusions of the analysis, which was limited to an indication of the important regularity of the analysed phenomenon.

In total, 35 NUTS-2 regions from the Visegrád Group countries were analysed. They include 16 Polish, 8 Czech, 7 Hungarian and 4 Slovak regions. Due to the restrictions on access to data the research period for certain indicators may be shorter. The difficulties in accessing the data on the functioning of the industry, mainly due to the principles of statistical confidentiality and trade secrets of companies, were widely referred to in previous works by Rachwał (2008, 2010a). The study used data from Eurostat and the Central Statistical Office of Poland (GUS).

RESEARCH ISSUES IN THE LIGHT OF THE LITERATURE

The undertaken research problems were the subject of interest of various earlier authors. The themes undertaken in the 1990s mainly referred to the objectives and scope of the economic transition in the countries of Central and Eastern Europe (Bożyk 1999; Balcerowicz 1995; Kołodko 2000; Kornai 1997; Łukawer 1994a, b; Parysek 1998; Rosati 1998) and the privatisation of state enterprises, among which a prominent place was occupied by industrial enterprises (Bałtowski 2002; Karpińska-Mizielińska & Smuga 1995; Misztal 1993, 2000, 2003). A number of researchers undertook the problem of spatial adaptation (Stryjakiewicz 1999), restructuring (Jakóbik 1993) and structural changes of the industry in Poland and other countries of Central and Eastern Europe (incl. Abraham & Ese 1999; Domański 2003, 2006; Karpiński 2008; Lux 2010; Macias 2006; Paszkowski 1996; Rachwał 2009; Rochnowski 2001; Vishnevsky et al. 2011). A special place in these considerations is occupied by the issue of restructuring of selected industries (e.g. Czapliński 2011; Lizak 2009; Marszał,1993; Pakuła 1992; Rydz & Szymańska 2002; Tkocz 2006; Wiedermann 2002), and various industrial enterprises (Pełka 1994; Rachwał 2002, 2006a, 2006b, 2007; Sudoł & Karaszewski 1996). Under the conditions of the construction of the knowledge-based economy, researchers undertook the problem of the role of industry in the new conditions of economic development (Rachwał 2013; Zioło 2009), innovation and industrial competitiveness of Poland and other European countries (Doloreux & Parto 2005; Gierańczyk 2003, 2009, 2010; Gierańczyk & Rachwał 2012; Piras et al. 2012; Rachwał & Boguś 2012; Świadek 2006), as well as changes in the branch structure of the industry of Poland (Rachwał 2010b, 2011a) and the impact of the economic crisis on its functioning (Rachwał 2011b).

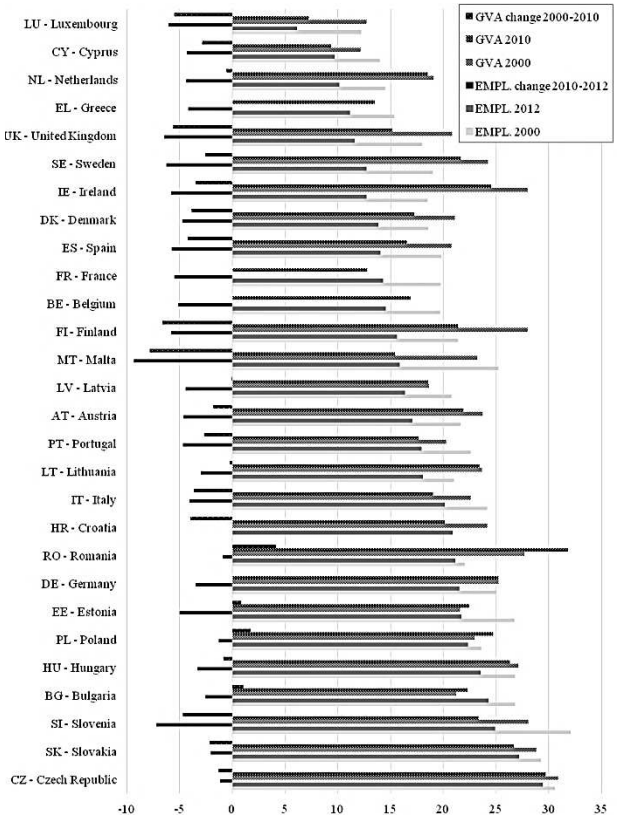
The issue of spatial diversity of industry in the regions of Poland and other European countries has been the subject of interest of, e.g., López-Bazo et al. (1999), Mikołajewicz (1995), Mrozińska (2013), Oort & Bosma (2013) and Rachwał et al. (2008a, 2008b, 2009), as well as other authors, who studied the issue of the transformation of industry in different regions (e.g. Malisiewicz & Zioło 1994; Pakuła 2003; Rydz & Jażewicz 2001; Tkocz 2001). In these works, however, there is no comparison of industrial regions in the V4 countries in recent years of the economic crisis.

We need to pay attention to the special place occupied by competitiveness and innovativeness of the V4 regional economy in the years 2001 to 2008, as presented in the work of Golejewska (2013). The results show that capital regions tend to develop faster and that there is a significant diversity of regional competitiveness and innovativeness across the V4 countries. The main

conclusion from her cluster analysis is that the development of the regions in the Visegrád Group countries depends on their "nationality". The author also pointed to the correlation between innovation indicators (R&D expenditures and patent applications to the EPO) and the growth of the regional GDP per capita. She points out the fact that one of the factors affecting the innovativeness of regions is the structure of the industry, although she does not devote much space to the analysis of the role of industrial activity in the process.

CHANGING ROLE OF INDUSTRY IN THE ECONOMY OF THE V4 COUNTRIES COMPARED TO OTHER EU STATES

According to the theory of the three sectors, whose authorship is attributed to A. Fisher, C. Clark and J. Fourastié (Czapliński et al. 2013, p. 176), industry, after a growth phase, loses its share in the structure of employment in favour of services. Today this regularity is observed in virtually all countries in the post-industrial stage of development. Also in the analysed period 2000-2012 in the V4 countries, as in other EU states, there was a decline in the share of industry in employment (see Fig. 1).



Source: own elaboration based on Eurostat data

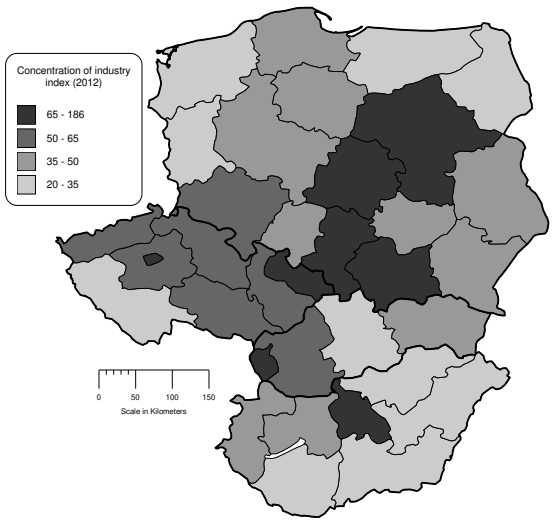
Figure 1 Changes in the share of industry in employment (EMPL) and gross value added (GVA) in the EU states: 2000-2012 (pp).

It should be noted that the decrease was much smaller in the V4 countries (in the Czech Republic by 1.1 pp, in Poland by 1.3 pp, in Slovakia by 2.1 pp and in Hungary by 3.3 pp) than in the Western EU countries, although the shares of industry in employment in Central and Eastern Europe are far greater, amounting in 2012 from 18.1% in Lithuania to 29.4% in the Czech Republic. The largest drops - by more than 6 pp - were recorded in Malta, the UK, Sweden and Luxembourg.

Somewhat different is the variation in the case of the share of industry in the gross value added. Firstly, it should be noted that this participation is generally higher than in the case of employment, especially in Western countries and Scandinavia, which follows from the structure of the industry in these countries. The dominant role in this structure is not played by the traditional labour-intensive industries, but by more modern, high-value-added industries. Secondly, it should be noted that drops in the share of industry in the countries of Central and Eastern Europe are generally very small, and in some countries (e.g. Poland, Romania, Bulgaria and Estonia) the share of industry in GVA is up by 4.2 pp. In this situation it is difficult to speak of a universal deindustrialisation of Europe, but rather of only the confirmation of the thesis of the decline in the importance of industry in the mobilisation of labour resources and consistent reindustrialisation processes in the countries of Central and Eastern Europe in the context of economic transformation.

INDUSTRY CONCENTRATION IN REGIONS OF V4 COUNTRIES

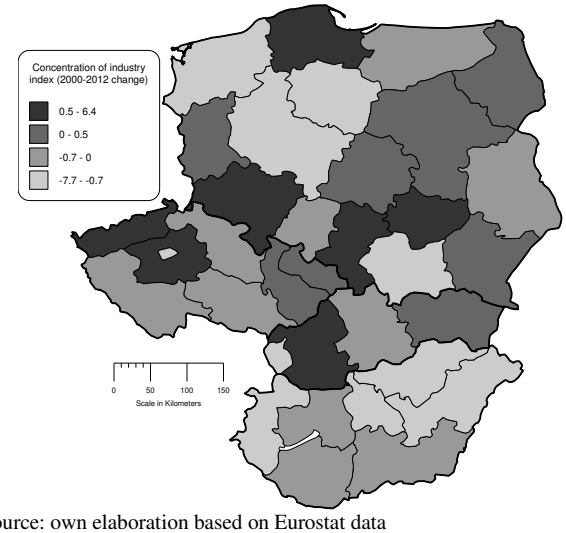
The concentration of industrial activity, measured by the number of employees in industry per 1000 km^2, shows a high spatial diversity in the V4 regions (Fig. 2).



Source: own elaboration based on Eurostat data

Figure 2 Concentration of industry index in the regions of the V4 in 2012

The V4 regions with a high industrial concentration include the capitals of all countries (Bratislava, Budapest, Prague and Warsaw) as well as the region of Moravian Silesia (Moravskoslezsko) in the Czech Republic and the regions of the Śląskie, Małopolskie and Łódzkie Voivodeships in Poland. In addition, the regions of the Czech Republic have much higher concentration indexes than other regions of Hungary, central Slovakia and north-western and north-eastern Poland. This spatial concentration refers to the traditionally shaped industrial districts in these countries. In the analysed period of 2000-2012, this index, however, underwent significant changes (Fig. 3).



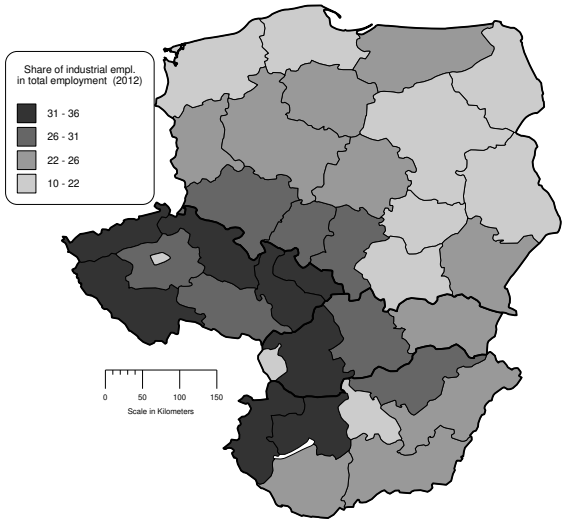
Source: own elaboration based on Eurostat data

Figure 3 Change of concentration of industry index in the V4 region in the years 2000-2012

High increases in the industry index's value were recorded in two north-western regions of the Czech Republic, Západné Slovensko in Slovakia and in four Polish regions: Śląskie, Dolnośląskie, Pomorskie and Świętokrzyskie Voivodeships. Noteworthy is the decrease in concentration in the capital regions of Prague, Bratislava and Budapest and other regions of Hungary. It should be noted, however, that this index was based on the number of employees in industry, and in the period considered Hungary witnessed the emergence of new and development of operating industrial enterprises that are far more technologically advanced (mainly in the automotive and consumer electronics), and also less labour intensive, which, as noted by Gierańczyk & Rachwał (2012), is probably one of the causes of dynamic growth in the participation of high-tech products in the export of Hungary in the first decade of the twentieth century. Of great importance among such changes of the spatial concentration are the investments in automotive companies in the regions of the V4 countries, belonging now among the world centres of production of cars and their components (Wójtowicz & Rachwał 2014).

PARTICIPATION OF INDUSTRY IN EMPLOYMENT AND GVA IN THE REGIONS OF THE V4 COUNTRIES

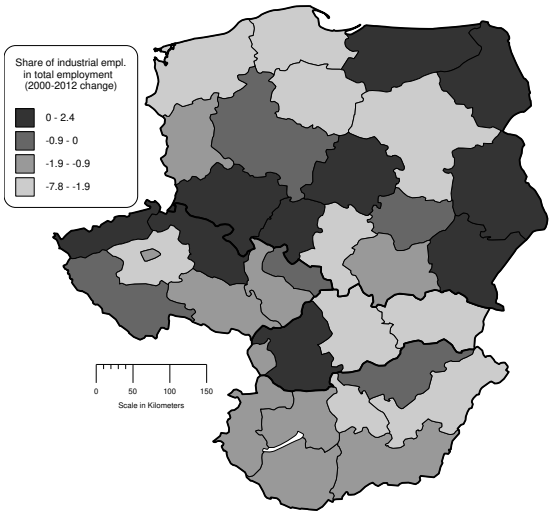
In order to capture the role of industry in the regional economy of the V4 countries indicators of industry participation in employment and GVA were used. They exhibit a large spatial diversity. The rate of participation of industry in employment in 2012 ranged from 10.6% in the region of Prague to 35.2% in the Moravian Silesia in the Czech Republic (Fig. 4).



Source: own elaboration based on Eurostat data

Figure 4 Share of industry in total employment in the V4 regions in 2012 (%)

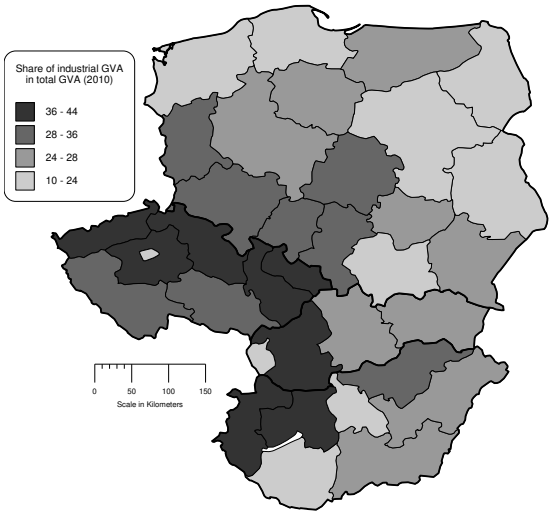
A high share of industry in employment, over 31%, is also seen in other regions of the Czech Republic, Západné Slovensko in Slovakia and the western regions of Hungary. The lowest rates, below 22%, are characteristic for the capital regions (besides the already mentioned Prague, also Bratislava, Budapest and Warsaw - the Mazowieckie Voivodeship) as well as the eastern (especially the Lubelskie and Podlaskie Voivodeships) and north-western regions of Poland. Although in the analysed period (2000-2012) in most regions of the V4 a drop was recorded in the share of industry in employment, even by almost 8 pp in the Śląskie Voivodeship (Fig. 5), it is worth noting that in 15 of the 35 regions an increase in employment in this sector was recorded. Assuming the base year as 100, the calculated index of dynamics ranged from 85.5 to 115.4. As a result, in some regions, mainly of eastern, central and south-western Poland, as well as the northern regions of the Czech Republic and in Západné Slovensko in Slovakia, a slight increase in the share of employment in industry was noted. In all the regions of Hungary there was a decline in the share of the industry in employment.



Source: own elaboration based on Eurostat data

Figure 5 Change in the share of industry in total employment in the regions of the V4 in the years 2000-2012 (pp)

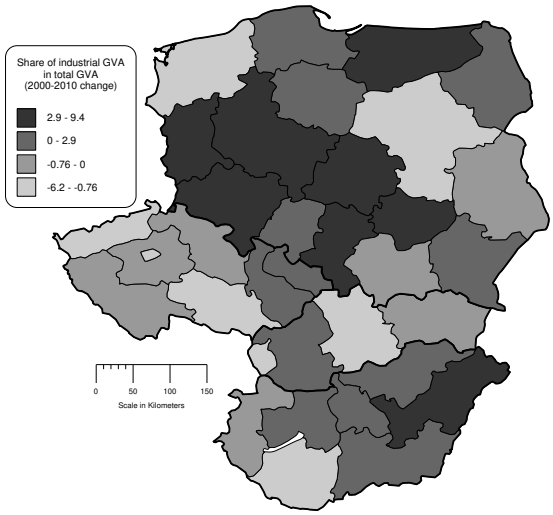
The situation is somewhat different in the case of gross value added in the industry. The area with a large proportion, over 36%, includes the northern regions of the Czech Republic as well as Western Slovakia and Hungary (Fig. 6). The low shares are recorded in the capital regions, where service activities normally dominate, and in the southern and eastern regions of Hungary, eastern Slovakia and eastern Poland.



Source: own elaboration based on the Eurostat data

Figure 6 Share of industry in GVA in the V4 regions in 2010 (%)

In the period 2000-2010 in all the regions, growth was recorded in gross value added of industry at current prices, up to 3-fold. Large differences in the dynamics mean that the increase in the share of industry in GVA also applied to the regions where the share was low at the beginning of the study period (Fig. 7). Increases were recorded in 20 of 35 regions, and so twice as many as than the increases in the share of industry in employment. The highest increases in this share were recorded in the south-western provinces of Poland (including the Dolnośląskie Voivodeship, up by 9.4 pp), the Warmińsko-Mazurskie Voivodeship (PL) and the region of Észak-Alföld (HU).



Source: own elaboration based on Eurostat data

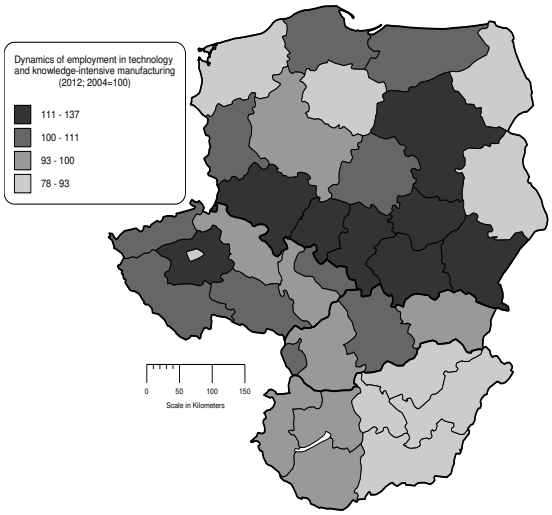
Figure 7 Change in the share of industry in GVA in the regions of the V4 in the years 2000-2012 (pp)

DYNAMICS OF THE GROSS FORMATION CAPITAL AND HTEC[1] EMPLOYMENT IN THE V4 REGIONS

An expression of changes in industry associated with the construction of the knowledge-based economy is the employment in technology- and knowledge-intensive manufacturing. In the years 2004-2012 (for which the data is available), there was a significant increase in employment in this sector in the voivodeships of central and south Poland and the region Střední Cechy (CZ). The drop in employment mainly referred to the regions of Hungary and Slovakia, as well as certain voivodeships of Poland (Fig. 8).

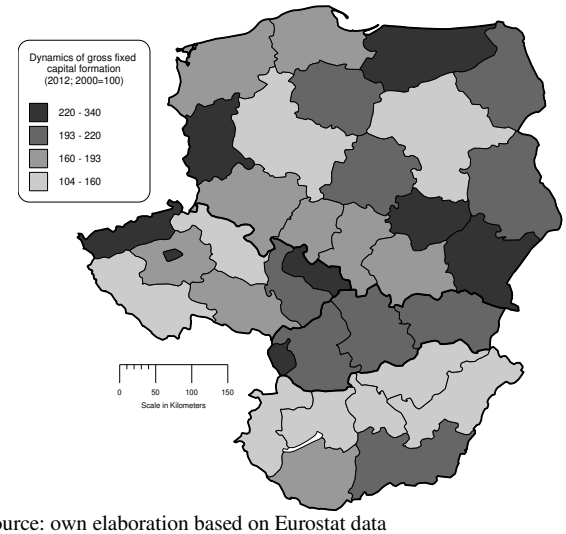
Competitiveness of industry is also affected by the level of capital investment. The analysis of the gross fixed capital formation indicates that in the years 2000-2012 the largest increases in expenditures were recorded in some regions of Poland and the Czech Republic (including the region of Prague) and in the Bratislava region (Fig. 9). Low increases were observed in the regions of Hungary, two regions of the Czech Republic and two largest voivodeships of Poland, the Mazowieckie and Wielkopolskie Voivodeships.

[1] *HTEC: high-tech industry and knowledge-intensive manufacturing*



Source: own elaboration based on Eurostat data

Figure 8 Growth of employment in technology- and knowledge-intensive manufacturing in the regions V4 in the years 2004-2012 (2004=100)



Source: own elaboration based on Eurostat data

Figure 9 Dynamics of gross fixed capital formation in the regions V4 in the years 2000-2012 (2000=100)

CONCLUSIONS AND RECOMMENDATIONS

The analysis points to the declining role of industry in the total employment in the V4 countries against other European countries, although the rate of decline of the participation of industry is much lower than in the countries of Western Europe. Still, the share of industry in employment is relatively high compared to other EU countries. In contrast, the shares of industry in gross value added are higher than in the case of employment, because of the increased importance of modern industries in the structure of GVA, generating high added value tax. Importantly, the regions with a high concentration of industry still include the capital regions of all the Visegrád countries and regions of the Moravian Silesia (Moravskoslezsko) in the Czech Republic as well as the Śląskie, Małopolskie and Łódzkie Voivodeships in Poland. Concentration of industry, therefore, refers to the pre-shaped areas of concentration (industrial districts).

It seems, therefore, that the traditional industrialised regions occurring in the area of the Visegrád countries, being subject to intense changes as a result of the increasing globalisation in terms of shaping the knowledge-based economy, should seek to strengthen the role of modern industries. Both employment and gross value added indicate that in the study area there are regions which have significant industrial potential, which is often the driving force behind their socio-economic development as a result of the occurrence of the multiplier effect. Conclusions from the analysis indicate the need for continued research on the changes of the regional economy in these countries because their development path differs from that of the regions of Western Europe. The results of the research can be used in the formulation of goals and objectives of regional policy in the V4 countries, in which a significant place should be taken by the goals related to industrial activities, the importance of which is still large in the economic structure.

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Technological Market Conjuncture: Risk Assessment Commercialization of Intellectual Property

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SUMMARY

This paper deals with the determination of the risk assessment process in market conditions using the method of paired comparisons. The most important factors influencing the level of market appeal of intelligent technology are defined and stipulated. Recommendations are made for reducing the impact of risk factors in course of the commercialization of intellectual property.
Keywords: market conditions, risk, market technology, intellectual property, paired comparison
Journal of Economic Literature (JEL) code:M15

INTRODUCTION

Intellectual property has become one of the most important resources in the 21st century. Companies are increasingly becoming aware of the importance of intellectual property (IP) assets nowadays, as a means to expand their business, to raise capital and to provide financial gain (European IPR Helpdesk, 2012). Just like financial capital or commodities or labor, IP is more than an economic asset – it also forms the basis of a global market. Since 2010, the number and scale of patent and intellectual property transactions worldwide has increased a great deal. Deals such as the Nortel patent sale (US$ 4.5 billion), and Google's acquisition of Motorola Mobility for its patent portfolio (US$ 12.5 billion) have propelled the pure intellectual property market into the spotlight (EverEdgeIP, 2014). However, this market is not just for technology giants — given the right advice, small and medium enterprises can participate and profit as well. We frequently encounter the "Rembrandt in the attic" phenomenon, where local companies were previously unaware of hidden intellectual property related value on their balance sheets.

Commercialization is the process of bringing intellectual property (IP) to the market in order for it to be exploited in return of business profits and growth. Commercialization is the end goal of the innovation process — it is the stage at which the strongest innovations, having been carefully selected, assessed and managed, are converted into commercial value.

In the market of intellectual property there are three key models of commercialization: sale, license, and manufacture & distribution (Figure 1). Risks should also be counted for in any IP commercialization. Although the very nature of risks will depend on the type of commercialization and its arrangement, their preventive identification, assessment and management would give organizations a lower exposure to risks (Fact sheet, 2013).

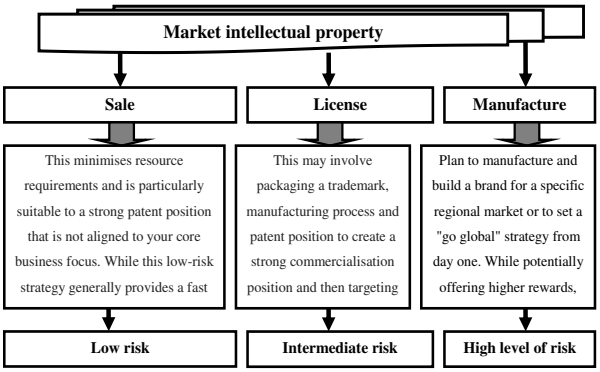

Figure 1 The risk level of market commercialization of intellectual property

Any entrepreneur should then make a start to identify and monitor the IP assets owned and used for their proper accounting, to assess risks, to overcome problems and to assess their commercial value in order to use them strategically and increase the company's revenues.

Recent studies show that a significant number of factors used in assessing the technological conditions of the market (demand, supply, price, quality, effect, etc.) are probabilistic in nature and ultimately lead to uncertainty and lack of validity of the calculated results.

In our opinion, the results of these kinds of indexes need to ensure an appropriate methodological evaluation of the results, the level of which is consistent with the risk assessment calculations based on the full group of disparate phenomena. The lower the level of risk assessment in market conditions, the greater the accuracy of the calculations of the commercial potential of intellectual property, and the better the transfer process will proceed without any problems.

DESCRIPTION AND METHOD OF FORMATION OF THE FACTORS OF RISK

Quantifying the probability of risk is difficult; the results of the calculations are based on calculations of the frequency of display of certain phenomena, i.e. the presence of certain statistics. Statistical calculations should be considered more objective, since they are based on objective (actual) data. However, their use is difficult for several reasons:

- such data are not always available; in most cases they simply cannot be obtained;
- statistics do not account for sudden changes in market conditions;
- they do not include all elements of the formation of market conditions, as some of them are not quantifiable measurements.
- In such circumstances, the theory and practice of risk assessment recommends the use of expert (subjective, heuristic) methods, which are devoid of the above deficiencies. They are oriented to the average estimates of some experts about the level of opportunistic risk (Kucherenko 2005). We consider it appropriate to study the level of risk of market conditions consisting intellectual property using heuristic methods, including the method of paired comparisons. This is the method adapted by Gerasymchuk & Koschiy (2009) and Kobeleva & Pererva (2012) to market conditions, to evaluate the risk of market operation under limited statistics and te performance of a number of factors that are difficult to measure (Golubkov 2000; Machine 2003).

METHOD

To assess the risk of opportunistic functioning in the technology market and the electrical industry, according to recommendations in the literature (Gerasymchuk & Koschiy 2009; Kobeleva & Perera 2012), the authors carried out interviews with a group of experts (leading specialists of JSC "Ukrelectromash", JSC "Electric machine", JSC "Electric motor"), who were asked a specific set of factors that are media market risks (see Table 1).

Table 1
Factory risks in the Ukrainian market for electrical engineering technology

Code	Factors	Notes
F1	Deterioration nation-Ukrainian market	Activities of all kinds of markets are closely linked
F2	Disadvantageous legal support for market processes in Ukraine	Transparency and consistency of commercial law
F3	The emergence of shortages of electricity for industrial needs	No electricity in electrical engineering IP does not make sense
F4	The emergence of alternative intellectual technologies (reducing market size)	This is one of the integral risk factors
F5	Increasing the share of imports in the technological market of Ukraine	Imports replacing Ukrainian developers
F6	Increased political instability in Ukraine	Political risks directly affect the economy
F7	Decrease in the intellectual development of domestic production	Quality is an important situational factor
F8	Increased fiscal pressures on the state of the IP	There may be unintended consequences
F9	The complexities of software production using IP	Leads to a reduction of production
F10	Changing target consumers for imported technologies	Leads to a change in market structure in favor of imports
F11	Rising cost of developing Ukrainian real IP	Leads to increased prices and reduced sales
F12	Turmoil in the banking sector (difficulty getting loans)	Difficulties in producing and distributing
F13	Decrease in exports of Ukrainian intellectual technologies	Increased supply in the domestic market
F14	The absence or reduction of state support for innovation activities	Difficulties in innovation policy
F15	Worsening job market mechanisms for production and marketing of innovative products	Leads to a deterioration in market conditions
F16	Unfair trading partners	Leads to frustration in themarket

The experts were asked to identify the importance of risk factors in terms of their impact on the deterioration of the technological market (Gerasymchuk & Koschiy 2009; Kobeleva & Perera 2012). Procedure of the examination is based on the method of pairwise comparison factors. They are compared with each other in pairs, in which each subsequent assessment is not related to the previous one. These paired scores form the matrix of paired preferences, and special treatment provides numerical indices for priority setting objectives for a particular company.

The responses of the experts were processed, grouped and presented in a table of benefits (Table 2). Evaluation of experts was carried out using a table of criteria, the

construction of which was performed by the following algorithm. When comparing the two risk factors expert at their intersection (the intersection of the column and rows) exhibited one of three predefined ratings (Kobeleva & Perera 2012; Nikitin 2011; Machine 2003):

- grade "1.0" if the factor specified in column had, in his opinion, a greater degree of risk (priority column);
- grade "0.0" if the factor specified in column had, in his opinion, a lower level of risk (priority tape);
- grade "0.5" if the factor specified in column had, in his opinion, the same level of risk (equivalent risk factors).

Responses from all 16 experts are listed in Table 2, which presents the final results of the first stage examination of the importance of risk factors. In forming Table 2 estimates put each expert disposed.

ANALYSIS OF EXPERT ASSESSMENTS

Analysis of the results allows us to draw several important conclusions. First, Ukrainian developers of intelligent technologies do not care much about opportunities for financial assistance from the state to support their business. Factor F14 "The absence or reduction of state support for innovation" has been identified by experts as the least risky (Table 2). In our opinion, this is due to lack of such support from the government over the years and the practical adaptation of IP to the situation.

Experts explain the minimal attention to the risk of opportunistic factor F16 "unfair trading partners" by the presence of elements of chaos and lack of signs of a civilized market. The same explanation can be used for factor F15 "Worsening job market mechanisms for the production and marketing of innovative products" (rated 11th) and factor F8 "Strengthening the fiscal pressure on the state of IP" (rated 13th). The low ranking factor F12 "turmoil in the banking sector (difficulty getting loans)", in our opinion, can be explained by the passage of local IP over obstacles of the global financial crisis and the entry in this field specific immunity. Getting credit loans was a challenge for Ukrainian innovative enterprises at the best of times. High grade Ukrainian scientific developments in the domestic market that do not generate a critical state process reduce exports of these products (factor F 13). Ukrainian science in electrical engineering still has an ample supply of technological possibilities for innovation of production.

Table 2

Expert assessments of the risk factors of technological Ukrainian market conditions (market IP)

Call risk factor	Call risk factor																Total	Rank
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16		
F1	X	10.0	7.5	3.5	7.0	12.5	6.5	12.5	11.5	10.0	8.0	13.0	14.5	15.0	11.0	15.5	158.0	5
F2	6.0	X	3.5	5.0	7.5	10.5	4.0	11.5	9.5	7.0	9.5	11.5	12.0	14.0	11.5	14.5	137.5	6
F3	8.5	12.5	X	7.0	9.5	12.0	9.0	14.0	11.5	10.5	10.0	14.0	14.0	15.0	12.0	14.5	174.0	2
F4	12.5	11	9.0	X	10.5	15.0	9.5	15.0	13.0	12.5	13.0	14.5	15.0	16.0	14.5	15.5	196.5	1
F5	9.0	8.5	6.5	5.5	X	10.0	7.0	12.5	12.0	11.0	9.5	11.5	12.5	15.0	13.5	15.5	158.5	4
F6	3.5	5.5	4.0	1.0	6.0	X	3.5	9.5	8.0	7.5	5.5	8.5	10.0	13.5	8.5	14.0	113.5	10
F7	9.5	12.0	7.0	6.5	9.0	12.5	X	12.5	12.0	11.0	10.5	13.0	13.5	14.5	12.0	15.0	161.5	3
F8	3.5	4.5	2.0	1.0	3.5	6.5	3.5	X	5.5	2.5	6.5	7.5	8.0	12.5	6.0	13.5	89.5	13
F9	4.5	6.5	4.5	3.0	4.0	8.0	4.0	10.5	X	8.0	8.5	9.5	10.5	15.0	12.5	14.0	123.0	9
F10	6.0	9.0	5.5	3.5	5.0	8.5	5.0	13.5	8.0	X	7.5	10.0	10.5	15.5	8.0	14.5	132.0	8
F11	8.0	6.5	6.0	3.0	6.5	10.5	5.5	9.5	7.5	8.5	X	9.5	11.5	15.0	12.5	13.5	133.5	7
F12	3.0	4.5	2.0	1.5	4.5	7.5	3.0	8.5	6.5	6.0	6.5	X	8.0	14.5	7.0	13.0	96.0	12
F13	1.5	4.0	2.0	1.0	3.5	6.0	2.5	8.0	5.5	5.5	4.5	8.0	X	9.0	7.0	10.5	78.5	14
F14	1.0	2.0	1.0	0.0	1.0	2.5	1.5	0.5	1.0	3.5	1.0	1.5	6.0	X	1.5	6.5	30.5	16
F15	5.0	4.5	4.0	1.5	2.5	7.5	4.0	10.0	3.5	6.0	3.5	9.0	9.0	14.5	X	14.0	98.5	11
F16	0.5	1.5	1.5	0.5	0.5	2.0	1.0	2.5	2.0	1.5	2.5	3.0	5.5	9.5	2.0	X	36.0	15

Using data from Table 2 the 10 most important risk factors of technological Ukrainian market conditions were identified: F4, F3, F7, F5, F1, F 2, F 11, F 10, F9 and F6. However, the data in Table 2 can establish only rank risk factor conditions; they do not allow us to set the "weight" factor in the creation of one or another market conditions. The theory and practice of paired comparisons to simplify the calculations weighting factors in tabular form recommend swapping columns and rows in Table 2 (Belyaevsky 2007). As a result of these actions an enhanced opportunistic risk factor table can be obtained (Table 3).

Table 3
Improved table reviewing the most important factors of the technological risk opportunistic market

Call risk factor	Call risk factor									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
F1	X	6.0	8.5	12.5	9.0	3.5	9.5	4.5	6.0	8.0
F2	10.0	X	12.5	11.0	8.5	5.5	12.0	6.5	9.0	6.5
F3	7.5	3.5	X	9.0	6.5	4.0	7.0	4.5	5.5	6.0
F4	3.5	5.0	7.0	X	5.5	1.0	6.5	3.0	3.5	3.0
F5	7.0	7.5	9.5	10.5	X	6.0	9.0	4.0	5.0	6.5
F6	12.5	10.5	12.0	15.0	10.0	X	12.5	8.0	8.5	10.5
F7	6.5	4.0	9.0	9.5	7.0	3.5	X	4.0	5.0	5.5
F9	11.5	9.5	11.5	13.0	12.0	8.0	12.0	X	8.0	7.5
F10	10.0	7.0	10.5	12.5	11.0	7.5	11.0	8.0	X	8.5
F11	8.0	9.5	10.0	13.0	9.5	5.5	10.5	8.5	7.5	X

In order to establish the weight of the highest rated risk factors of the opportunistic technological market, we assume that the factor obeys the normal law of distribution (Kucherenko 2008; Obolentseva 2010), and thus the number of experts who consider a certain factor more risky, in their opinion, and give it a higher (or lower) risk factor should be taken into account. Based on this premise, it is possible, knowing the appropriate proportion of experts, to establish the relative importance (preference) Factor *i* to factor *j*.

DETERMINATION OF THE MOST SIGNIFICANT RISK FACTORS

According to the enhanced opportunistic risk factor table (Table 3) we find the benefits of HIV symptoms (factor) *i* on criterion (factor) *j*. Thus, we look at the total points received by each factor in a pairwise comparison of the 16 experts. This means that the maximum score that could get the most important risk factor is 16 (one of the experts in this factor compared to the other would give an advantage to it). In this case, the proportion of cases benefits would be equal to unity (16 : 16) = 1, where there is full agreement of expert opinion as to the advantages of this opportunistic risk factor over another. The results of the calculations are summarized in Table. 4.

In a mathematical model that underlies the scale by the method of paired comparisons, it is assumed that the number of cases is subject to the normal distribution law and is described by the Laplace integral function $F(Q_{ij})$:

$$F(Q_{ij}) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Q_{ij}} e^{-\frac{Q_{ij}^2}{2}} dQ, \qquad (1)$$

where Qij is a random variable, which then determines the specific location of each trait and can be interpreted as a quantitative assessment of the relative advantages of variable (factor) *i* on criterion (factor) *j*; F(Qij) - the probability of favoring signs *i* and sign before *j*.

Table 4
Calculation of particle instances of expert preferences factor i and to factor j

Call risk factor	Call risk factor									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
F1	X	0.375	0.531	0.781	0.562	0.219	0.594	0.281	0.375	0.500
F2	0.625	X	0.781	0.687	0.531	0.344	0.75	0.405	0.562	0.405
F3	0.469	0.219	X	0.562	0.405	0.25	0.437	0.281	0.344	0.375
F4	0.219	0.312	0.437	X	0.344	0.062	0.405	0.187	0.219	0.187
F5	0.437	0.469	0.594	0.656	X	0.375	0.562	0.25	0.312	0.405
F6	0.781	0.656	0.75	0.937	0.625	X	0.781	0.500	0.531	0.656
F7	0.405	0.25	0.562	0.594	0.437	0.219	X	0.25	0.312	0.344
F9	0.719	0.594	0.719	0.812	0.75	0.500	0.75	X	0.500	0.469
F10	0.625	0.437	0.656	0.781	0.687	0.469	0.687	0.500	X	0.531
F11	0.500	0.594	0.625	0.812	0.594	0.344	0.656	0.531	0.469	X

In this case, the value of $F(Q_{ij})$ can be interpreted as the proportion of cases with a comparative advantage of one feature over another. Relative advantages and features to feature *j* can be determined from the tables of integral Laplace function (normal distribution functions normalized distribution). Table 5 allows you to find the value function of Laplace for the values of the argument, or, alternatively, by the values of the Laplace function you search for the value of the argument that will work in this case. This means that during this study we have to

know the probability of occurrence (percentage of cases of preferences) we estimate the value of a random variable (numeric value of comparative advantage).

However, the feature table of the integral Laplace function is that it is built for argument values between 0 and Q_{ij}, and not for the range of values from - ∞ to Q_{ij}, as required by Equation (2). The table of values of the integral Laplace function can determine the value of Q_{ij} (relative advantage factor and to factor *j*), only in cases where the proportion of cases favoring factor and to factor *j* is greater than or equal to 0.5 ($F(Q_{ij}) \geq 0.5$). Positive values correspond to probabilities Q_{ij} $F(Q_{ij}) \geq 0.5$. Therefore, to find the probability of occurrence for negative values Q_{ij} when using this table based on the principle of symmetry ($Q_{ij} = - Q_{ij}$), take in the first table $F(Q_{ij})$ larger than 0.5, subtract the difference [$F(Q_{ij})$ – 0.5], and then calculate the function in the table. The symmetrical number Q_{ij} has a negative sign and the same absolute value. Based on these provisions of the probability of occurrence for negative values Q_{ij} is based on the symmetry of the normal distribution (Feschur et al. 2009; Gerasimchuk & Koschiy 2009; Nikitin 2011):

$$F(- Q_{ij}) = 1 - F(Q_{ij}) \quad (2)$$

Using the table of Laplace integral function (Gerasymchuk & Koschiy 2009; Kobeleva & Perera 2012) and using Equation (2) will determine the numerical value of relative advantage. The calculation results are summarized in Table 5.

The next stage of calculation of weighting coefficients opportunistic risk factors is to convert the particular instances of the expert preferences factor and to factor *j* (Table 4) $F(Q_{ij})$ in the value of the argument Q_{ij} using Equation (3) and Table 5. The calculation results are given in Table 6, which is based on the asymmetric principle that is the accepted premise $Q_{ij} = - Q_{ij}$, and diagonally the table exhibited zero.

Table 5
Table (numeric) value of relative advantage, by using the integral function of the Laplace proportion of cases in Table 4

Probability of the benefits, $F(Q_{ij})$	The numerical value of the relative advantages, Q_{ij}	Probability of the benefits, [1- $F(Q_{ij})$]	The numerical value of the relative advantages, - Q_{ij}
0.500	0.00	0.500	0.00
0.531	0.08	0.469	-0.08
0.563	0.16	0.437	-0.16
0.594	0.24	0.405	-0.24
0.625	0.32	0.375	-0.32
0.656	0.41	0.344	-0.41
0.687	0.49	0.312	-0.49
0.719	0.58	0.281	-0.58
0.750	0.67	0.250	-0.67
0.781	0.78	0.219	-0.78
0.813	0.89	0.187	-0.89
0.875	1.15	0.125	-1.15
0.937	1.54	0.062	-1.54
0.9997	4.00	0.000	-4.00

Using the data of Table 6 is necessary to determine the significance of factors that affect the level of the situation of the Ukrainian market of intellectual property in the direction of deterioration. It has been proposed to solve this problem using selection criteria better option (Gerasymchuk & Koschiy 2009; Kobeleva & Perera 2012), which gives the most "weight" in the deterioration process as market factors, which will be the largest amount relative advantages provided by experts. The importance of other (already less important) factors is determined by a similar scenario.

Table 6
The value of the relative merits of factor i in front of factor j

Call risk factor	Call risk factor									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
F1	0	-0.32	0.08	0.78	0.16	-0.78	0.24	-0.58	-0.32	0.00
F2	0.32	0	0.78	0.49	0.08	-0.41	0.75	-0.24	0.16	-0.24
F3	-0.08	-0.78	0	0.16	-0.24	0.25	-0.16	-0.58	-0.41	-0.32
F4	-0.78	-0.49	-0.16	0	-0.41	-1.54	-0.24	-0.89	-0.78	-0.89
F5	-0.16	-0.08	0.24	0.41	0	-0.32	0.16	0.25	-0.49	-0.24
F6	0.78	0.41	0.75	1.54	0.32	0	0.78	0.00	0.08	0.41
F7	-0.24	0.25	0.16	0.24	-0.16	-0.78	0	0.25	-0.49	-0.41
F9	0.58	0.24	0.58	0.89	0.75	0.00	0.75	0	0.00	-0.08
F10	0.32	-0.16	0.41	0.78	0.49	-0.08	0.49	0.00	0	0.08
F11	0.00	0.24	0.32	0.89	0.24	-0.41	0.41	0.08	-0.08	0

The results of the corresponding calculations quantitative evaluation values of the factors in the deterioration of operating conditions of technological intellectual property market are presented in Table 7.

Table 7
Defining opportunistic risk factors of loss

Call risk factor	Call risk factor									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
F1	0	-0.32	0.08	0.78	0.16	-0.78	0.24	-0.58	-0.32	0.00
F2	0.32	0	0.78	0.49	0.08	-0.41	0.75	-0.24	0.16	-0.24
F3	-0.08	-0.78	0	0.16	-0.24	0.25	-0.16	-0.58	-0.41	-0.32
F4	-0.78	-0.49	-0.16	0	-0.41	-1.54	-0.24	-0.89	-0.78	-0.89
F5	-0.16	-0.08	0.24	0.41	0	-0.32	0.16	0.25	-0.49	-0.24
F6	0.78	0.41	0.75	1.54	0.32	0	0.78	0.00	0.08	0.41
F7	-0.24	0.25	0.16	0.24	-0.16	-0.78	0	0.25	-0.49	-0.41
F9	0.58	0.24	0.58	0.89	0.75	0.00	0.75	0	0.00	-0.08
F10	0.32	-0.16	0.41	0.78	0.49	-0.08	0.49	0.00	0	0.08
F11	0.00	0.24	0.32	0.89	0.24	-0.41	0.41	0.08	-0.08	0
$\sum F_{ij}$	0.74	-0.69	3.16	6.18	1.23	-4.07	3.18	-1.71	-2.33	-1.69
$\overline{F}_{ij} = \frac{\sum F_{ij}}{16}$	0.04	-0.04	0.19	0.38	0.07	-0.25	0.19	-0.10	-0.15	-0.10
$\overline{F}_{ij}^{mp} = \frac{\sum F_{ij}}{16} - (-0,25-1)$	1.29	1.21	1.44	1.63	1.32	1.0	1.44	1.15	1.10	1.15
$\sum \overline{F_{ij}^{mp}}$	12.73									
Нормування вагомості факторів кон'юнктурного ризику: $F_{ij}^{ваг} = \overline{F_{ij}^{mp}} / \sum \overline{F_{ij}^{mp}} = \overline{F_{ij}^{mp}} / 12,73$										
$F_i^{ваг}$	0.10	0.09	0.12	0.13	0.11	0.07	0.12	0.09	0.08	0.09

To calculate the weight of opportunistic risk factors in Table 7, the calculations of the arithmetic mean of the relative advantages was carried out, and then transformed to obtain only positive values and normalized (the sum of normalized values of weighting factors analyzed is equal to one).

The next action is a quantitative assessment of risk deterioration of the Ukrainian market of intellectual property generated by each of the above mentioned factors. The evaluation displayed was performed by the same expert group on a 10-point scale (10 points – the strongest impact factor on the deterioration of market conditions). Results of expert risk assessment by each factor are shown in Table 8.

Table 8
Expert assessment of the impact of situational factors on the deterioration of the conditions for the functioning of the Ukrainian market of intellectual property

Number of experts	Call risk factor									
	F1	F2	F3	F4	F5	F6	F7	F9	F10	F11
№1	4	5	5	6	5	4	6	3	6	5
№2	3	3	6	8	4	3	9	4	5	6
№3	5	4	8	5	6	5	6	3	7	7
№4	4	2	3	6	3	2	7	3	5	5
№5	3	5	4	9	5	5	9	4	6	6
№6	2	4	7	7	4	3	7	2	5	4
№7	1	2	5	5	7	4	5	5	8	8
№8	5	3	8	9	5	6	9	6	6	5
№9	4	5	3	8	4	4	8	4	6	8
№10	4	3	6	7	6	3	6	2	8	6
№11	3	4	4	9	4	2	8	3	9	4
№12	2	5	6	8	7	5	6	5	5	7
№13	5	6	8	6	5	3	8	3	7	5
№14	2	3	3	9	3	4	7	2	8	6
№15	3	5	5	7	6	5	7	5	5	8
№16	2	3	6	5	4	3	8	2	6	5
Total points	52	62	87	114	78	61	116	56	102	95
Mean score	3.25	3.87	5.43	7.12	4.87	3.81	7.25	3.50	6.37	5.93

Using data from Table 7 and 8 we have the opportunity to conduct a quantitative assessment of risk measures leading to a deterioration process of the market. For this purpose we use the following formula (Belyaevsky 2007):

$$O_{risk} = \sum_{i=1}^{i=n} (F_i^{risk} F_i^{imp}), \quad (3)$$

where

Orisk - risk deterioration of the Ukrainian market of intellectual property;

F_i^{imp} - The weight of i factor opportunistic risk;

F_i^{risk} - The degree of opportunistic risk and expense, the i factor.

The corresponding calculations for determining the quantitative assessment of the risk of worsening market conditions are summarized in Table 9.

Table 9
Calculation of the quantitative evaluation of the risk of deterioration of the Ukrainian market of intellectual property

Code	What are the factors	F_i^{imp}	F_i^{risk}	$\Phi_i^{imp}\Phi_i^{risk}$
F1	Deterioration of Ukrainian market	0.10	3.25	0.325
F2	Disadvantages legal support market processes in Ukraine	0.09	3.87	0.348
F3	The emergence of shortages of electricity for industrial needs	0.12	5.43	0.652
F4	The emergence of alternative intellectual technologies (reducing market size)	0.13	7.12	0.926
F5	Increasing the share of imports in the technological market of Ukraine	0.11	4.87	0.536
F6	Increased political instability in Ukraine	0.07	3.81	0.267
F7	Decrease in the intellectual development of domestic production	0.12	7.25	0.870
F9	The complexities of software production using IP	0.09	3.50	0.315
F10	Changing your target consumers for imported technologies	0.08	6.37	0.510
F11	Rising cost of developing Ukrainian real IP	0.09	5.93	0.534
Total:		1.00		5.283

To evaluate the results obtained (Table 9) it necessary to make the criteria of interpretation of quantitative assessments of the risk of deterioration of the Ukrainian market of intellectual property. Based on the processing and completion of research proposals in this area (Belyaevsky 2007) appropriate recommendations were given, the use of which enables us to provide an economic interpretation of the quantitative results presented in Table 9. Suggestions in this regard are summarized in Table 10.

Table 10
Guidelines for assessing opportunistic risk

The value of an interval of Powers line		General description of the risk	Detailed description of the risk of worsening market conditions
beginning	end		
0	0.5	Missing risk	The market is under development. The level of competition is low. Technology dominates the preferences of consumers.
0.5	2.8	Minimal risk	The market is almost formed. A healthy level of competition. No specific threat of deterioration.
2.8	5.5	The risk increased	Market in the stage of commercial success. Threat of increased competition. Technology should be modernized or replaced by a more progressive approach.
5.5	7.5	Critical risk	Market in the early stages of decline. Threats of competition intensified. An urgent need to diversify the market and technological policy.
7.5	10.0	Unacceptable risk	The critical state of the market. The technology is not competitive. Need replacement technology or to change segment.

CONCLUSIONS

Estimation of the risk of opportunistic suggests that the domestic market of intellectual property in the field of electrical production is at high risk (5.283 points out of maximum 10) of deterioration in the conditions of its operation. The most important risk factors for conditions of the market are defined as follows: a decrease in the production of Ukrainian intellectual technologies and the emergence of alternative national scientific developments (reduction of market size).

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The Choice of the Public-Private Partnership Model to Address Social and Economic Development of the State in the Context of a Competitive Environment with Uncertainty and Risks

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SUMMARY

This article discusses the growing importance of public-private partnership due to modern economic conditions and extensive privatization activity. The institute of public-private partnership provides mechanisms for redistribution of risk among the subjects of new market relations. This cooperation appeared as a result of the complex development process during the last two decades. Today it plays a significant role in problem solving concerning public infrastructure development.

Keywords: public-private partnership, the partnership model, partnership schemes, market relations, public-private partnership, risks.

Journal of Economic Literature (JEL) codes: L32

INTRODUCTION

The privatization process has dramatically changed the structure of the national economy of Ukraine. As a result, a strong private sector has been created in the last 20 years. This has significantly affected both the internal and international economy. The private sector includes the largest machine-building, metallurgical, steel and chemical plants, fuel and energy complexes, transport and educational settings. Business owners have formed the new influential class. The functions of the state have been fundamentally changed. Constantly increasing tax burdens, unreasonable fiscal policy and illegal activity of representatives of the Prosecutor's office, investigative bodies, tax administrations and other state officials caused conflict between business and government. The budget deficit led to serious difficulty in industrial and social sphere. However, some representatives of small, medium and large businesses have achieved good results. They successfully participate in solving important national issues on mutually beneficial terms.

This cooperation is particularly important in case of discussing re-engineering issues based on innovation of the entire industrial sector. It goes without saying that it would be problematic to achieve strategic development objectives without constructive interaction and partnership of the private business and government institutions. If programs are focused only on the use of budgetary funds, they would not allow the authorities to perform large-scale projects aimed at improving the domestic manufacturing competitiveness.

PUBLIC-PRIVATE PARTNERSHIPS

The public-private partnership (PPP) is an internationally recognized cooperation which aims to solve such kinds of problems. Nowadays public-private partnerships (PPP) are growing in popularity all over the world. They allow the state government and municipal authorities to establish cooperation with the private sector in the matter of modernization and development of required infrastructure. Indeed, the Ukranian government is interested in expanding public-private cooperation. However, many countries still face difficulties in conducting negotiations, planning and formation of PPP. A good thing about countries with economies in transition is that they are trying to find the b ways and methods of overcoming their difficulties. Fortunately, the European Bank for Reconstruction and Development

(EBRD) is at the forefront of those who assist them in these issues.

The works of Bhavnani K. (2009), Cokins G. (2009), Zapatrina & Lebeda (2011), Pavlyuk K. (2010), Pyltyay (2011), Sharinger L. (2004), Tarash & Petrova (2012), Varnavsky V. (2011), Vilisov M. (2006), Cherevikov E. (2009) Wirick D. (2009), Zapatrina I. (2011) and other authors are devoted to development problems in different aspects of public-private partnerships. This form of relationship between the state and private sector is widely used in various activities of enterprises all over the world. Therefore, the importance of more profound study of this issue is constantly growing. The term "public private partnership" appeared in the early 1990s. It is associated with the British model of PPP. In 1992, the government of John Major announced the Private Finance Initiative (PFI) which represented a modernized State Property Management concept. The essence of the PFI is to provide the private sector with the opportunity to finance objects owned by the state (social-cultural and industrial infrastructure) according to public-private partnership agreements. This radical change in the UK state management system led to a significant transformation in the institutional environment as well as in the relationship between the state apparatus and private business.

Various PPP forms have become a typical feature of the modern mixed economy. They can be intensively used in different branches of production worldwide. The mixed economy combines the elements of market and team management. It tends to be an alternative form of management. In fact, a 100% market economy has never existed, although, England in the nineteenth century was close to such a kind of system. Nowadays in the USA the majority of decisions are made by the market; however, the role of government is not reduced. The government plays an important role in market conditions. The state authorities are responsible for decrees and regulations governing economic environment, health services, education, law enforcement, business and environmental pollution (Zudin A.Yu. 1999).

In modern understanding, partnership between the state and business is considered to be the crucial direction in the innovation of world economy development. It provides constructive relations between the state and business that are based on the set of advantages of the market and state regulatory mechanisms and management. The main task of the state is to ensure the public interest, not only to support business. The partnership between the state and business is important for solving social issues as well as for implementing socially-significant tasks and programs. The partnership is especially relevant in times of crisis, when the state becomes an organizer, regulator and customer of innovative transformations in accordance with economic and socio-political demands of the society.

Public-private partnership in the context of innovation environment should be focused on the formation of the necessary level of innovation activity. Besides, it has to ensure the balance of interests between participants of innovation and investment processes. The nature of these relations, methods and concrete forms can vary significantly depending on the level and peculiarities of national market development. Along with this, the state should never be free from the social features related to national interests. In its turn, business is always the source of the social wealth increment.

Numerous studies indicate the trend towards intensification of relations between the state and private business within modern economic globalization, when the money goes into the sphere of state property.

The institutional environment, which implies the partnership, tends to be one of the newest stages of partnership development. It appears in the period of liberalization and plays an important role in improving market structures and the economy in general. Unlike traditional relations, developing a partnership creates its base models of financing, ownership and management methods. The efficient use of traditionally consecutive principles of state governance is an essential factor in ensuring the effectiveness of innovation processes. In turn, private enterprise features quick response to market signals, the propensity for innovation, efficiency, and the ability to take risks.

As global practice shows, using the advantages of both forms of property is possible within various forms of public-private partnership. A rage of these forms makes it possible to keep the most important national objects in state ownership and devolve a part of the ownership rights on the private sector. In this case, the partnership of the state and business attracts additional capital (including foreign capital) to the public sector. Apart from that, the state reduces budget problems and shares the majority of the risks with the business sector. In turn, business gets the volume of work, certain state guarantees and support. The system combines the resources and potentials. This form is based on decreasing the direct state influence on economy, devolving functional competences on the private sector and improving the regulatory process. The state can be compared with an agency which realizes socially significant goods and services. The state can partly produce these goods by itself and at the same time attract the capacity and ability of the private sector. To put it briefly, business is invited to participate in state assets management in order to improve the quality of state projects implementation. "Public-private partnership is a specific, multidimensional form of interaction between the state and private sector in the economic sphere. Its basic feature is the balance of interests, rights and obligations of participants during its implementation." (Deryabina M. 2009, p. 122).

The Ukrainian energy market is a good example of PPP. It includes representatives of both the public and private sector. However, the relationship between participants of the energy market seems to be rather difficult today, especially if the issue concerns the

balance of interests for different forms of ownership. Taking the characteristics of the energy system into consideration, the use of a contractual partnership model would be the most appropriate. Within the framework of the program of the energy market liberalization the conclusion of bilateral agreements is provided to all participants of the energy market in order to reduce uncertainty and risks. Over the last years constant work on establishing the conditions and rules is being conducted. This can help to reduce the risks since the first stage of the new energy market, particularly during the conclusion of bilateral agreements, for both state ownership and other participants of private property market.

Nowadays the most active partnership of state and business is carried out in branches of production infrastructure: power engineering, railway transport, ports, airports, main gas transportation, communal services and other branches associated with the support of the economy and society. Besides, much work related to redistribution of property rights between the state and private business in public services sector is being conducted. This branch is historically connected with the dominant role of the state in a range of key powers. The concept of risk sharing is an efficient mechanism which helps to solve conflicts between participants. According to this concept, certain types of risks should be taken by the party which is the most adapted for their objective assessment, control and management.

The organizational and legal basis of interaction between public partners and private partners as well as the main principles of state-private partnership in Ukraine are carried out according to the Law of Ukraine “On state private partnership” on a contractual basis. Public-private partnership in Ukraine is a system of relations between public and private partners. The resources of both partners are combined with an appropriate distribution of risks, liability and remuneration (claims) between them. This implies mutually beneficial long-term cooperation in the creation (restoration) of new facilities and/or modernization (reconstruction) of existing facilities requiring the attraction of investments, and use (operation) of objects. The law “On public-private partnership” in Ukraine provides for the implementation of projects only in the form of the contract, whereas some European countries have no such limitation. In most cases, a special structure is created in the form of a legal entity with the participation of the public and private partners. Sometimes financial institutions can also take part in the process. The agreements are concluded within this association. This allows the achievement of maximum transaction transparency. The law defines legal, economic and organizational principles of public-private partnership in Ukraine. Besides, it regulates the relations connected with the preparation, execution and termination of contracts concluded within public-private partnership. The law guarantees the observance of rights and legitimate interests of the participants (The Law of Ukraine "On Public-Private Partnership" 2010). At the legislative level, some aspects of regulating the use of PPP in practice are covered in laws (Law of Ukraine "On the lease of state and communal property" 1992; Law of Ukraine "On the financial leasing" 1997; Law of Ukraine "On the lease of earth" 1998) but there are still a number of unresolved problems in this area.

Projects implemented within the public-private partnership have a strategic character for development of the state economy as well as for separate regions.

The basic principles of public-private partnership include:

- Equality of public and private partners before the law;
- Prohibition of discrimination human rights of public and private partners;
- Coordination of interests of public and private partners for mutual benefit;
- Fair distribution of risks associated with the implementation of the agreements concluded within public-private partnership;
- The choice of private partner on a competitive basis, except as required by law.

Public-private partnership is widely used in mechanical engineering and in other spheres.

Implementation of public-private partnership in certain areas provides the execution of one or more of the following functions: designing, financing, construction, rehabilitation (reconstruction, modernization); exploitation, search, services, and other functions associated with the execution of the agreements concluded within public-private partnership.

Objects are subject to return to the public partner after the termination of the agreement concluded within public-private partnership. Ownership of the objects which were built, rebuilt, or reconstructed within a public-private partnership belongs to the public partner. The state guarantees compliance with the legislation of Ukraine requirements for activities of private partners associated with the implementation of the agreements concluded within public-private partnership, and protection of the rights and lawful interests of private partners.

If we consider the situation in Russia, then it is necessary to notice that at present intensive work is being conducted there on creation of a normative legal base for the development of a State Private Partnership with regards to the original national experience of Russia, world political and economic tendencies, possibility of borrowing foreign mechanisms, instruments and technologies and their adaptation in the Russian terms.

For decisions on many socially meaningful problems special-purpose programs are widely used in Russia. These are accepted to attribute to the forms of SPP on the grounds that initiative of statement of a problem for decision with a programmatic method can belong to not only any imperious organ (to public authority of the Russian Federation, subjects of the Russian Federation or

organ of local self-government) but also to other participants – to physical and/or legal persons.

At present in Russia four basic forms of SPP are commonly distinguished:

- concession (long-term agreements that a private partner builds and carries out exploitation of an object, and the property of an object is in the hands of the state; for indemnification of the charges a private company gets payment from a population and/or state);
- projects financed by the Investment fund of Russia, which is used by the federal government as a channel of financing;
- special economic zones, which are territories where tax treatment is in force and other privileges for businesses operating in accordance with the Russian legislation;
- other forms (Yemelyanov Yu. S. 2012).

The practice of state-private partnerships is widely distributed in the European countries and this fact presents undoubted interest. Only for the period 2001-2009 they signed 750 SPP-projects for the sum of 100 billion pounds. In the United Kingdom alone there are 526 projects with a volume of 61 billion pounds. In countries EC specific gravity of investments on principles of SPP makes: railways - 46%, motorways - 35%, energy - 7%, airports - 6%. The largest project on a concession basis is the Eurotunnel (the general volume of investments is 15 billion dollars). For 20 years EC plans to attract approximately 400 billion Euros in trans-European transport, telecommunication networks and power infrastructure by means of SPP (U Di 2009).

A considerable role in the stimulation of development shallow firms in the United Kingdom belongs to the fiscal policy of the government. They refer establishment for the shallow firms of the lowered rate of tax behaves from corporations to the measures of general character. The record of income and expenses is conducted only de-facto, regardless of what period they behave to.

Programs for providing financial help:

- "Chart of grants",
- "Agencies of help to the enterprises of local value" that carry out sponsorship of shallow firms at regional level have enormous value in the development of small business in Great Britain
- "Chart of assistance in creation of enterprises" envisages financial help to unemployed people who intend to begin their own business. Special programs provide financial help to young people for the creation or expansion of their business, preparation of businessmen in the field of shallow business; help to municipal authorities on business of creation of new and development of existing shallow business in cities. Professional preparation of shallow businessmen is carried out by special councils of preparation of specialists.

The practice of grants to small and medium-sized businesses of risk capital will be realized in some countries (Belgium, France, the Netherlands and others). In particular, the governments of these countries guarantee indemnification of possible losses of venture funds.

The economy of a number of developed and lately developing countries widely applies the new special form of cooperation of the state and private business. This special form of partnership is designated usually by the term Public Private Partnership (PPP). This form is based on weakening of direct influence of the state in economy, delegation of functional powers to the private sector both simultaneous maintenance and strengthening of adjusting. The state is an agency for the realization of socially meaningful benefits and services. It can produce some parts of these benefits independently, and others by bringing in possibilities and capabilities of the private sector. Business is invited to join in the management of state assets for the improvement and quality realization of state projects.

Today direct state support of innovative activity in the form of SPP is one of the major instruments of development the sphere of research and development in the developed western countries. So, for example, in France in 2002 78% of the direct financing of R&D was through PPP projects as compared to 37% in 1998. The government of the Netherlands reserved 805 million Euros in the 2003-2010 period for financing SPP in strategically important spheres.

In the USA assistance in the development of small business is in the competence of a special state organization - the Administration in Matters of Small Business (AMB), created by the Congress of the USA in 1953. Its duty is to render a financial and consultative help to the shallow businessmen, to assist in the receipt of governmental orders and contracting with major concerns.

The typical experience of the USA is that the state actively takes under its guardianship the accumulated potential of fundamental science with the purpose of converting it into a market commodity and increasing on this basis the competitiveness of national economy (Abdulov A.N. 2005). This policy is complemented by such important elements as innovative strategy; this is the basis for commercialization of most technological novelties.

In accordance with the federal programs of support, small businesses get direct and assured loans. Another measure for the encouragement of private initiative is tax and depreciation deductions.

The federal authorities pay special attention to stimulation of development of innovative small businesses both by the selection of grants (subsidies) and by means of contracting for development of new products and technologies.

In Japan they practice the selection of subsidies and loans - direct credits (the Japanese bank of development

offers them to small enterprises functioning in industries with the best prospects) and assured loans (due to introduction of tax deductions, commercial banks gladly offer credit to small business), also granting long-term (5-20 years) loans to the association of small enterprises from facilities.

Thus, given the experience of the world of PPP application, as well as features and patterns of development of the Ukranian market, it is possible to highlight the advantages and disadvantages of the practical use of partnerships between business entities that are presented in Fig. 1.

Factors that distinguish the types of partnerships include the volume of the competences of property, investment obligations of parties passed to the private partner, principles of division of risks between partners, to responsibility for realization of different types of works, including building, exploitation, management, etc.

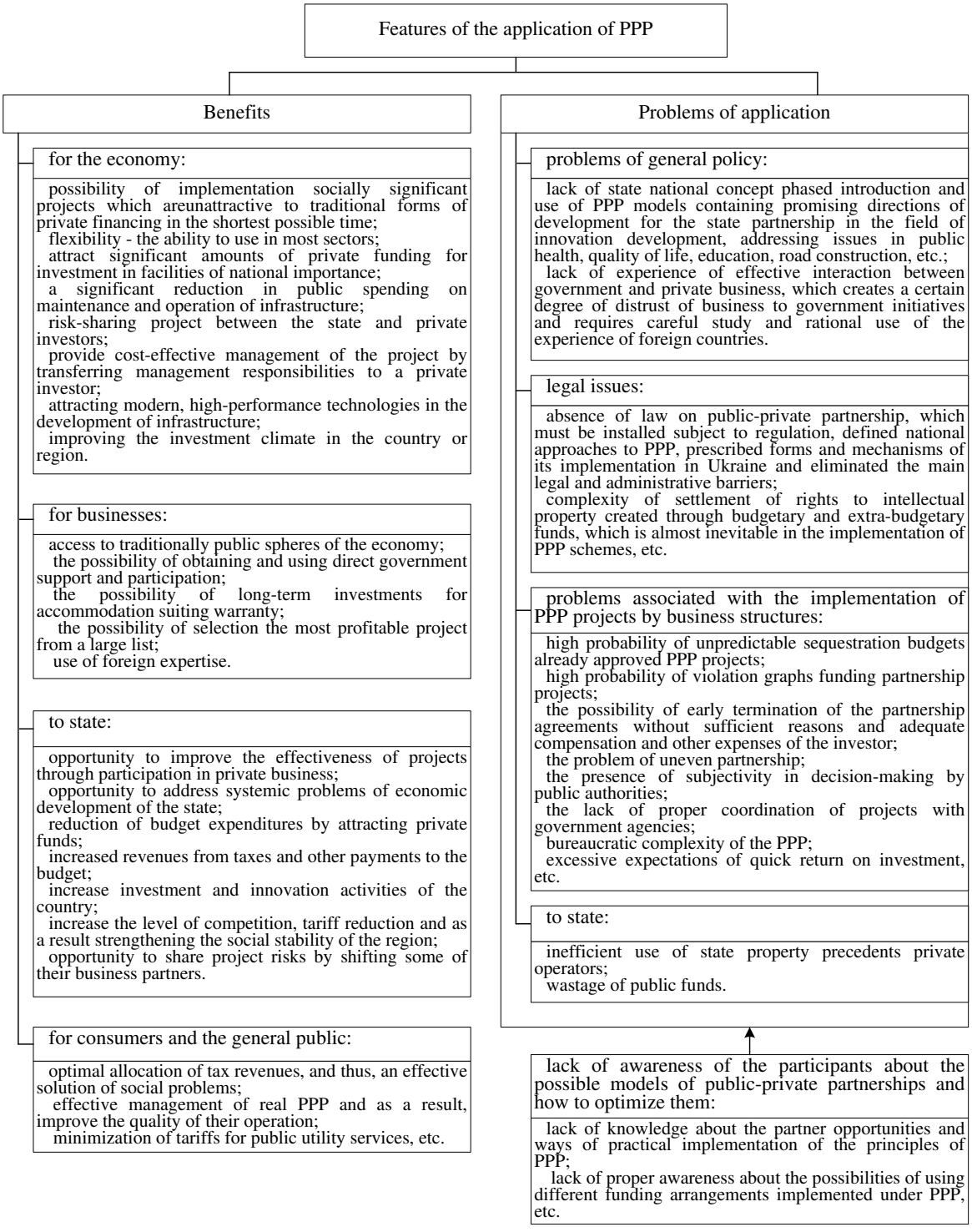

Figure 1 Analysis of the use of public-private partnerships

First chart of them is BOT (Build, Operate, and Transfer – building, exploitation/management, and transmission). This chart is used mainly in concessions. An infrastructural object is created due to a concessionaire that after completion of building takes the title exploitation of the erected object during a term sufficient for recoupment of the inlaid facilities. After expiration of ths term the object returns to the state. A concessionaire gets the competence of the use, but does not possess the object, whose owner is the state.

The second chart is BOOT (Build, Own, Operate, Transfer – building, possession, exploitation/management, transmission). In this case a private partner gets not only the competence of the use but also possesses an object during the term of agreement, after expiration of the agreement the object is passed to the public power.

Reverse BOOT also exists, where power finances and erects an infrastructural object, and then passes it in a confidence management to the private partner with a right for the priate partner to gradually buy back the property.

The chart of BTO (Build, Transfer, and Operate – building, transmission, exploitation/management) supposes the transmission of object to the public power at once after completion of building. After its reception by the state it is passed to the use of the private partner, but without the transmission of rights for possession.

During realization of chart of BOO (Build, Own, Operate – building, possession, exploitation/management) the created object is not passed to public ownership after expiration of the term of agreement, and remains at the disposal of the investor.

In the use of chart of BOMT (Build, Operate, Maintain, Transfer – building, exploitation/ management, service, transmission) the special focus is on responsibility of the private partner for maintenance and permanent repair of the infrastructural objects that it has erected.

DBOOT (Design, Build, Own, Operate, Transfer – planning, building, possession, exploitation/management, transmission). The feature of agreements of this type consists of the responsibility of the private partner not only for building infrastructural objects but also for their planning.

In case of agreements of the type DBFO (Design, Build, Finance, Operate – planning, building, financing, exploitation/management) besides the responsibility of the private partner for planning, there is a special provision that it is also responsible for financing the building of infrastructural objects (Deryabina M. 2009).

Global experience of the realization of partner projects testifies to flexibility in the choice of model of the partnership. The choice of one of these models is produced depending on in what spheres an agreement will be realized (Makhortov E.A. 2008).

CONCLUSIONS

1. The model of operator is characterized by the clear division of responsibility between a private partner and the state for the maintenance of supervisory functions after the state.
2. The model of co-operation is used wherein certain services are not clearly enough distinguished and certain, and that is why it is difficult to make them the separate objects of taxation and depreciation decrees. At that rate partnership will be realized through a joint project company of the state and private investor.
3. The model of concession operates in industries with a protracted term of realization of projects, and also in those cases when assignment of ownership rights from the state to a private partner is eliminated for political or legal reasons. For Ukraine it is attractive during realization of projects for re-engineering of machine-building enterprises having a strategic value.
4. A contractual model is used in the energy industry in which investments are first of all allotted to lowering current expenses. Thus the economy gained from the decline of current expenses quite often exceeds investment expenses. Application of the contractual model to the participants of the modern power market within the framework of its reformation is especially urgent.
5. A leasing model is most suitable for building public buildings.

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The Role of Higher Education Institutions in the Entrepreneurship of Hungarian Students[1]

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SUMMARY

Entrepreneurial activity is a decisive factor in the dynamics of job creation and economic growth. That is why it is crucial to identify the most important factors influencing the attitudes and the entrepreneurial intentions towards entrepreneurship and to determine the possible fields of intervention targeting the creation of as many new and viable enterprises as possible. Although education may play an important role in entrepreneurship, its direct impact has not yet been revealed. Education may be crucial in awaking of entrepreneurial thinking, in obtaining the basic knowledge about starting and running one's own business and in directly promoting enterprises. The Hungarian database of the GUESSS research project, with almost 6,000 respondents, helps us to evaluate the role of education on entrepreneurship. We compare the course, service and resource supply of Hungarian higher education institutions and the exploitation of them by Hungarian students, than we highlight the positive relationship between the efforts of colleges and universities and the entrepreneurial intentions and activities of students.
Keywords: entrepreneurship; role of higher institutions in entrepreneurship; entrepreneurial intentions
Journal of Economic Literature (JEL) codes: M13

INTRODUCTION

Small and medium enterprises (SMEs) are of high importance to economic growth (Blanchflower 2000; Carree et al. 2002; Carree & Thurik, 2010), primarily through their favourable effects on knowledge spillover (Acs et al. 2005). They have a significant role in innovation, too (Papanek et al. 2009). Entrepreneurial activity reduces unemployment and stimulates entrepreneurial activity (Audretsch et al. 2001). The SME sector provided 85% of new jobs in the European Union between 2002 and 2010 (de Kok et al. 2011), while in Hungary its contribution to employment was 70% (HCSO 2011: 26). Among SMEs the role of the high-growth gazelles is of higher importance in the above mentioned fields (Békés & Muraközy 2012), in addition they are more responsive to innovation than SMEs who cannot reach such a fast growth (OECD 2002; Autio et al. 2007; Papanek 2010). Due to these characteristics, becoming an entrepreneur and motivating fast-growing enterprises are of high priority in national economic policy.

LITERATURE REVIEW

As promoting entrepreneurship is a core objective of many countries, measuring its actual level and developing models to understand its contributing factors are crucial. Several methodologies can be found in the literature. The Eurobarometer Survey on Entrepreneurship has been studying the development of entrepreneurship in EU Member States for over a decade in order to explain the setting up of businesses and business growth (EC 2012a).

The Global Entrepreneurship and Development Index (GEDI) of the Global Entrepreneurship Monitor (GEM) regards entrepreneurship as a multidimensional concept where both individual and environmental factors are important and the institutional setup determines the effectiveness of individual (Szerb et al. 2012).

The Social Cognitive Theory of Bandura (1977), the Entrepreneurial Event model of Shapero and Sokol (1982) and the Theory of Planned Behaviour of Ajzen (1991) try also to describe the above-mentioned multidimensional nature. The three models consider the value system, attitudes and impressions of the individual to be crucial, and they include the environment and the reaction of the society into the model and emphasize the interrelationship between them. In evaluating the role of environment, education plays a vital role, since here students' entrepreneurial intention can be influenced in a relatively easy, organised way.

Although education may play an important role in the growth aspiration of enterprises (Storey 1994), its direct effect on business start up is doubtful. It stimulates

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entrepreneurial intention of students to be an entrepreneur (EC 2012b), but there in no consensus as far as the mechanism is concerned. Traditional educational methods (like lectures) develop entrepreneurial traits and attributes to a lesser degree (EC 2008), but still have a significant role on entrepreneurial intention (Gubik & Farkas 2014). Skills crucial to run a successful enterprise are more likely to be acquired in existing businesses (Szirmai & Csapó 2006), however, educational methods that seem to be more effective are very challenging for the institutions. They not only have high resource needs, but also both teachers and students must realise and appreciate their possibilities.

The aim of this paper is to identify the type of courses and services of a particular institution which really contribute to the students' intentions to set up a business of their own, and to determine how efficient these courses and services are in creating a business-friendly atmosphere that promotes entrepreneurship intentions.

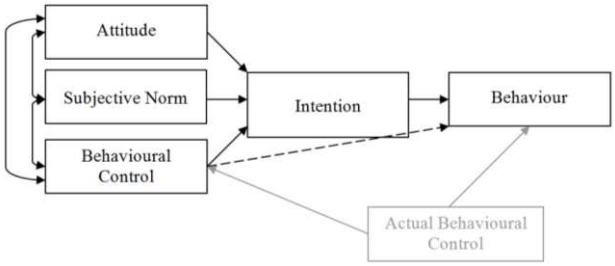
METHODS

The paper uses the database of the international research project GUESSS (Global University Entrepreneurial Spirit Students' Survey). This project is coordinated by the Swiss Research Institute of Small Business and Entrepreneurship at the University of St. Gallen (KMU-HSG) and it investigates entrepreneurial intentions and activities of students, basically with four groups of questions, namely the willingness to start a venture traceable in the students' career plans, the influence of university/college environment, the entrepreneurial intention of students and the role of family businesses influencing this attitude.

The survey is conducted every second year. The first survey was conducted in 2003 with the participation of two countries. The last questionnaire was published in 2011, when 26 countries joined the project.[2] In the fifth survey in 2011, 93,265 students took part in the survey from 502 higher education institutions. In Hungary, 5,677 students filled in the electronic questionnaire (the average response rate was 8%, and only institutions where over 1,000 students studied were selected for the survey). Table 1 shows the distribution of Hungarian respondents by institution.

THE CONCEPT OF THE RESEARCH

The research concept of GUESSS relies on Ajzen's Theory of Planned Behaviour (1991). According to this theory, attitude, subjective norms and the degree of behavioural control together influence the individual's willingness to become an entrepreneur who can eventually manifest in actions. Figure 1 illustrates Ajzen's Theory of Planned Behaviour (TPB).



Source: Ajzen, 2006

Figure 1 Factors Shaping Entrepreneurial Intentions

One of the main ideas of Ajzen's Theory is the difference between intentions and behaviours. If there is a serious entrepreneurial intention, it does not necessarily mean that the entrepreneurial activity will be pursued and an enterprise will be set up. Intentions depend on the attitudes towards behaviour, subjective norms and the perceived behavioural control. Actual pursued activities cannot be expected without serious intentions. Objective factors such as available financial resources and opened-up opportunities (money, time, etc.) that are required for carrying out intentions also influence business activities. This factor is termed actual control in the revised model of Ajzen's Theory (Ajzen, 2006).

According to this model, there is a direct positive relationship between the entrepreneurial attitude and the willingness to start up a business. The more favourable a person's attitude toward entrepreneurship is, the stronger his intention to run an enterprise. A supportive social environment is also nourishing for entrepreneurship intentions. Thus, the more positively the individual's environment reacts to his entrepreneurial intention, the more likely he will show a willingness to start up his own business.

The third factor, the perceived control over events, has also a direct influence on the individual's intention to start up an enterprise, and can have a significant effect on the behaviour as well. The impact of the perceived behavioural control on intentions and actions is twofold. Firstly, the more an individual feels that he is in control of his surroundings, the more likely he is to be in favour of starting up his own venture. Secondly, self-efficacy also has a positive effect on entrepreneurial intention. The more the person feels that he has acquired the appropriate skills and knowledge to start up an enterprise, the more likely he is to think his own business can be launched (Ajzen 2002).

The factors influencing intention are interlinked as well. The twofold nature of the perceived behavioural control consisting of susceptibility to control and self-

[2] *For the details of the survey see Farkas & Gubik 2013, or the homepage of the survey: http://www.guesssurvey.org/.*

efficacy are also positively related. The latter can be interpreted as an individual who feels he has the required skills and experience and thinks that he is in control of the events.

Education seems to be able to support entrepreneurial intentions through subjective norm behavioural control. Subjective norms can be promoted by creating a supportive entrepreneurial environment in higher education institutions in general. Up-to-date information about how to start and run a business (e.g. courses, seminars) and direct practical entrepreneurial experience (e.g. mentoring, coaching, networking with entrepreneurs) can contribute to the increase of self-efficacy, which is the feeling of the individual that he/she has acquired the appropriate skills and knowledge to start up an enterprise. This positive feeling increases also the perception that the individual is in control of events (controllability).

Table 1
Participation data for Hungarian institutions in GUESSS 2011

Name of Institution	No. of students enrolled for 2009/2010	Distribution of enrolled students	No. of sent inquiries (link)*	No. of completed questionnaires	Distribution of completed questionnaires	Response rate
BME – Budapest University of Technology and Economics (Budapesti Műszaki és Gazdaságtudományi Egyetem)	23,219	8.0%	0	5	0.1%	
BCE – Corvinus University of Budapest (Budapesti Corvinus Egyetem)	17,422	6.0%	4,800	201	3.5%	4.2%
SZE – Széchenyi István University (Széchenyi István Egyetem)	10,786	3.7%	8,900	681	12.0%	7.7%
DE – University of Debrecen (Debreceni Tudományegyetem)	30,728	10.6%	n.a.	538	9.5%	
ME – University of Miskolc (Miskolci Egyetem)	13,940	4.8%	14,055	620	10.9%	4.4%
PTE – University of Pécs (Pécsi Tudományegyetem)	29,032	10.0%	8,400	757	13.3%	9.0%
SZTE – University of Szeged (Szegedi Tudományegyetem)	27,436	9.5%	n.a.	254	4.5%	
PE – University of Pannonia (Pannon Egyetem)	10,125	3.5%	0	1	0.0%	
KE – Kaposvár University (Kaposvári Egyetem)	3,244	1.1%	n.a.	38	0.7%	
NYME – University of West Hungary (Nyugat-magyarországi Egyetem)	14,261	4.9%	7,600	291	5.1%	3.8%
ELTE – Eötvös Lóránd University (Eötvös Lóránd Tudományegyetem)	30,767	10.6%	n.a.	175	3.1%	
SZIE – Szent István University (Szent István Egyetem)	10,786	3.7%	n.a.	166	2.9%	
BGF – Budapest Business School (Budapesti Gazdasági Főiskola)	17,911	6.2%	13,622	620	10.9%	4.6%
BMF – Óbuda University (Óbudai Egyetem)	11,438	4.0%	0	5	0.1%	
DF – College of Dunaújváros (Dunaújvárosi Főiskola)	4,312	1.5%	2,460	158	2.8%	6.4%
KRF – Károly Róbert College (Károly Róbert Főiskola)	11,530	4.0%	8,000	97	1.7%	1.2%
ÁVF – Budapest College of Management (Általános Vállalkozási Főiskola)	2,949	1.0%	n.a.	147	2.6%	
GDF – Dennis Gábor College (Gábor Dénes Főiskola)	2,720	0.9%	n.a.	182	3.2%	
EJF – Eötvös József College (Eötvös József Főiskola)	1,634	0.6%	1,350	65	1.1%	4.8%
BKF –University of Applied sciences Budapest (Budapesti Kommunikációs és Üzleti Főiskola)	2353	0.8%	0	1	0.0%	
KJF – Kodolányi János University of Applied Sciences (Kodolányi János Főiskola)	6,673	2.3%	n.a.	423	7.5%	
MÜTF – College for Modern Business Studies (Modern Üzleti Tudományok Főiskolája)	2,073	0.7%	1,200	145	2.6%	12.1%
SE – Semmelweis University, (Semmelweis Egyetem)	3,173	1.1%	330	65	1.1%	19.7%
Others		0.0%		42	0.7%	
Total	289,336	100.0%	70,717	5,677	100%	8.0% (average)

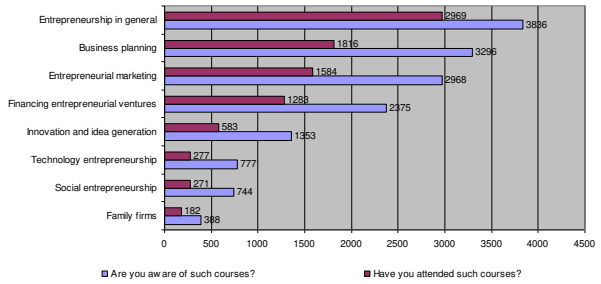
* Sent inquiry (link) – the number of students that received the internet link for filling in the GUESSS questionnaire. 0 means that the institution has not made the questionnaire available for its students either through its internal system or in any other form.

Source: own calculation according to the GUESSS 2011 database

RESULTS

The higher education courses, services, infrastructure and resources offered to students differ from institution to institution. Differences in the students' exploitation of the offered courses can also be observed. This paper analyses the institutional differences related to perception of these offerings and investigates whether there is a link between the study profiles of the institutions surveyed and the extent of differences between them.

The first question series is related to the offered courses and seminars by the universities. The students were asked whether they were aware of what was on offer at their institution and whether they attended the offered courses. Figure 2 shows that the students studied the basics of management in the frame of 'Entrepreneurship in general'. Only a few students were aware of specialised courses ('Family firms', 'Innovation and idea generation' etc.). The course 'Entrepreneurship in general' had the highest ratio of attendance (77.3%). This can be explained by the fact that this was a core and probably compulsory course in most fields of study.

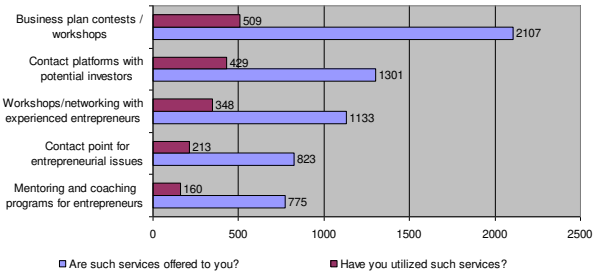


Own calculation, N=5677

Figure 2 Students' awareness of university offerings and their utilisation

The second question was about the networking and coaching offerings (services) and their utilisation. The 'Business plan contests/workshops' were the best-known offerings of networking and coaching. Just over 20 percent of respondents were aware of 'Contact platforms with potential investors' and even fewer of them knew about 'Workshops/networking with experienced entrepreneurs' or 'Contact points for entrepreneurial issues'. It is also noteworthy that the utilisation of these services was extremely low. Only 'Workshops/ Networking with experienced entrepreneurs' and 'Contact platforms with potential investors' (e.g. "business angels") amounted to 30%. Without the high exploitation of such services, these programs increase the entrepreneurial environment of the institution but have little direct effect on students' entrepreneurial intention.

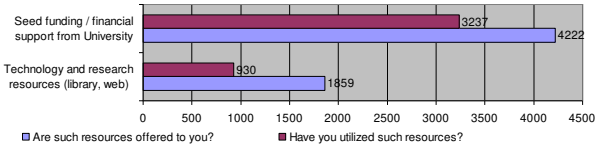
The results related to networking and advisory services are shown in Figure 3.



Own calculation, N=5677

Figure 3 Students' awareness of university's networking and coaching offerings and their utilisation

The third question dealt with the resources institutions offered to students. Figure 4 shows the provision of higher education resources which were available and utilised by founders/entrepreneurs. A high ratio of responding students reported the availability of the resources and a large number of them utilised the resources offered by their institution.



Own calculation, N=5677

Figure 4 Resources offered by higher education institutions and their utilisation

In order to compare the institutions' supply of courses, services, infrastructure and resources, and to find the relationship between this and entrepreneurial intention, three new variables were created: the three indexes show the number of offered courses and services (the variables have the values 0-8 in case of courses, 0-5 in case of services and 0-2 in case of resources). The utilisation of each service is expressed by the ratio of utilisation measured in percentages. Table 2 summarises the average availability and utilisation of the higher education courses, services and resources offered by universities in Hungary according to the students of our database.

The Hungarian higher education institutions have an average of 2.77 business courses (according to the students). The attended courses have an average of 1.58, which represents an average exploitation of 56.69 percent. The average value of networking and mentoring services is 1.08. The utilised services have a national average of 0.29 and the rate of exploitation is 26.12 percent. The provided resources have a national average of 1.07 percent, the exploited resources have an average of 0.73 percent and the rate of exploitation is 69.97 percent. This shows that students are passive as far as services' exploitation is concerned. Institutes should motivate students so that the exploitation of these services increases and their positive impact on intention can be experienced.

Table 2
Average number of courses and services provided by the higher education institutions

	N	Average	Standard deviation
Number of all lectures and seminars	5677	2.77	2.07
Number of all networking and coaching offerings	5677	1.08	1.37
Number of provided resources	5677	1.07	0.75
Number of attended lectures and seminars	5677	1.58	1.70
Number of utilised networking and coaching offerings	5677	0.29	0.74
Number of utilised resources	5677	0.73	0.71
Ratio of attended lectures and seminars	4508	56.69	38.50
Ratio of utilised networking and coaching offerings	2818	26.12	38.62
Ratio of utilised resources	4260	69.98	41.89

Own calculation

Relationship between Services of Higher Education Institutions and Entrepreneurial Intention

Entrepreneurial intention could be measured by the following item on the questionnaire: Please indicate if and how seriously you have been thinking about founding your own company. The possible answers were as follows: 0 Never; 1 Sketchily; 2 Repeatedly; 3 Relatively concrete; 4 I have made an explicit decision to found a company; 5 I have a concrete time plan when to make different steps for founding; 6 I have already started with the realisation; 7 I am already self-employed in my own founded firm; 8 I have already founded more than one company, and am active in at least one of them. Here we use the variation of the variable consisting of three categories: active founder (7-8), intentional founder (2-6), non-founder (0-1). Table 3 shows the average values of the previously generated indexes grouped by the entrepreneurial intention of the students.

Table 3
Courses and services provided by the higher education institutions by entrepreneurial intention of the students (average)

	Not founders	Intentional founders	Active founders	Average	Cramer V	Sig.
Number of all lectures and seminars	2.56	3.00	3.07	2.77	.090	.000
Number of all networking and coaching offerings	1.01	1.17	1.04	1.08	.050	.001
Number of provided resources	1.07	1.09	0.77	1.07	.059	.000
Number of attended lectures and seminars	1.37	1.80	2.08	1.58	.101	.000
Number of utilised networking and coaching offerings	0.24	0.35	0.27	0.29	.074	.000
Number of utilised resources	0.72	0.77	0.46	0.73	.057	.000
Ratio of attended lectures and seminars	53.33	59.54	69.80	56.69	.093	.001
Ratio of utilised networking and coaching offerings	22.81	29.31	29.11	26.12	.073	.066
Ratio of utilised resources	68.19	72.30	61.31	69.98	.044	.003

Own calculation, *p=0.000

The results clearly show that as for the courses and services, the active and intentional founders have a better knowledge about the opportunities provided by their institutions and in the same time they exploited the available services at a higher ratio than the non-founders. Every relationship is significant, but the correlation is stronger for exploitation than for having information about the possibilities.

The correlation between the exploitation of courses – services and the business start-up intentions remained if the field of study – business/economics, natural sciences (including engineering), social sciences (including humanities) – was a control variable.

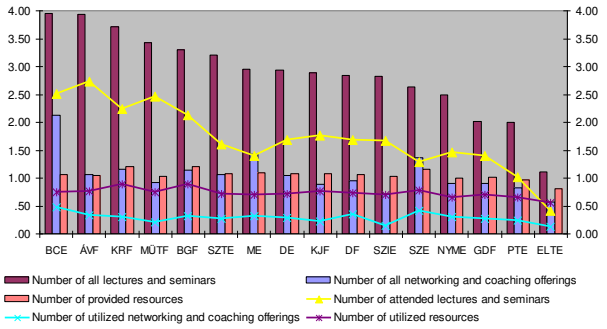
The conclusion to be drawn is that higher education institutions' services play a significant role in students' entrepreneurial intention. Traditional methods (courses, seminars) and new ways (e.g. mentoring, coaching, networking with entrepreneurs) also significantly contribute to the entrepreneurial intention of students, but the effect of traditional methods seems to be higher.

Differences by Higher Education Institution

Significant differences can be observed in the above analysed fields from institution to institution. Figure 5 lists the 16 higher education institutions whose students returned at least 70 completed questionnaires. The vertical axis shows the number of seminars, services and resources.

Corvinus University of Budapest (3.95), the Budapest College of Management (3.94) and Károly Róbert College (3.72) lead the list in terms of the number of offered courses and seminars. The average number of attended courses is 1.58 in Hungary, which represents an average utilisation of 56.69 percent. There are also differences between the institutions in terms of utilisation of the offered courses and seminars. Students at the Dennis Gabor College (72.40 percent utilisation, 1.39 attended courses) and the College for Modern Business Studies (72.10 percent, 2.46 attended courses) were the most active. The highest number of networking and

coaching services were offered by Corvinus University of Budapest (2.13), the University of Miskolc (1.43) and Széchenyi István University (1.37). The utilised networking and coaching offerings accounted for an average of 0.29 in Hungary, the average rate of utilisation amounted to 26.11 percent.



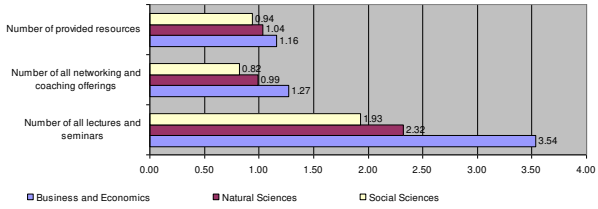
Own calculation

Figure 5 Types of services of higher education institutions and their utilisation

No significant differences could be detected in provided resources and their utilisation at the higher education institutions. This is partly due to the fact that only two response possibilities were offered in the questionnaire, so the new variable could only have three values. The national average in terms of provided resources is 1.07 while the average of utilisation is 0.73.

Differences by Fields of Study

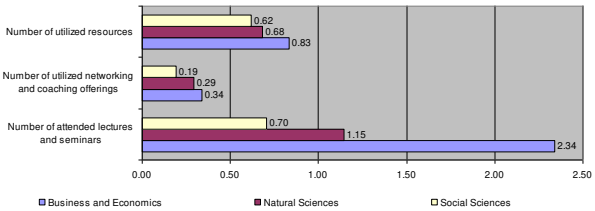
All three groups of questions showed significant differences by field of study. Figure 6 shows the national average for the fields of study considering number of provided courses, services and resources. Figure 7 represents the average national utilisation by fields of study.



Own calculation, N=5677

Figure 6 The number of courses, services and resources of higher education institutions by fields of study

Students at the field of business/ economics have the widest choice of entrepreneurial lectures and seminars. The exploitation is also high, with an average of 2.34. They were either offered the highest number of networking and coaching services and resources or were the most aware of them. Students of the field business/ economics utilised the offered services at the highest ratio, as well. Students of the field social sciences utilised the least these services.

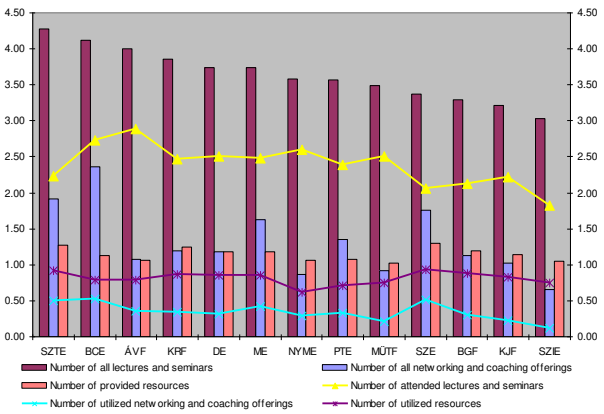


Own calculation, N=5677

Figure 7 Number of attended courses, utilised services and resources by fields of study

Figure 8 shows that the business/economics students had almost the same opportunities in terms of offered courses and available resources. According to the students' responses, the best performing institution offered only one course more than the worst performing one. There is only a slight difference in ranking of institutions between the current and the previous combined results. The best performing institution was the University of Szeged (4.28), followed by Corvinus University of Budapest (4.12), and the Budapest College of Management (4.00). The ranking of the institutions is slightly different if the utilisation of courses was taken into account. The Budapest College of Management (2.89) and Budapest Corvinus University (2.73) remained leaders, but the performance of the University of Szeged (2.24) was lower.

Significant differences can be observed in terms of offered services. The best service providers offered almost four times as many services to its students as the worst performing ones. The three best service providers were the University of Szeged (2.36), Corvinus University of Budapest (1.92) and Széchenyi István University (1.75), and the ratio of utilisation was also the highest in these three institutions. There is no notable difference between the institutions in providing resources considering the reasons described above.



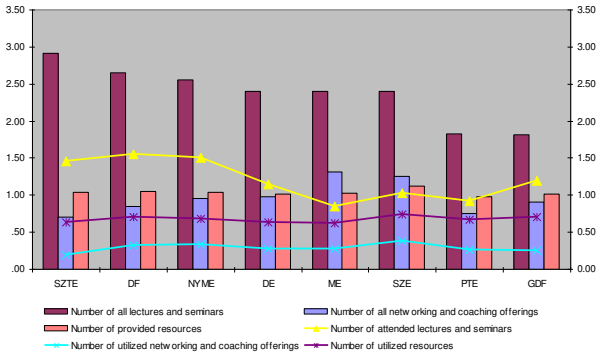
Own calculation

Figure 8 Provided services and their utilisation at the field of business/economics

Figure 9 shows the responses of natural science students. The University of Szeged (2.91), offered the highest number of courses followed by the College of Dunaújváros (2.66), and the University of West Hungary (2.55). Considering the rate of course attendance these three institutions are also leaders. It is clearly seen that the utilisation of offerings is lower in almost all institutions than in the field of business/ economics.

There are striking differences in terms of networking and coaching offerings. The difference between the highest and lowest service providing institutions is nearly twice as much.

The University of Miskolc (1.32) leads the chart. It is followed by Széchenyi István University (1.26) and the University of Debrecen (0.98). All in all, the utilisation is low and shows no significant differences between the institutions. Considering the provision of resources and their utilisation in the surveyed institutions, only a slight difference can be observed.



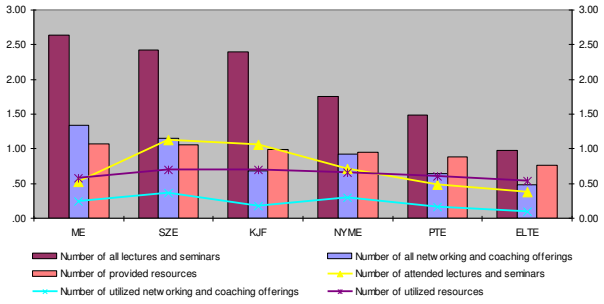
Own calculation

Figure 9 Services offered by higher education institutions of natural sciences and their utilisation

Figure 10 contains the responses of social science and humanities students. There are significant differences in terms of offered courses. The University of Miskolc (2.63) offered the highest number of courses, followed by Széchenyi István University (2.43), and Kodolányi János University of Applied Sciences (2.40). Considering the number of utilised lectures and seminars, the performance of the University of Miskolc (0.52) is less prominent. The students at Széchenyi István University (1.12) and Kodolányi János University of Applied Sciences (1.05) proved to be the most active.

In terms of provided services the University of Miskolc (1.34) is ranked the first again, followed by Szent István University (1.15) and the University of West Hungary (0.92). However, there are no significant differences between the institutions considering the offered resources.

The analyses by field of study show that ranking entire higher education institutions without taking their profile into consideration is impossible, mainly because this would pose the institutions offering programs only in business and economics in a more positive light. However, it can be stated that these institutions – due to their clear profile – offer better access to business/ economics services than the institutions with a wider training profile.



Own calculation

Figure 10 Services offered by higher education institutions of social sciences and their utilisation

At the same time the wide profile of institutions, namely the existence of business programs, helps also students in the fields of natural sciences and social sciences to meet the adequate number of courses and services. As was stated previously, such courses and services are essential in the evolution of entrepreneurial intentions.

SUMMARY

According to the model of the research (the Ajzen Theory of Planned Behaviour) entrepreneurial intention depends on the attitudes towards behaviour, subjective norms and the perceived behavioural control. Education seems to be able to support intentions through the second and third factors. Subjective norms can be promoted by creating a supportive entrepreneurial environment in institutions of higher education in general. Up-to-date information about how to start and run a business (e.g. courses, seminars) and direct practical entrepreneurial experience (e.g. mentoring, coaching, networking with entrepreneurs) can contribute to the increase of self-efficacy, which is the feeling of the individual that he/she has acquired the appropriate skills and knowledge to start up an enterprise. This positive feeling increases also the perception that he/she is in control of the events (controllability). This is why education may be crucial in awaking entrepreneurial intention, in obtaining basic knowledge about starting and running one's own business, and in directly promoting enterprises.

The higher education courses, services, infrastructure and resources offered to students differ from institution to institution. It is worth mentioning that these numbers show students' perception and not necessarily the real situation. If the communication of the institution toward students is insufficient, the rank of the institution can be weaker than it would be according to objective data.

Differences in the student exploitation of the number of offered courses and networking and coaching services can also be observed. Beside the increase in the availability of services, also an increase in the students' demand for them is needed. In those fields where this demand is extremely low and/or the increase of it is difficult, higher education institutions might want to consider using pressure – for example in form of compulsory subjects – to increase the exploitation.

Informative, opinion-shaping programs would be as important as the professional programs, since they contribute to the creation of an entrepreneurial environment. The social status of entrepreneurs is low and entrepreneurship as a career is less accepted in Hungary than would be desirable (EC 2007). This fact has a negative impact on business start-up. Here again, higher education institutions can play a leading role.

All three groups of questions (courses, resources, services) showed significant differences considering field of study. Students in the field of business/ economics were either offered the highest number of services and resources or were the most aware of them. Students of business/economics utilised the offered courses and services at the highest ratio, too. The entrepreneurial intention is the highest among them.

The analyses by field of study show that ranking entire higher education institutions without taking their profile into consideration is impossible, mainly because this would pose the institutions offering programs only in business and economics in a more positive light. It can be stated that these institutions – due to their clear profile – offer better access to business/ economics services than institutions with a wide training profile. At the same time students of social sciences and natural sciences in higher education institutions with wider profiles (that also have business programmes) have better access to such services, and therefore have advantages compared to institutions with only a social or natural science profile.

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Conventional or Atypical: FDI in the Internationalisation Process of Polish Firms

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SUMMARY

The principal aim of this study is to provide preliminary evidence on whether Polish firms behave according to the conventional theory of firm internationalisation. To fulfil this objective, an overarching research hypothesis that Polish firms follow gradual expansion patterns is formulated based on theoretical concepts and available data on Polish internationalisation. It is subsequently tested on a sample of 98 Polish outward investors. While the study confirms the gradual expansion patterns of Polish firms, in which exports and contract manufacturing mostly precede foreign direct investiment (FDI) projects in a given host country, there is also visible evidence for irregular internationalisation paths, in which FDI is the first entry mode into foreign markets. The vast majority of Polish outward investors still control a limited network of foreign subsidiaries. The paper is one of the few studies explicitly related to establishment chains of Polish firms, thus providing an empirical contribution to the debate on the internationalisation of emerging multinationals. The limited scope of Polish firms' internationalisation indicates an important need for a more widespread implementation of support policies.

Keywords: outward FDI, internationalisation paths, entry modes, Poland
Journal of Economic Literature (JEL) code: F14, F20, F21, F23, M16

INTRODUCTION

Outward foreign direct investment (OFDI) by firms originating from the region of Central and Eastern Europe (CEE), including Poland, has dramatically increased throughout the last decade. This trend raises the need for explanations related to numerous specific issues connected with this new category of multinationals, their international competitiveness, their motives for undertaking foreign expansion and the optimal operating modes, or the role of previous experience for the internationalisation process. While the region is obviously heterogeneous in terms of economic and institutional development, with several countries lagging behind on the path of economic transition, even relatively more advanced new EU members like Poland are still not unanimously regarded as advanced economies (see e.g. FTSE 2013). Indeed, indigenous firms suffer from competitive disadvantages due to the fact of being latecomers to the global economy and international business operations (Svetličič 2003).

This emergence of new corporations in the global economy, as demonstrated by both large greenfield investments and significant cross-border acquisition transactions – often carried out in developed countries by firms based in developing countries – has quite rightly attracted the attention not only of scholars, but also of policy makers and practitioners (Jormanainen & Koveshnikov 2012). It has strongly polarised international business academics in regards to its specific character. Hence, calls to revisit extant theoretical concepts have been formulated, while other scholars claim that the explanation of this phenomenon does not necessitate new dedicated theories. A position inbetween argues that the context of "infant" multinational enterprises (MNEs), which have only recently embarked on their international expansion paths, enables us to test and enrich extant theories (Obłój 2014).

Accordingly, the purpose of this paper is to investigate the role of FDI in the internationalisation of Polish firms in the light of existing theoretical concepts. It is theorised, based on conventional process models, that Polish firms would follow gradual expansion paths. This claim is explored based on primary data from a sample of Polish outward investors. The paper is organised as follows: first, theoretical models of conventional internationalisation paths, which explicitly embrace FDI, are briefly presented and discussed. Second, they are complemented by new theoretical perspectives based on the experience of emerging multinational firms. Third, the Polish context is

introduced on the level of geographical and sectoral trends in Polish outward FDI, which is subsequently supplemented by a brief review of studies on the expansion paths of Polish firms. Fourth, the results of the present empirical research are presented and discussed with a focus on their implications.

LITERATURE REVIEW

FDI as a Stage in the Internationalisation Process – Theoretical Perspectives

While there have been a number of internationalisation process models based on the concept that firms start their foreign expansion with entry modes requiring the lowest commitment of resources and gradually increase this commitment (e.g. Cavusgil 1984; Reid 1981), these models have predominantly been focused on export entry modes. Researchers from the so-called Uppsala school considered internationalisation as a gradual, evolutionary and sequential process, which develops in an interaction between the creation of knowledge about international markets and operations on the one hand, and a rising commitment of resources on the other hand (Johanson & Vahlne 1990). The model has its origins in the behavioural theory of the firm, as internationalisation is regarded as a result of managerial decisions (Johanson & Vahlne 1977). The internationalisation mechanism comprises state aspects and change aspects. The former are the resource commitment to foreign markets and knowledge about foreign markets and operations. Change aspects relate to decisions about resource commitments and performance of extant business activities. Market knowledge and market commitment are supposed to affect decisions leading to further commitment and the way in which present operations are executed. On the other hand, commitment decisions and current activities influence the level of market knowledge and resource commitments (Johanson & Vahlne 2009).

Accordingly, Johanson and Vahlne propose that the internationalisation process occurs in a causal cycle of development of experiential knowledge, i.e. it can be developed through one's own experience. An important premise of the Uppsala model is namely the fact that the perception of foreign market opportunities and challenges is affected by experiential knowledge, which helps reduce uncertainty and thus constitutes a key driver of internationalisation. They also distinguish between general and market-specific knowledge, the former referring to overall management practices or customer characteristics, regardless of location, while the latter one being more strongly influenced by a country's culture, local business environment and individual customers. Eriksson et al. (1997) differentiate between two types of experiential knowledge: internationalisation knowledge, referring to a firm's capability and resources to engage in international operations, and market knowledge. The latter concept embraces foreign business knowledge and foreign institutional knowledge. The lack of general internationalisation knowledge may afflict foreign business and foreign institutional knowledge while, conversely, deficiencies in the latter two types of knowledge can act as inhibitors of further internationalisation (Eriksson et al. 2001).

Internationalisation patterns can be analysed from the viewpoint of two dimensions. First, the establishment chain refers to operating modes within a given host country. According to the establishment chain, firms pass from a stage of no regular export activities through stages of exports via agents, sales subsidiaries and manufacturing subsidiaries (Johanson & Wiedersheim-Paul 1975). The sequence of a firm's engagement in the foreign market is related to an increasing resource commitment and embeddedness in local market environments. Second, firms expand into foreign markets in accordance with the psychic distance chain, i.e. initially host countries with smaller differences in language, culture, political systems, etc. are selected. These are factors which might disturb the flow of information between the firm and the market. The notion of psychic distance is inherently related to that of the liability of foreignness, or the costs of doing business abroad which cause a competitive disadvantage for the foreign venture of the firm (Zaheer 1995).

The Uppsala model has been an influential approach in international business scholarship. However, it has also faced criticism in different aspects. First, empirical evidence demonstrates that the actually observed paths might often be irregular (e.g. Van de Ven 1992). The falling importance of country boundaries accelerated by information technology progress, as well as overall trade and capital flow liberalisation, increase the pace of international competition (Axinn & Matthyssens 2002; Fletcher 2001). Hence, the deterministic character of the stages model has been challenged by the emergence of such phenomena as leapfrogging of sequential internationalisation modes posited by the Uppsala model, or even the establishment of born global firms (Freeman & Cavusgil 1984). Further, the Uppsala model has been criticised for not considering all essential internationalisation modes (see e.g. Vissak 2010) or the fact that the concept of distance might not apply to all firms in the same manner, since factors such as the amount of the firm's prior experience may play a crucial role in distance perception (Langhoff 1997). In response to the said limitation, Johanson and Vahlne (2009) later admitted that their model holds more for smaller firms with more limited resources, or that experience acquired in other similar contexts may also moderate the propensity to expand abroad (Johanson & Johanson 2006).

Proponents of the Finnish perspective on the internationalisation process, Welch and Luostarinen (1988) do accommodate some of the aforementioned

criticisms by acknowledging that foreign expansion does not necessarily have to be linear, since learning from other markets can accelerate the process or, conversely, unfavourable conditions may result in partial contraction decisions. They attempt to incorporate more explanatory variables in the mechanism of internationalisation, both accelerating or curbing the process, inter alia resource availability, knowledge development, communication networks, coping with risk and uncertainty, the desired level control over foreign markets in order to exploit one's own resources and implement firm strategy abroad, or the commitment of management to developing international strategy. Furthermore, internationalisation is considered to be affected by context-based factors, including government policies or activities of intermediaries. The authors also recognise that the rising number of international acquisitions allow firms to shorten the paths of foreign expansion. They also draw attention to the fact that even if a gradual expansion pattern is followed within one country market, this may not be the case in other markets, since internationalisation experience can be transferred between markets.

The aforementioned emergence of multinational firms from emerging markets and the related firm-level evidence has raised several questions as to the applicability of internationalisation models formulated in the context of advanced economies. Mathews (2006) argues for new multinationals from the Asia-Pacific region that they leapfrog the usual stages of foreign expansion in order to catch up in technological terms and reduce the competitiveness gap vis-à-vis international players. In his LLL model, he regards linkages with other players as a source for obtaining new resources necessary to be initially successful in foreign markets. Second, these linkages have to possess the potential to be leveraged by the newcomers in global competition. Finally, the learning dimensions imply that in order to sustain international competitiveness, latercomer firms have to internalise and spread new knowledge within the corporate network in order to improve the effectiveness of operations. In a similar vein, Luo and Tung (2007) argue in their "springboard" perspective that the latecomer advantage of emerging market firms can be overcome by aggressive acquistions of assets from developed MNEs in order to close the competitiveness gap. In other words, internationalisation occurs despite the lack of resources, traditionally seen as a foundation for successfully competing abroad (e.g. Hymer 1976). On the contrary, it is internationalisation which is used to improve the firms' international competitive position. In this pursuit of competitiveness, the said firms frequently also follow accelerated internationalisation paths, as compared to conventional theory predictions (Bonaglia et al. 2007). Child and Rodrigues (2005) also provide evidence for competitive enhancing by emerging multinationals from China who seek technological and brand assets abroad, although they began this process through passive internationalisation by becoming original equipment manufacturers.

Polish Outward FDI – a Macro- and Mesoeconomic Perspective

The scrutiny of macro- and mesoeconomic level data concerning Polish outward FDI allows us to formulate several general conclusions. First, Polish investments abroad have dynamically grown in the period 2002-2012, with a slowdown related to the financial crisis of 2008-2009 (see Table 1). Second, in terms of the geographic structure of outward FDI, Europe has consistently remained the major destination for Polish firms throughout the last decade, including both institutionally and economically more and less developed countries as compared to Poland. However, a peculiar observation can be made that the most important locations in terms of the total value of stocks include Luxembourg, Cyprus, the Netherlands and Switzerland. While the latter two host countries can arguably constitute locations of Polish subsidiaries engaging in business operations, it is rather doubtful that the two former nations host operational FDI on such a large scale, given particularly the size of their home markets. It can be argued whether typical motives described by conventional internationalisation motives explain these capital flows, since the tax profiles of these locations make them likely to become attractive destinations for capital-in-transit, which is directed to third countries (Zimny 2011). Thus, in order to remain coherent with the theoretical reasoning presented above, it is more legitimate to consider such countries as United Kingdom, Germany or Czech Republic as the recipients of actual operational FDI. Among non-European locations, North America occupies a significant place, while the role of Asia and other locations is still limited.

In terms of the sectoral structure of Polish outward FDI, a clear rise in the relevance of service investments can be witnessed (see Table 2). These include, inter alia, wholesale and retail trade and repairs, transportation and storage, accommodation and food services, information and communication, as well as financial and insurance activities. Among industry sectors, manufacturing has clearly prevailed, followed by construction and mining. On the whole, the structure of Polish OFDI increasingly resembles the structure of activity sectors typical of mature economies. However, the dominance of services among foreign affiliates may be to some extent explained by the fact that many of them engage in sales and marketing activities for their Polish parent firms and thus are registered under another type of activity.

Polish Outward FDI – Selected Empirical Studies

Empirical studies on Polish OFDI have been conducted using both macro- and micro-level data. On the whole, a geographic focus on neighbouring economies could be observed (Gorynia et al. 2012; Rosati & Wilinski 2003). Obłój and Wąsowska (2012) examined the connection between host-country resources and Polish outward investment to these locations. They found that market size and economic growth are the most influential variables, with a lesser role of labour costs. This finding remains coherent with other studies (Czaplewski & Wiśniewska 2007; Kępka 2011; Karpińska-Mizielińska & Smuga 2007). Moreover, Obłój and Wąsowska's (2012) findings suggest that although geographic distance was a relevant barrier to FDI, psychic distance was not found to be a statistically significant variable, since the bulk of investments have been focused on culturally proximate CEE countries. The same marginal impact could be stated for political risk specific to the region (Obłój & Wąsowska 2012). Jaworek (2008, 2013) found that market-seeking was a major motive for outward FDI, while other motives were found to be contingent on the level of economic development of the foreign market. A similar interrelationship could be found in the qualitative study of Gorynia et al. (2013). Likewise, while investment barriers in new and old EU member states pertained rather to saturated target markets and a high level of competitiveness, the major impediments in non-EU CEE countries were related to excessive bureaucracy, corruption and regulative instability (Jaworek 2008, 2013). Moreover, a relationship between the motives and modes of FDI was found, in that strategic asset-seeking FDI was carried out in the form of acquisitions, while efficiency-seeking investments rather took the form of greenfield investment (Gorynia et al. 2014).

In terms of internationalisation paths and the character of FDI as opposed to received theory, there have been few attempts at investigating Polish outward FDI from this perspective. Previous studies have suggested a gradual expansion pattern, whereby exports precede FDI in a gradual internationalisation pattern (Gołębiowski & Witek-Hajduk 2007; Śliwiński 2012). However, on the other hand Jarosiński (2013) identifies born global firms in Poland that follow accelerated internationalisation paths. While Polish firms have been argued to possess certain marketing, managerial and organisational skills which can be leveraged in foreign markets (Gorynia et al. 2014), they have also been found to be limited in their financial potential or foreign market knowledge (Karpińska-Mizielińska & Smuga 2007). Thus, it is proposed that Polish firms engaging in FDI will behave according to the prediction of the Uppsala model:

H: Polish outward foreign direct investors follow gradual internationalisation paths.

Table 1
Polish OFDI stocks in million PLN by geographical location (2002-2012)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Europe	4 112	6 237	8 498	18 482	39 300	48 809	65 674	78 162	121 045	156 325	165 964
Luxembourg	344	238	372	604	10 341	10 161	14 098	16 755	26 765	40 382	38 723
Cyprus	512	337	289	500	1 020	1 001	2 272	2 354	5 659	11 177	18 194
United Kingdom	157	240	302	925	3 175	2 792	3 410	3 717	16 600	18 649	17 975
Netherlands	1 048	1 128	1 581	1 537	3 667	3 158	6 618	6 572	9 345	10 278	13 182
Switzerland	382	415	1 459	6 386	8 335	12 547	16 322	19 168	9 053	8 500	12 860
Belgium	0	21	149	8	11	109	61	3 369	6 762	9 314	9 334
Czech Republic	167	322	293	2 326	2 758	4 155	4 195	4 333	7 160	8 384	8 079
Germany	109	856	1 174	952	1 219	2 012	2 480	3 044	6 190	7 122	7 993
Lithuania	90	137	140	224	2 203	2 808	3 119	3 517	6 456	8 419	7 671
Norway	-1	0	-12	45	140	1 165	1 602	3 124	3 833	4 859	5 160
Russian Federation	33	204	285	645	817	1 397	2 064	2 227	3 034	3 989	4 382
Africa	146	150	197	294	363	321	480	498	584	690	703
North America	302	270	247	458	557	613	1 247	1 267	6 008	7 519	6 408
Central America	40	45	42	107	102	146	1 290	1 655	289	228	515
South America	0	3	1	5	8	12	14	17	107	186	242
Asia	687	1 009	731	834	1 044	1 386	2 007	2 288	3 592	4 167	3 870
Oceania and Polar Regions			1	2	4	7	37	49	102	108	102
Total World	5 591	8 035	10 031	20 478	41 673	51 569	71 069	84 252	131 735	169 697	177 805

Source: own calculations based on data of the National Bank of Poland (2003-2013).

Table 2
Polish OFDI stocks in million PLN by sector of activity (2002-2012)

Economic activity of the direct investment enterprise	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Agriculture, Forestry and Fishing	1	9	4	-1	-5	-5	-6	-2	6	78	129
Mining and Quarrying	43	165	-2	29	136	50	126	359	1 900	3 027	3 242
Manufacturing	301	1 450	1 805	3 511	4 257	5 226	6 938	12 130	50 672	58 780	51 223
Electricity, Gas, Steam and Air Conditioning Supply	12	16	16	16	5	829	1 143	1 891	3 024	4 244	1 918
Water Supply; Sewerage, Waste Management and Remediation Activities									-125	-137	24
Construction	87	137	121	691	912	1 029	1 335	1 204	4 265	7 142	6 240
Total Services	4 446	4 434	5 100	5 902	8 213	8 878	43 549	49 772	65 468	90 550	114 715
Total	5 591	8 035	10 031	20 478	41 673	51 569	71 069	84 252	131 735	169 697	177 805

Source: own calculations based on data of the National Bank of Poland (2003-2013).

MATERIAL AND METHODS

Data Collection

Data were gathered from a sample of firms investing abroad and registered in Poland, regardless of their ultimate ownership. A proprietary database of 910 firms was created based on several data sources, including Amadeus, Kompass Poland, BPR Benchmark Poland and Deal Watch, as well as press articles and company reports. Between May and June 2013, an invitation to participate in the study with a link to a web-based survey was sent to top managers directly responsible for foreign operations or other managers with a request to forward it to the former. The survey contained a broader catalogue of questions, since it is designed for a larger project on Polish OFDI. Therefore, it contained a number of aspects not explicitly explored in this paper.

Due to frequent concerns about technical reliability, response rates or security of electronic surveys (Kim & Gray 2008), a professional IT services agency was entrusted with the preparation of the survey, its execution and repeated reminders. The automated survey management system was supported by a substantial number of personal contacts with the sample firms in order to identify appropriate respondents and persuade them to take part in the study. Moreover, additional interviews and secondary sources including annual reports were used to complete missing survey data. Therefore, a total sample of 98 complete surveys was obtained, which corresponds to a usable response rate of approximately 11%.

Sample Structure

The distribution of sample firm characteristics is by and large similar to that of the entire population in regards to industry classification and parent nationality (compare GUS 2012). Thus, the collected data allow for a detailed exploration of sectoral, geographic, modal and size structure of Polish OFDI. The studied sample was dominated by manufacturing industries (59% of firms), followed by services (39%). In terms of firm size, companies with over 500 employees constituted 48% of the sample. While in order to qualify for the study, the surveyed firms had to be registered in Poland, their ultimate owners might be located abroad. Therefore, firms with more than 10% of foreign capital constitute 46% of the sample. With regard to FDI forms employed, 57% of the firms had already had experience with wholly-owned greenfield subsidiaries, while 22% had established joint ventures abroad. Notably, 42% of the sample had undertaken foreign acquisitions, while a further 5% can be classified as brownfield investments (Meyer & Estrin, 2001). See Tables 3-6 for a summary of key descriptive statistics.

Table 3
Sectoral distribution of major FDI of each firm in the sample (N=98)

Sector	Total Manufacturing	Total services
Number of FDI	59	39
Percentage	60.0	40.0

Source: survey data.

Table 4
Firm size distribution of FDI in the sample (N=98)

Size (employment)	0-49	50-99	100-249	250-499	500-999	1000-1999	>1999
Number of firms	8	8	13	21	13	15	20
Percentage	8.0	8.0	13.0	21.0	13.0	15.0	21.0

Source: survey data.

Table 5
FDI modes in the sample (N=98)

FDI Mode	Greenfield	Acquisition	Joint venture	Others (incl. brownfield)
Number of firms	57	42	23	9
Percentage	58.0	43.0	23.0	9.0

Source: survey data

Table 6
Ownership structure of surveyed firms (N=98)

Foreign ownership level	0%	1-10%	11-24%	25-49%	50-74%	75-100%
Number of firms	28	24	21	9	16	0
Percentage	29.0	24.0	21.0	9.0	16.0	9.0

Source: survey data

RESULTS

The study reveals that the surveyed firms located their first FDI projects in Germany (18%), the Czech Republic (14%) and Romania (13%) (see Table 7). Accordingly, this reveals a clear concentration on geographically close markets. The same finding applies to the location of major FDI projects to date, whereby in some cases these were identical with the first investment (see Table 8). Firms undertook their largest FDI to date mostly in Germany (16%), Ukraine (15%), the Czech Republic (13%) and Romania (10%). In the context of Polish OFDI described in the preceding section, this also reflects the fact that respondents were requested to refer only to affiliates engaged in manufacturing and distribution, as opposed to special purpose vehicles and other elements of corporate financial structure, thus diminishing the notable role of such locations as Luxembourg, Switzerland or the Netherlands (Zimny 2011).

Table 7
Geographic distribution of the first FDI (N=98)

Country	Germany	Czech Republic	Romania	Ukraine	Russia	Lithuania	Other
Number of FDI	18	14	13	12	8	5	28
Percentage	20.0	15.0	14.0	13.0	9.0	5.0	43.0

Source: survey data.

Table 8
Geographic distribution of biggest FDI of each firm (N=98)

Country	Germany	Ukraine	Czech Republic	Romania	Russia	Slovakia	Other
Number of FDI	16	15	13	10	9	5	30
Percentage	18.0	16.0	14.0	11.0	10.0	5.0	45.0

Source: survey data.

This still limited geographical scope of foreign operations is further reflected by the fact that 70% of the firms have foreign subsidiaries in only up to 3 countries (see Table 9). Thus, sales and marketing activities are predominant (58% of the studies major affiliates of each firm, as opposed to 31% engaging also or instead in services, while 37% were active in production). This coincides with the declared motives of undertaking the biggest FDI project. On a scale from 1 (irrelevant) to 5 (highly relevant), most firms indicated market-seeking motives, such as further expansion abroad (3.77), access to a new market (3.71), or market share increase (3.53).

These were followed by the intention to realise scale effects (3.41) and access to distribution channels (3.23). However, contrary to the aforementioned experience of firms from some other, particularly Asian, emerging markets which sought to enhance their competitiveness by undertaking FDI, asset-seeking motives were on the whole found to be only marginal (1.98 for new human resources, 1.88 for new brands or 1.61 for new technology). This is additional evidence for a rather conventional development of Polish firms' international expansion.

Table 9
Total number of foreign affiliates per outward investor (N=98)

Foreign affiliates per firm	1-3	4-6	7-10	11-15	>15
Number of FDI	69	19	4	2	4
Percentage	70.0	19.0	4.0	2.0	4.0

Source: survey data.

Table 10
Internationalisation modes prior to first FDI (N=98)

Internationalisation mode	Export	Contract Manufacturing	Licensing	Franchising	Other	None
Number of FDI	53	12	1	0	0	37
Percentage	54.0	12.0	1.0	0.0	0.0	38.0

Source: survey data.

Table 11
Internationalisation modes prior to subsequent FDI projects (N=98)

Internationalisation mode	Export	Contract Manufacturing	Licensing	Franchising	Another FDI	Other	None
Number of FDI	42	7	2	1	5	0	17
Percentage	63,0	3,0	3,0	1,0	7,0	0,0	25,0

Source: survey data.

In regards to the establishment chain, Polish firms followed predominantly sequential paths (see Tables 10 & 11). In relation to both the first FDI, as well as to the subsequent ones (if applicable), exports were the most frequent mode of initial foreign market penetration (53% for the first FDI and 42% for subsequent ones), followed by contract manufacturing. Meanwhile, subsequent FDI projects were also followed by other investments in the same host country, revealing a more developed network of foreign affiliates. However, while these results do confirm the hypothesised gradual character of Polish firms' internationalisation, they nevertheless reveal that about 37% of first FDI projects and 17% of all subsequent ones occurred without any prior operations in the target market.

DISCUSSION AND CONCLUSION

The present study aims to make an explorative contribution to the current debate as to the unconventional character of FDI undertaken by firms from emerging markets. Descriptive statistics from a sample of outward investors from Poland indicate that their internationalisation patterns have mostly followed a gradual pattern, as predicted by conventional internationalisation motives. This statement refers to the fact that foreign markets were penetrated by a sequence of gradually rising resource commitments, as well as to the geographical patterns of Polish foreign affiliate locations, whereby geographically proximate locations clearly prevail. In the same vein, the said affiliates predominantly carried out sales and marketing activities and were driven by motives related to increasing global presence or accessing distribution channels.

However, there is also evidence that a not insignificant proportion of FDI projects in a given country were not preceded by any other form of presence. A possible explanation for this phenomenon would be that the penetration of other foreign markets with non-equity entry modes allowed firms to gather sufficient market knowledge on doing business in similar country contexts and thus facilitated the decision to commit substantial resources without any prior presence there. Another argument is related to the existence of the so-called home-country advantage related to the knowledge of operating in an institutionally and economically similar market, which facilitates operation in a foreign market even despite the lack of earlier experience.

This study is obviously burdened with several methodical limitations, one of them being the mere use of descriptive statistics. Further research requires econometric tests of interrelationships between variables affecting the internationalisation paths of Polish firms. Future studies on the expansion of firms from CEE countries should investigate the role of prior experience

in countries with a similar institutional and economic development level as compared to the analysed host country, and on the sequence and pace of expansion to that market, an aspect which was indirectly signalled in the present study, but clearly deserves more attention. Another relevant research problem is the impact of resource-based variables which can affect the propensity of firms to follow shorter internationalisation paths.

Finally, the results also bear an implication for economic policy related to firm internationalisation in the form of both exports and FDI. The still limited geographic scope, as well as a careful approach to committing resources abroad, calls for dedicated support measures to increase the propensity of domestic firms to accept risks and leverage opportunities related to foreign operations. This refers not only to support measures directly related to financing or transaction insurance, but also the availability of specific data on foreign markets, opportunities in terms of business projects and potential partners abroad. At the same time, the results have consequences for the management of firm internationalisation. Accordingly, given limited managerial, financial and informational resources, particularly in case of younger firms, a gradual process of foreign expansion may be a more appropriate solution. However, substantial evidence for an immediate entry into a new market via FDI suggests that the transfer of experience from other foreign operations could encourage firms to allocate more significant resources more quickly to exploit new foreign opportunities which can be beneficial to parent firm competitiveness.

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