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ROLE OF E-BUSINESS IN THE PERCEPTION OF ICT IMPACT ON REVENUE GROWTH

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Abstract. Perceived gain from the use of e-business information and communication technologies (ICT) represents the main driver that motivates companies to implement them. The study focuses on the perception of e-business ICT applications within companies. On the sample of 11,072 companies from 27 EU states, we have determined which of e-business ICT application the companies use and how they perceive the impact of ICT on their revenue growth. An ordinal regression and decision tree analysis have been used to identify a portfolio of e-business ICT applications. We have also proposed three hypotheses to test whether the perceived impact of ICT is influenced by the number of implemented e-business ICT applications, or by the number of procurement-orientated e-business ICT applications, or even by the number of sales-orientated ones. The research not only helps practitioners to recognize which tools are behind the positive perception regarding the impact of ICT on revenue growth, but it tries to answer the question of whether the quantity of implemented applications really improves the acknowledged influence of ICT on revenue growth.

Keywords. ICT, e-commerce, e-business, revenue growth, enterprises, impact, procurement, sales, marketing.

JEL Classification: M15, O14, O3.

Introduction

For the past two decades Information and Communication Technologies (ICT) have penetrated every single area of the company. However, the recent financial crisis has slowed down the rapid growth of ICT, as well as the implementation of ICT within companies. Now, in times of great uncertainty, firms have to choose very carefully which ICT solution to implement. They are not willing to experiment without some kind of assurance that such implementation will increase their economic performance. Therefore, in order to support innovation through ICT, the relations between ICT and selected economic performance indicators should be analysed and determined. Although many studies have tried to identify the impact of ICT on productivity or competitiveness improvement, most of them deal with this issue at the macroeconomic level, or in relation to the market value (Nasab, Aghaei

2009; Roztocki, Weistroffer 2011; Roztocki, Weistroffer 2009; Sassia, Goaieda 2013; Seo *et al.* 2009; Venturini 2015; Vu 2011).

The impact of ICT on the different socio-economic domains has been analysed in several studies. Most of them focus on performance indicators, such as productivity, investment efficiency or organizational change. Some researchers advocate that ICT have a positive influence on productivity, revenue growth and competitiveness (Bernroider *et al.* 2011; Cardona *et al.* 2013; Ciarli, Rabelloti 2007; Hall *et al.* 2013; Johansson, Sudzina 2008; Koellinger 2006; Tarutė, Gatautis 2014; Pettersson 2009; Ruddock 2006) and that ICT not only improve the efficient use of labour and capital within the organization, but also force companies to be more innovative (Doucek 2009; Hall *et al.* 2013; Higón 2011; Novotny 2008; Paľová 2010; Steinfield *et al.* 2010; UNCTAD 2007). However, it should be mentioned that ICT support productivity indirectly and the level of this support depends, apart from ICT investment, on the complementary investment in labour skills, *human capital, and organizational processes (*Arvanitis, Loukis 2009; Bayo-Moriones *et al.* 2013; Cardona *et al.* 2013; Doucek *et al.* 2014; Hempell, Zwick 2008; Paľová, Weinaug 2009; Ceccobelli *et al.* 2012; Zgodavova, Bober 2012). On the other side of the barricade stand the supporters of the "information paradox" (Frisk 2014; Silvius 2010) who proclaim a very weak or no relation between the use of ICT and the economic performance. Similar results were supported later by Ollo-López and Aramendía-Muneta (2012). They have found that the use of diverse ICT does not seem to have any effect on the level of competitiveness of firms. However, the use of ICT seems to favour innovation in companies. Empirical studies, conducted by Loukis *et al.* (2013) and Pilat (2005), show a positive return on investment in ICT, but with a high level of variability in different companies. This variability is based not only on different sectors and company sizes, but also on different ICT implementation strategies, and on the structure of ICT services implemented and used in business processes.

This paper analyses the above-mentioned relations from the enterprise's point of view. Its motivation is to determine whether companies recognize the role of e-business ICT applications as a driver towards better economic performance indicators and, consequently, whether they can use them as an aid kit for surviving a crisis. As an economic performance indicator, we have chosen the most understandable one, and more transparent for decision makers, i.e. the revenue growth. In particular, we examine whether the number, orientation (procurement, marketing and sale) or structure of adopted e-business ICT applications influence a company's perception of the ICT impact on revenue growth. Other ambition is to identify e-business applications whose adoption can persuade companies about the positive impact of ICT on revenue growth.

Based on the above-mentioned aspiration and some contradictory evidence of ICT impact, we have formulated 3 hypotheses followed up by a research question that arises from them (see Fig. 1 for illustration).

H1: There is a strong relation between the number of adopted e-business ICT applications and the perceived impact of ICT on revenue growth.

H2: There is a strong relation between the number of adopted e-procurement-oriented e-business ICT applications and the perceived impact of ICT on revenue growth.

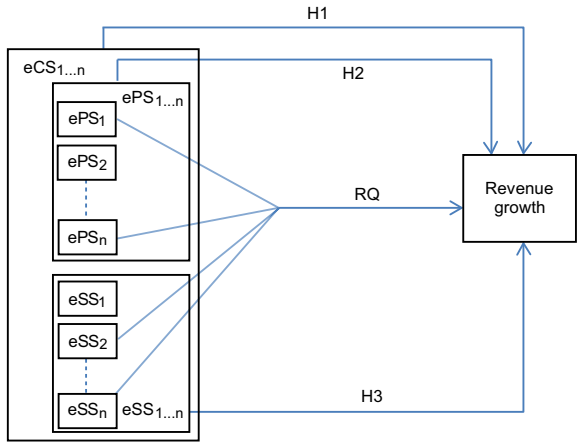

Fig. 1. Research framework
Source: designed by the authors.

H3: There is a strong relation between the number of adopted e-sales and marketing-oriented e-business ICT applications and the perceived impact of ICT on revenue growth.

Research question: Adoption of a particular e-business ICT application in enterprises has a positive influence on the perceived impact of ICT on their revenue growth.

The purpose of Hypotheses 1, 2 and 3 is to determine the role that the volume of adopted e-business ICT applications plays in managerial perception of the impact of ICT on revenue growth. They can prove that the number of adopted e-business-related ICT applications influences the perceived impact of ICT on revenue growth in companies.

Although the formulation of Hypothesis 1 does not differentiate between e-business-related ICT, Hypothesis 2 covers only e-ordering and e-procurement-oriented applications and Hypothesis 3 targets e-sales- and marketing-focused ones. The reason for such decomposition is the ambition to find out whether one group of specialized ICT is more influential than another. On the other hand, the research question is based on the identification of particular e-business ICT applications with substantial positive influence on the company's perception of ICT impact on revenue growth. Based on our analysis, a portfolio of these applications has been proposed.

1. Methodology

The raw data used draw from a comprehensive survey conducted by an EC initiative called e-Business W@tch (from 2006, 2007). This EC (European Commission) initiative examines the impact of ICT and e-business on enterprises, industries and the economy. Conducted in 2006–2007, it is probably the most extensive study to focus on the impacts of electronic commerce on companies from different sectors (impact of the financial crisis is avoided). It includes telephone interviews with decision-makers and the size of the sample, i.e. 11,072 enterprises in 10 sectors from all 27 EU Member States, Norway and Turkey, is suitable

for our research (e-Business W@tch 2006). Data from this study have been used in several research papers (Loukis, Charalabidis 2013; Qu *et al.* 2015). From the questionnaire we have extracted 19 "yes" or "no" questions about the adoption of e-business ICT applications and one evaluation question about the perceived impact of ICT on revenue growth. Possible answers to the evaluation questions, "positive", "negative" and "none", were put in order and rank in the following manner: 1 – "negative", 2 – "none", 3 – "positive".

2. Research on the effect of ICT on revenue growth

Hypotheses 1, 2, and 3 are based on the assumption that the quantity of various e-business ICT applications used to conduct business can reflect the degree to which e-business has been adopted across the company. Therefore, e-business adoption is measured by the number of e-business ICT applications implemented by the enterprise. This assumption is inspired by Koellinger's argument that the number of ICT applications positively impacts the increase in productivity (Koellinger 2006, 2008). Using the e-business profile generated from e-business watch survey, three aggregated indexes are calculated. The first one, the "eBusiness index", specifies the number of adopted e-business ICT applications within the enterprise. The index covers all the ICT applications identified in the study. Each implemented application increases the index by one point. Therefore, the "eBusiness index" can vary from 0 to 19. It is used to test Hypothesis 1. The second index, the "eProcurement index", specifies how many e-procurement-orientated e-business ICT applications have been implemented within the enterprise. It focuses on specific applications, which support and improve e-ordering and e-procurement processes. It varies from 0 to 7 and is used to test Hypothesis 2. Finally, the "eSales index" determines how many e-sales and marketing-orientated e-business ICT applications have been adopted within the enterprise. It considers only applications, which support and improve e-sales and marketing processes. The index varies from 0 to 10 and is used to test Hypothesis 3. The structure of the indexes and their link to the questionnaire (numbers of questions) are presented in Table 1.

In order to test all three hypotheses, relations between indexes and the evaluation question (H4a) are measured. Strength of these relations is tested at the 0.05 level of significance by Kendall tau-c correlation coefficient and by Somers'd. These measures have been selected because indexes, as well as answers to the evaluation question (H4a), represent ordinal variables with a different size of categories. For example, the scale of "eBusiness index" varies from 0 to 19 and, the scale of question H4a has only three values 1 – "negative", 2 – "none", 3 – "positive". Kendall tau-c (τ_c) correlation coefficient represents a symmetric measure of associations between ordinal variables with different number of categories (Argyrous 2005). As a symmetric measure, it is used based on the premise that the number of e-business ICT applications implemented within companies influences the perceived impact of ICT on revenue growth exactly the same way as the perceived impact of ICT on revenue growth influences the number of adopted e-business ICT applications. On the other hand, Somers'd (d), as an asymmetric measure of association (Argyrous 2005), is used because of the premise of a one-way relation between indexes and the evaluation question (H4a). In particular, the volume of adoption represented by indexes (independent variable) determines the perceived impact

Table 1. Indexes composition – intensity of e-business usage

Indexes		Transcriptions of questions in questionnaire	Answers
eBusiness index	eProcurement index	E1: Does your company use the Internet or other computer-mediated networks to place orders for goods or services online?	1-Yes / 2- No
		E7: Does your company currently support the selection of suppliers or procurement processes using specific IT solutions?	
		E8a: Do you use IT solutions for finding suppliers in the market?	
		E8b: Do you use IT solutions for inviting suppliers to quote prices or submit proposals?	
		E8c: Do you use IT solutions for ordering goods or services?	
		E8d: Do you use IT solutions for running online auctions?	
		F13a: Is your company's ICT system linked to the ICT system of your suppliers?	
	eSales index	F1: Does your company have its own website on the Internet?	
		F2: Does your company use a CRM system that is a specific software suite for customer relationship management?	
		F4: Does your company enable customers to order goods or book services online from the website or through other computer-mediated networks?	
		F10: Does your company support marketing or sales processes using specific IT solutions?	
		F11a: Does your company use IT solutions for publishing offers to customers?	
		F11b: Does your company use IT solutions for publishing offers to answer calls for proposals or tenders?	
		F11c: Does your company use IT solutions for launching sales auctions, such as on B2B or B2C marketplaces?	
		F11d: Does your company use IT solutions for receiving orders from customers?	
		F11e: Does your company use IT solutions for enabling customers to pay online for ordered products or services?	
		F13b: Is your company's ICT system linked to the ICT system of your customers?	
		F12d: Do you use functionalities offered via the ICT system of a supplier or customer either for sourcing, procurement or sales-related processes?	
		F12e: Do you use functionalities offered on e-marketplaces or trading networks either for sourcing, procurement or sales-related processes?	
Evaluation question		H4a: Would you say the influence of ICT on revenue growth has been …?	1 NEGATIVE 2 NONE 3 POSITIVE

of ICT on revenue growth (dependent variable). Both measures have values from the interval [–1; 1]. Analogous to Pearson's correlation coefficient, relations between variables can be considered strong, if the values of the coefficients are close to 1 (positive impact) or close to –1 (negative impact). The closer the values are to 0 from both sides, the weaker the relation between the variables is (Newson 2002). As Kendall's tau-c (τ_c) and Somers'd (d) are measures of probability (Newson 2002), we consider a relation moderate, if the absolute value of at least one correlation coefficient is higher than 0.5 $\left(|\tau_c| \geq 0.5 \text{ or } |d| \geq 0.5\right)$. To confirm a strong relation, the absolute value of at least one coefficient should be higher than 0.75 $\left(|\tau_c| \geq 0.75 \text{ or } |d| \geq 0.75\right)$.

Research question is analysed using econometric analysis and a decision tree. The purpose of the econometric analysis is to identify e-business ICT applications with significant influence on the perceived impact of ICT on revenue growth. It is based on an econometric model, where questions E1, E7, E8a, E8b, E8c, E8d, F1, F2, F4, F10, F11a, F11b, F11c, F11d, F11e, F12d, F12e, F13a, F13b with their answers represent dichotomous nominal independent variables, and the evaluation question (H4a) represents the dependent ordinal variable. Character of the dependent variable requires the use of ordinal regression, and its distribution determines the link function. Out of 11,072 companies, 149 (1.3%) perceive the impact of ICT on revenue growth as negative; 5,547 (50.1%) cannot recognize any influence; and 5,376 (48.6%) companies acknowledge a positive impact. Therefore, the probability that the answer 3 – "positive" occurs is higher than the probability of answer 1 – "negative". Such a skewed distribution of the dependent variable, where higher categories are more probable, has led to a selection of Complementary log-log link function and a formulation of the following model:

$$\log\left(-\log\left(1-\gamma_{ij}\right)\right) = \theta_j - \left[\beta_1 x_{i1} + \beta_2 x_{i2} + ... + \beta_p x_{ip}\right], \quad (1)$$

where γ_{ij} is the cumulative probability of the j^{th} category for the i^{th} case; θ_j is the threshold (equivalent to intercept) for the j^{th} category; p is the number of regression coefficients; $x_{i1} \ldots x_{ip}$ are the values of predictors (answers to questions) for the i^{th} case; $b_1 \ldots b_p$ are regression coefficients.

The research question has also been analysed by a decision tree. It identifies crucial e-business applications, whose adoption has led to a percentage increase in the number of companies with positively perceived impact of ICT on revenue growth. Apart from the econometric model, the decision tree also presents significant combinations of e-business applications and their common impact on a company's perception. All the questions used in the econometric model as independent variables are also used as input variables for the decision tree. The tree is generated using the C5.0 algorithm in SPSS Clementine. Its accuracy is ensured by a cross-validation procedure based on 10 folds.

3. Results

Our research consists of two parts: testing of hypotheses and a formulation of e-business portfolio via an econometric model and a decision tree. Hypotheses are tested by non-parametric correlation analyses, where indexes are linked to the evaluation question in order to

measure the strength of relations between the adoption of various types of e-business applications and the perceived impact of ICT on revenue growth. Results are presented in Table 2.

Table 2. Correlation analyses (symmetric and asymmetric)

	Kendall τ_c coefficient		Value	Approx. sig.	Verdict
Hypothesis 1:	eBusiness index * H4a		0.289	0.000	Not confirmed
Hypothesis 2:	eProcurement index * H4a		0.191	0.000	Not confirmed
Hypothesis 3:	eSales index * H4a		0.271	0.000	Not confirmed
Somers' d	Independent variable	Dependent variable	Value	Approx. sig.	Verdict
Hypothesis 1:	eBusiness index	H4a	0.228	0.000	Not confirmed
Hypothesis 2:	eProcurement index		0.196	0.000	Not confirmed
Hypothesis 3:	eSales index		0.237	0.000	Not confirmed

Hypothesis 1 is based on the correlation between "eBusiness index" and the evaluation question. As demonstrated in Table 3, although the relation between these variables is statistically significant (*Approx. Sig.* > 0.05), the values of both correlation coefficients are too small to accept Hypothesis 1. Similarly, the relation between the eProcurement index and the evaluation question is statistically significant, but due to the small correlation coefficients Hypothesis 2 cannot be accepted. Moreover, the statistically significant relation between the eSales index and the evaluation question, together with small coefficients, is the reason why Hypothesis 3 cannot be confirmed, either. However, when comparing both correlation coefficients mentioned in Hypothesis 2 and Hypothesis 3, it can be concluded that the perceived impact of ICT on revenue growth is more affected by e-sales and marketing-oriented applications than by e-ordering- and e-procurement-oriented ones.

To conclude, the number of adopted e-business applications influences the perception of the ICT impact on revenue growth. However, the influence is not strong enough to say that the increase in quantity of adopted e-business ICT applications will ensure a better perception of ICT impact on revenue growth. Generally, it means that the number of implemented e-business ICT applications does not strongly correlate with a company's satisfaction regarding the impact of ICT in terms of revenue growth. It can be caused by a different sensitivity of particular applications to the perceived impact of ICT on revenue growth. Some of them can have a stronger impact than others. This inconsistency may account for small correlation coefficients. It is the ambition of the research question to identify influential applications. The results form the second part of the research.

The process of identifying the influential e-business ICT applications starts with an econometric model based on ordinal regression. The first model had 19 predictors based on the questions in Table 1, and it definitely predicted 63.9% values. On the other hand, it had 9 statistically insignificant factors at 0.05% level of significance. These factors were removed and the model was re-estimated. The final model has 10 predictors and rightly predicted 63.7% values. All these predictors are statistically significant at 0.05% level of significance and, together with their estimates, are presented in Table 3.

Table 3. Predictors and estimated parameters in econometric model

	Question	Est.	St. dev	Df	Sig.	Question	Est.	St. dev	Df	Sig.
Location	[e1 = 1]	.263	.029	1	.000	[f11_3 = 1]	.586	.174	1	.001
	[e1 = 2]	0	.	0	.	[f11_3 = 2]	0	.	0	.
	[f1 = 1]	.419	.030	1	.000	[f11_5 = 1]	.327	.123	1	.008
	[f1 = 2]	0	.	0	.	[f11_5 = 2]	0	.	0	.
	[f2 = 1]	.325	.049	1	.000	[f12_5 = 1]	.343	.095	1	.000
	[f2 = 2]	0	.	0	.	[f12_5 = 2]	0	.	0	.
	[f4 = 1]	.360	.037	1	.000	[f13_1 = 1]	.259	.056	1	.000
	[f4 = 2]	0	.	0	.	[f13_1 = 2]	0	.	0	.
	[f11_1 = 1]	.443	.079	1	.000	[f13_2 = 1]	.212	.057	1	.000
	[f11_1 = 2]	0	.	0	.	[f13_2 = 2]	0	.	0	.
Threshold	[h4_1 = 1]	–3.725	.084	1	.000	*Est.* – estimation *St. dev* – standard deviation *Df* – degree of freedom *Sig.* – significance				
	[h4_1 = 2]	.340	.024	1	.000					

To identify an influential application, the location part of the model is very important. It represents estimates of regression coefficients. As shown in Table 4, all the estimated coefficients in the location part are positive. Based on the structure of the model, positive estimated coefficients mean that the implementation of a particular e-business application covered by a question in Table 1 would significantly, and in a positive manner, influence the perceived impact of ICT on revenue growth. The value of the estimated coefficient, together with its standard deviation, represents the strength of this positive influence. Moreover, the model identifies e-business ICT applications whose implementation should significantly positively improve a company's perception of ICT impact on revenue growth. The portfolio of applications determined by the model contains: 1) IT solutions used to launch sales auctions on B2B or B2C marketplaces, 2) IT solutions used for publishing offers to customers, 3) website on the Internet, 4) IT solutions that enable customers to order goods or book services online from the website, or through other computer-mediated networks, 5) IT solutions which use functionalities offered via the ICT system of a supplier or customer, either for sourcing, procurement or sales-related processes, 6) IT solutions which enable customers to pay online for ordered products or services, 7) specific software suite for customer relationship management, 8) IT solutions enabling to place orders for goods or services online, 9) IT systems which are linked to the ICT system of suppliers, 10) IT systems which are linked to the ICT system of customers.

The decision tree, presented in Figure 2, provides a different view of the ICT impact on revenue growth. The decision tree itself illustrates how the perception of ICT impact on revenue growth is changing, based on the combination of adopted e-business applications. The used algorithm split the sample based on the applications that provide the maximum information gain at each level. The tree illustrates the hierarchy of the

e-business ICT applications, which, from the companies' point of view, have a positive impact on revenue growth. Figure 2 represents the top four levels of the tree. As we can see, the palette of questions at the top of the tree is similar to the structure of questions, which the econometric model recognized as significant. For example, IT solutions, which enable launching of sales auctions, were, by both methods, identified as a significant factor influencing the perceived impact of ICT on revenue growth. As the decision tree outlines, the positive impact of ICT on revenue growth is perceived by 87.2% companies with IT solutions that enable them to launch sales auctions. That means that 87.2% companies, which use sales auction for doing business, recognized the positive impact of ICT on revenue growth (Node 66). It also means that the adoption of IT solutions, which enable launching of a sales auction, increase a probability that such a company will recognize a positive impact of ICT on its revenue growth. On the other hand, only 47% companies, which do not use sales auctions, recognize the positive impact of ICT on revenue growth (Node 1). Therefore, it can be concluded that using sales auction for doing business should be recognized as a factor, which leads to a recognition of positive impact of ICT on revenue growth. We can see a similar situation in companies, which do not use sales auctions, but they use IT solutions to enable customers to pay for ordered products or services online. 81.3% of them recognize the positive impact of ICT on revenue growth (Node 65). It means that if a company implements an IT solution to enable customers to pay online, or to launch sales auction, it is highly probable (81.3% or 87.2%) that the perceived impact of ICT on revenue growth will be positive. Sliding down the tree, it can be noted that a website on the Internet does not yield such plausible results. Only 54% companies with websites and without any ICT application mentioned earlier consider the impact of ICT on revenue growth as positive. The remaining 46% companies think that ICT have no influence or even negative influence on revenue growth (Node 28). The percentage of companies which consider the impact of ICT as positive rapidly increases (73.8%), if the examined companies have a website and also an IT system which uses functionalities offered on e-marketplaces or trading networks, whether it is for sourcing, procurement or sales-related processes. This means, that it is highly probable (73.8%), that a combination of these two types of e-business applications will result in the recognition of a positive impact of ICT on revenue growth. Finally, even if a company does not want to adopt any of these applications, but still wants an ICT application that would be responsible for positive recognition of ICT impact on revenue growth, there is a way to do that. As shown in Figure 2, two thirds of companies, which use ICT to run online auctions and do not use any of the previously mentioned applications, state that ICT have a positive impact on their revenue. So there is a fair probability (66.7%) that an investment in IT solutions to run online auctions will results in the recognition of a positive impact of ICT on revenue growth (Node 27). However, the left side of the decision tree implies that two thirds of companies, which do not have any applications identified earlier, cannot recognize any influence of ICT on their revenue growth (Node 4). Therefore, it can be concluded that if a company does not launch a sales auction, enable its customers to pay online, or it does not have a website or run an online auction, the ICT of such a company will be (with a 67.5% probability) considered as non-influential in terms of revenue growth.

The presented research contributes to academic discussions with several findings. Based on the distribution of the evaluation question, we have found out that companies do not perceive ICT as something of negative influence on revenue growth. On the other hand, most of the companies cannot recognize any impact of ICT towards revenue growth. In order to really experience a positive impact of ICT not only on revenue growth, companies have to focus on the structure and functionalities of their ICT. We have proven that differentiation through the adoption of various e-business ICT applications (specifically-oriented or not) does not seem to be the way towards a recognition of a positive impact on revenue growth. Moreover, we have shown that the adoption of even one proper ICT application can shift the perceived impact of ICT on revenue growth from "none" to "positive".

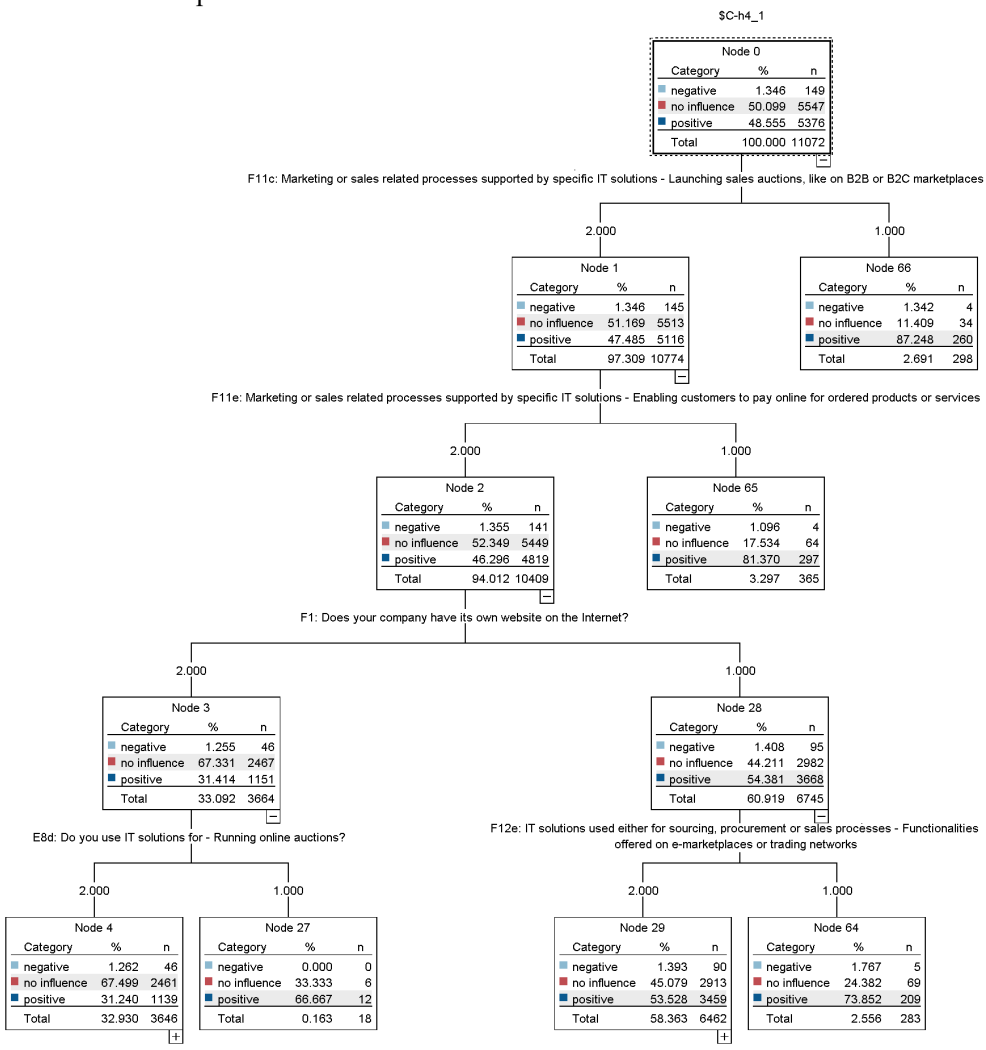

Fig. 2. Decision tree illustrating factors influencing perceived impact of ICT

Conclusions

The paper analyses the impact of e-business ICT applications on the perceived role of ICT in terms of revenue growth. It tries to determine how companies recognize the contribution of ICT, and whether an implementation of e-business applications can influence this opinion. To accomplish that, 19 types of e-business ICT applications, usually implemented by companies, were selected and examined against their perception of ICT impact on revenue growth. The study is based on three hypotheses concerning the relation between e-business ICT applications and the perception of ICT impact on revenue growth. Although our correlation analyses revealed that all three tested relations were statistically significant, none of them was strong enough to confirm a particular hypothesis. It means there is no strong (or even moderate) relation between the number of implemented e-business ICT applications and the perception of ICT impact on revenue growth.

The research question analysis, however, yields better results. Its aim is to build an e-business portfolio from ICT applications, which can positively influence the impact of ICT on revenue growth as perceived by companies. The econometric analysis, supported by the results of the decision tree, shows that IT solutions for launching sales auctions on B2B or B2C marketplaces, as well as IT solutions which enable customers to pay online for ordered products and services, are the most influential ones. A combination of a website and an IT system, which uses functionalities offered on e-marketplaces or trading networks, will, with a high probability, also have a positive effect on the recognition of ICT impact on revenue growth.

Based on the presented results, we can conclude that neither quantity nor e-sales or e-procurement orientation of e-business applications seems to significantly change a company's perception of the ICT role in revenue growth. On the other hand, it seems that, in terms of e-business adoption, it is more important to focus on just a few most efficient ICT applications, i.e. to focus more on quality not quantity.

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References

Argyrous, G. 2005. *Statistics for research: with a guide to SPSS*. Philadelphia: Sage.

Arvanitis, S.; Loukis, E. N. 2009. Information and communication technologies, human capital, workplace organization and labour productivity: a comparative study based on firm-level data for Greece and Switzerland, *Information Economics and Policy* 21(1): 43–61. http://dx.doi.org/10.1016/j.infoecopol.2008.09.002

Bayo-Moriones, A.; Billón, M.; Lera-López, F. 2013. Perceived performance effects of ICT in manufacturing SMEs, *Industrial Management & Data Systems* 113(1): 117–135. http://dx.doi.org/10.1108/02635571311289700

Bernroider, E.; Sudzina, F.; Pucihar, A. 2011. Contrasting ERP absorption between transition and developed economies from Central and Eastern Europe (CEE), *IS Management* 28(3): 240–257. http://dx.doi.org/10.1080/10580530.2011.585581

Cardona, M.; Kretschmer, T.; Strobel, T. 2013. ICT and productivity: conclusions from the empirical literature, *Information Economics and Policy* 25(3): 109–125. http://dx.doi.org/10.1016/j.infoecopol.2012.12.002

Ceccobelli, M.; Gitto, S.; Mancuso, P. 2012. ICT capital and labour productivity growth: a non-parametric analysis of 14 OECD countries, *Telecommunications Policy* 36(4): 282–292. http://dx.doi.org/10.1016/j.telpol.2011.12.012

Ciarli, T.; Rabellotti, R. 2007. ICT in industrial districts: an empirical analysis on adoption, use and impact*, Industry and Innovation* 14(3): 277–303. http://dx.doi.org/10.1080/13662710701369239

Doucek, P. 2009. ICT human capital – research and development work in ICT, in P. Doucek, G. Chroust, V. Oškrdal (Eds.). *IDIMT 2009: system and humans – a complex relationship.* Linz: Trauner Verlag universitat, 83–94.

e-Business W@tch. 2006. *e-Business Decision Maker Survey in European Enterprises* [online], [cited 13 February 2015]. e-Business Watch. Available from Internet: http://ec.europa.eu/enterprise/archives/e-business-watch/about/methodology.htm

Frisk, J. E.; Lindgren, R.; Mathiassen, L. 2014. Design matters for decision makers: discovering IT investment alternatives, *European Journal of Information Systems* 23(4): 442–461. http://dx.doi.org/10.1057/ejis.2013.13

Hall, B. H.; Lotti, F.; Mairesse, J. 2012. Evidence on the impact of R&D and ICT investments on innovation and productivity in Italian firms, *Economics of Innovation and New Technology* 22(3): 300–328. http://dx.doi.org/10.1080/10438599.2012.708134

Hempell, T.; Zwick, T. 2008. New technology, work organisation, and innovation, *Economics of Innovation and New Technology* 17(4): 331–354. http://dx.doi.org/10.1080/10438590701279649

Higón, D. A. 2011. The impact of ICT on innovation activities: evidence for UK SMEs, *International Small Business Journal* 30(6): 684–699. http://dx.doi.org/10.1177/0266242610374484

Johansson, B.; Sudzina, F. 2008. ERP systems and open source: an initial review and some implications for SMEs, *Journal of Enterprise Information Management* 21(6): 649–658. http://dx.doi.org/10.1108/17410390810911230

Koellinger, P. 2006. *The impact of ICT on Corporate Performance, Productivity and Employment Dynnamics* [online], [cited 13 February 2015]. Special study by e-Business W@tch. Available from Internet: http://ec.europa.eu/enterprise/archives/e-business-watch/studies/special_topics/2006/documents/TR_2006_ICT-Impact_I.pdf

Koellinger, P. 2008. The relationship between technology, innovation, and firm performance: empirical evidence from e-business in Europe, *Research Policy* 37(8): 1317–1328. http://dx.doi.org/10.1016/j.respol.2008.04.024

Loukis, E. N.; Charalabidis, Y. K. 2013. An empirical investigation of information systems interoperability business value in European firms, *Computers in Industry* 64(4): 412–420. http://dx.doi.org/10.1016/j.compind.2013.01.005

Loukis, E.; Soto-Acosta, P.; Pazalos, K. 2013. Using structural equation modelling for investigating the impact of e-business on ICT and non-ICT assets, processes and business performance, *Operational Research* 13(1): 89–111. http://dx.doi.org/10.1007/s12351-011-0110-x

Nasab, H. E.; Aghaei, M. 2009. The effect of ICT on economic growth: further evidence, *International Bulletin of Business Administration* 5: 46–56.

Newson, R. 2002. Parameters behind "non-parametric" statistics: Kendall's Tau, Somers' D and median differences, *Stata Journal* 2(1): 45–64.

Novotny, O. 2008. IT performance management as a part of the corporate performance management system, in P. Doucek, C. Gerhard, J. Klas (Eds), *IDIMT-2008 Managing the Unmanageable: 16th Interdisciplinary Information Management Talks,* 10–12 September 2008, Jindrichuv Hradec. Linz: Trauner Verlag Universitat, 15–22.

Ollo-López, A.; Aramendía-Muneta, M. E. 2012. ICT impact on competitiveness, innovation and environment, *Telematics and Informatic* 29(2): 204–210. http://dx.doi.org/10.1016/j.tele.2011.08.002

Paľová, D. 2010. Benefits of ICT education towards eGovernment, *Transactions of the Universities of Košice* 10(1): 35–41.

Paľová, D.; Weinaug, H. 2009. Systematic approach to evaluate a B2 (B2B) platform, in P. Mikulecký, T. Lišková, P. Čech, V. Bureš (Eds.). *Ambient Intelligence Perspectives: Ambient Intelligence and Smart Environments: Selected papers from the First International Ambient Intelligence Forum 2008*. NL: IOS Press, 194–202.

Pettersson, B. 2009. The connection between IT investments, competition, organizational changes and productivity, *Economic Review* 94(2): 72–85.

Pilat, D. 2005. The ICT productivity paradox, *OECD Economic Studies* 2004(1): 37–65.

Qu, W. G.; Pinsonneault, A.; Tomiuk, D.; Wang, S.; Liu, Y. 2015. The impacts of social trust on open and closed B2B e-commerce: a Europe-based study, *Information & Management* 52(2): 151–159. http://dx.doi.org/10.1016/j.im.2014.07.002

Roztocki, N.; Weistroffer, H. R. 2009. The impact of enterprise application integration on stock prices, *Journal of Enterprise Information Management* 22(6): 709–721.

Roztocki, N.; Weistroffer, H. R. 2011. From the special issue editors: information technology in transition economies, *Information Systems Management* 28(3): 188–191.

Ruddock, L. 2006. ICT in the construction sector: computing the economic benefits, *International Journal of Strategic Property Management* 10(1): 39–50.

Sassia, S.; Goaieda, M. 2013. Financial development, ICT diffusion and economic growth: lessons from MENA region, *Telecommunications Policy* 37(4): 252–261. http://dx.doi.org/10.1016/j.telpol.2012.12.004

Seo, H. J.; Lee, Y. S.; Oh, J. H. 2009. Does ICT investment widen the growth gap?, *Telecommunications Policy* 33(8): 422–431. http://dx.doi.org/10.1016/j.telpol.2009.04.001

Silvius, J. G. 2010. A conceptual model for aligning IT valuation methods, *International Journal of IT/Business Alignment and Governance* 1(3): 36–54. http://dx.doi.org/10.4018/jitbag.2010070103

Steinfield, Ch.; Scupola, A.; López-Nicolás, C. 2010. Social capital, ICT use and company performance: findings from the Medicon Valley biotech cluster, *Technological Forecasting and Social Change* 77(7): 1156–1166. http://dx.doi.org/10.1016/j.techfore.2010.03.004

Tarutė, A.; Gatautis, R. 2014. ICT impact on SMEs performance, *Procedia-Social and Behavioral Sciences* 110: 1218–1225. http://dx.doi.org/10.1016/j.sbspro.2013.12.968

UNCTAD. 2007. Science and technology for development the new paradigm of ICT [online], [cited 13 February 2015]. United Nations Conference on Trade and Development. Available from Internet: http://www.unctad.org/en/docs/sdteecb20071_en.pdf

Venturini, F. 2015. The modern drivers of productivity, *Research Policy* 44(2): 357–369. http://dx.doi.org/10.1016/j.respol.2014.10.011

Vu, K. M. 2011. ICT as a source of economic growth in the information age: empirical evidence from the 1996–2005 period, *Telecommunications Policy* 35(4): 357–372. http://dx.doi.org/10.1016/j.telpol.2011.02.008

Zgodavova, K.; Bober, P. 2012. An innovative approach to the integrated management system development: SIMPRO-IMS web based environment, *Quality Innovation Prosperity* 16(2): 59–70. http://dx.doi.org/10.12776/qip.v16i2.69

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