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E-COMMERCE PRODUCTIVITY PARADOX EVIDENCE FROM THE HUNGARIAN RETAIL SECTOR

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Abstract

Drastic increase in information technology investments and no growth in productivity and profitability – this was the famous "IT productivity paradox" of the 1980's and 1990's. B2C e-commerce systems, as mature, wide-spread and directly observable components of the corporate IT portfolio, are the perfect research subjects to further clarify the question of IT productivity in the new millennia. Are e-commerce resources associated with enhanced company competitiveness, productivity or financial performance? With routes in the resource based view, we analyzed the e-commerce capabilities of 187 Hungarian ICT retailer, explored the relationship between e-capabilities and corporate performance metrics with multivariate statistical methods. We found that online transactional capability has indeed a significant positive effect on Hungarian retail labor efficiency, the productivity paradox is dissolved. While online interactive capabilities have significant positive effect on bottom-line profitability, and a lagged positive effect on revenue growth; we could also find informational e-capabilities associated with inferior profitability.

Keywords: IT productivity, IT business value, electronic commerce, e-commerce value, e-tailers

Introduction

Drastic increase in IT investments and no growth in productivity and profitability – this was the famous "IT productivity paradox" of the 1980s and 1990s. In the form of Robert Solow's [1987] famous statement: "you can see the computer age everywhere but in the productivity statistics". This became the slogan setting a challenge for IT business value researchers from the 1990s. We can find a great many pieces of research proving and also disproving the productivity paradox, but following the turn of the millennium IT's positive effect on productivity – and also bottom-line company performance – have been confirmed. In their study Wan, Fang and

Wade [2007] reviewed all empirical studies on the IT productivity paradox conducted in the decade between 1996 and 2006. They concluded that by using more reliable data sources, selecting the appropriate level of analysis and involving complementary management skills the paradox seems to be dissolve. 64% of studies focusing on the company level and 75% of studies analyzing data revealed a clearly positive relationship between information technology and corporate performance [Wan – Fang – Wade, 2007, p. 6-7].

Where would it be easier to demonstrate the results of information technology investments, than in case of systems directly related to sales level and efficiency? Liang, You and Liu [2010] concluded in their meta-analysis, that primarily external, outward-facing IT capabilities affect financial performance. E-commerce value research became more popular after the millennia, when e-commerce reached a more significant market penetration, helping researchers to easily observe the quality and the effect of building online capabilities.

Companies planning to invest in e-commerce expect market share growth and improving retail efficiency [Gáti – Kolos, 2011]. In our research we expect the same: We look at the IT productivity dilemmas on the special field of e-commerce, and examine the relationship between e-commerce capabilities and productivity, and also bottom-line financial and market performance.

Literature Review

Behind the IT Productivity Paradox

Does or did the IT productivity paradox exist? If so, in which period? If not, why was it so difficult to find evidence of productivity improvement by information technology?[5] Explanations confirming and disconfirming the IT productivity paradox rely on one or more of the arguments listed below [based partly on Triplett, 1999, p. 309; Brynjolfsson – Yang, 1996 and Kauffman – Weill, 1989, p. 4]:

- We do not live in the age of computers in *every respect*. The computer age has not in fact exerted significant influence to the same extent on each area of the economy; it has appeared with varying intensity in different industries. In the United States, 70% of private sector IT investments were concentrated on the commercial and financial services sector in the early 1990s [Grilishes, 1994]. Similarly, even today in Hungary we can observe differences in the intensity of the use by different national economy sectors of various information technologies: While in financial services industry 100% of the employees use PC, and 82,5% of the

[5] As there are a rather large number of studies and also literature overviews [e.g. Kauffman – Weill, 1989; Brynjolfsson – Yang, 1996; Triplett, 1999; Dedrick et al., 2003, Lee – Kim, 2006] related to the subject, at this point I will only cover some key findings and central arguments.

companies have wired network, in accommodation and food service industry these statistics are only 73,5% and 8,7% respectively. [Central Statistical Office (KSH), 2008, p. 29].

- *No such paradox exists, only statistical methodologies applied in the field are inadequate.* For instance, a logarithmic scale should be used to demonstrate a relationship, or that researchers should be more careful by choosing the input and output metrics. This and the following argument fuels the research of valuation methodologies capturing the uncertainty and intangible nature of IT value creation [e.g. Kumar, 1997].
- Some of the value created by computer technology is *not measured by economic statistics*. Such intangible factors at the company level may include improved decision-making skills, market forecasting skills or higher employee satisfaction [e.g. Anandarajan – Wen, 1999]. No doubt, however, that a company's valuable intangible assets also have an impact on financial performance but the main problem of measuring intangible effects is the issue of capturing the long logical sequence of steps between inputs and outputs [e.g. Chen – Zhu, 2004]. That is where Davern and Wilkin [2010] also see one of the causes underlying the paradox and suggest multidimensional measurement by the concurrent use of perceived and objective metrics.
- It is possible that while focusing on IT investments we lose sight of the big picture, i.e. we should also pay attention to *complementary resources* [Zhu, 2004] and *other contextual factors*, such as related changes in management and organization [pl. Brynjolfsson – Hitt – Yang, 2002].
- *We cannot yet* see the effects of computer technology but we will in the near *future*; the impact of the new technology appears in macro-level statistics with a delay, i.e. there is a kind of lag effect [see Lee – Kim, 2006]. The reason should be sought in the long implementation phase of information technology and the protracted nature of corporate learning, which can mean a delay by as long as 2 to 4 years [Brynjolfsson – Hitt – Yang, 1998].
- *The productivity paradox does exist*; and the reason lies in *inadequate IT management*, i.e. not in technology itself but in the specific characteristics of implementation. It is therefore possible that the effectiveness of IT investments is of a rather diverse nature [Brynjolfsson – Hitt, 1995], as are the findings of empirical studies. So in large samples the effects of different company-level implementation strategies and results extinguish each other, which makes it impossible to draw unambiguous conclusions.
- The paradox exists if we only focus on the company in realizing benefits. As long as *examination extends to customers and final consumers* we can see that the company passes on (some of) the positive effects of IT investments to the consumer [e.g. Hitt – Brynjolfsson, 1996].

- *Even though there may be such a paradox, corporate top executives should focus on profitability and competitiveness* instead of productivity only. The importance of IT-generated productivity growth, or the lack of it, may be far outweighed by the technology supporting for example fast innovation-adaptation [Woods, 2010, interview with Andrew McAfee].
- *There is no such* paradox*; on the contrary, the opposite is true*; i.e. by the millennium a *"new productivity paradox"* relaced the old one [Anderson et. al., 2003]. The problem was no longer the lack of evidence of IT profitability but the demonstration of unexplainably high returns. Alternative explanations were given in an effort to resolve the new paradox: According to some, the reason for unusually high returns lied in overlooking hidden and organizational costs of information technology investments, while others believed high returns were understandable in the light of the high risk involved in IT investments [e.g. Dewan – Shi – Gurbaxani, 2003].

Based on the arguments above it is worth focusing our investigation on information technology-intensive industries; adjusting measurement techniques to the given industry and the specificities of IT investments; using more complex multivariate analytic techniques, and also looking for mid and long term relationships – that is also how we plan to maximize our chances of bypassing the problem of the productivity paradox and demonstrating real effects.

E-commerce Business Value

Let us turn our attention from the general IT productivity paradox problem to the more specific field of e-commerce productivity and value creation. Are the e-commerce resources associated with improved operational efficiencies or with competitive advantage?

On the market level Bakos [1998] found that corporate e-commerce value creation can be achieved via (1) increased personalization of products, (2) aggregation and disaggregation of information-based products and (3) lower search costs. On the other hand economic theory says that one of the most compelling advantage (also in financial terms) of e-commerce would be to decrease the transaction and agency costs for both retailers and customers [Malone – Laubacher, 1998]. A game theory modeling of the retail market [Bernstein et al., 2006] concluded that click-and-mortar could become the dominant business model, in some cases only in the form of strategic necessity which creates value mostly for the customers.

Event studies (focusing on the share price effects of e-commerce initiative announcements) indicate that the market sets a higher value on B2C initiatives in comparison to B2B projects, and that e-commerce investments related to tangible products are more valuable than the ones concerning digital products [Subramani – Walden, 2001]. Dehning et al. [2004] showed that while most of the positive value effect of e-commerce

announcements diminished after the year 2000, B2C initiatives and the e-commerce investments of traditional companies were still recognized by the stock market as value creation.

With routes in the resource-based view (RBV) of the firm Amit and Zott [2000] found four sources of e-commerce success: novelty, lock-in, complementarities, and efficiency. Zhu and Kraemer [2002] conceptualized the e-commerce resources in information-transaction-interaction-integration dimensions and found a significant positive effect on operative performance measurers like inventory turnover (see Table 1). Later Zhu [2004] used the same model in the retail industry and revealed the complementarities between e-commerce capabilities and IT infrastructure, and their joint positive effect on cost reduction and especially: on human resource productivity. In Europe, Merono-Cerdan and Soto-Acosta [2007] found similar complementarities between the corporate e-commerce capabilities: the information and interaction functions strongly support the positive financial effect of the transaction function of the website.

Table 1. E-commerce Business Value – Results Previous Studies
(*0,05 < p < 0,1; **0,01< p <0,05; *** p<0,01)

Authors	Profitability (ROA or gross margin or value added)	Inventory turnover	Sales revenue per employee
Zhu – Kraemer [2002]	model R^2: 0,140 e-com. R^2: -	model R^2: 0,412** e-com. R^2: 0,458*	
Zhu [2004]	model R^2: 0,361*** e-com. R^2: 0,104	model R^2: 0,312*** e-com. R^2: 0,129*	model R^2: 0,379*** e-com. R^2: 0,251**
Merono-Cerdan – Soto-Acosta [2007]	model R^2: 0,891*** e-com. R^2: 0,252***		

Zhuang and Lederer [2006] used similar resource categories like information-transaction-interaction but integrated with some technical and usability capabilities, human and business resources, where all but the human resources had significant positive effect on firms' financial performance. While Hulland – Wade – Antia [2007] use fairly different concepts of e-commerce resources in the retail industry, they found that technological and marketing resources do not have a direct positive effect on the firm performance, only through their model's intermediary variable, which is online channel commitment.

We can conclude, that in the first decade of the millennium e-commerce value researchers struggled with the problem of measurement and model building, while also producing some promising results on developed markets. Building upon the results of their concept construction efforts we

will look at the question of e-commerce productivity and value creation in Central-Eastern Europe in the years following a general economic downturn.

Research Questions and Methodology

Hypothesis Development

The theoretical and empirical findings discussed above lead us to the basic question: Are e-commerce resources associated with enhanced company competitiveness and financial performance? Can the – somewhat ambiguous and still weak – relationships found on developed markets repeated in Central-Easterns European context? In line with these question we wish to test the following statement:

There is a positive relationship between firm level e-commerce capabilities and the company competitiveness.

This hypothesis is the basic translation of the main research question of the resource-based view into the field of e-commerce value creation.

Based on the different operationalization of the concept of competitiveness, we can test the following three hypotheses:

H1: There is a positive relationship between firm level e-commerce capabilities and profitability of Hungarian ICT retailers.

Although RBV literature considers making above industry average profits is the primary expression of competitive advantage, market share (and its trends over time) can also serve as direct indicator of the formation of competitive advantage. According to a survey taken in 2002, European SMEs tend to expect increased sales revenues from their e-business applications, particularly from their e-commerce applications [Johnston – Wade – McClean, 2007, p. 357-8].

A somewhat similar but dominantly qualitative study conducted by Demeter and Matyusz [2006] found the success of the firm measured by financial ratios show strong correlation with the success of the IT area. The lack of such relationship would mean that either there is no value creation taking place or it is rather intangible or unsustainable in market competition.

H2: There is a positive relationship between firm level e-commerce capabilities and market performance of Hungarian ICT retailers.

Although profitability and market performance may seem less affected by direct e-commerce effects, the impact on operational efficiency ratios is worth examining as well. Earlier similar studies [Zhu – Kraemer, 2002 and Zhu, 2004] managed to relate e-commerce capabilities primarily to retail efficiency (per capita sales revenue and inventory turnover) ratios. This is reflected in the third hypothesis formulated.

H3: There is a positive relationship between firm level e-commerce capabilities and operational efficiency of Hungarian ICT retailers.

Research Framework

Our research model (see Figure 1) fits into the general framework of IT business value research [see Dehning – Richardson, 2002] with the use of e-commerce specific concepts of the resource-based view.

As mentioned above some researchers have already explored the specific field of e-commerce value creation on RBV foundations, the models of Zhu – Kraemer [2002]; Zhu [2004] and Marono-Cerdan – Soto-Acosta [2007] are the most similar to ours. The core constructs, definitions and measures are the following:

- *E-commerce capabilities*: E-commerce capabilities are measured by the widely used four-grade scale of (1) information, (2) transaction, (3) interaction and (4) customization. Similar concepts are used by other researchers, like: information-transaction-communication [Miranda – Banegil, 2004; Marono-Cerdan – Soto-Acosta, 2007]; information-transaction-interaction-integration [Zhu, 2002; Zhu – Kraemer, 2004]. Also similar e-commerce capabilities are measured by European and national ICT surveys [information-transaction-customization, see KSH, 2008]. The four core e-capabilities are measured by the occurrence of a set of e-commerce-related key-words, where the list of keywords is based on previous research, expert interviews and tested on a small sample. (See the list of e-commerce variables in the first column of Appendix 1).
- *Competitiveness and financial performance measures*: The RBV theory usually operationalizes the competitive advantage construct in terms of above industry average profitability [see Clemons – Row, 1991 or Piccoli-Ives, 2005]. Based on the system of traditional financial multiples [see Virág - Fiáth, 2010], the most common RBV performance categories [Aral – Weill, 2007] and the most popular metrics in the e-tailing industry [Zhuang – Lederer, 2003] We chose 3 types of financial metrics to represent the competitiveness and financial performance of the companies: (1) market metrics like revenue growth and market share changes, (2) profitability metrics like EBIT per sales, (3) efficiency metrics like inventory turnover, gross margin or human resource productivity in terms of sales per employee.

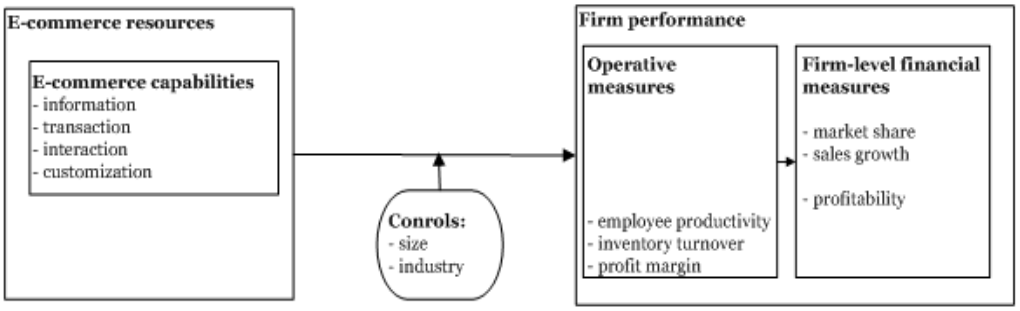

Figure 1. Conceptual Framework

Data

With 34% of the retail company websites enable online shopping [KSH, 2008], retail is a traditionally e-commerce intensive sector in Hungary. We chose an IT intensive subsector ICT retail industry, selling hardware, software and telecommunication equipment. According to Hungarian market studies [Kis, 2009] ICT retail is one of the most popular e-commerce industry, along with book retail, travel or insurance services, but it is one of the less researched areas. In the Hungarian ICT retail industry we conducted the following data collections for the years 2009 and 2010:

- *Primary data collection:* One of the innovations of the research methodology is the use of automated crawler-based data collection Web crawlers [see Chakrabarti, 2003] were created to explore the sampled websites and their e-commerce capabilities, using given key word sets and automated search mechanisms.
- *Secondary data sources*: For financial data we used public national sources (Ministry of Justice and Law Enforcement) and business databases like 'Complex Céginfó'.

All the 187 companies in our original sample were small and medium-sized enterprises (SMEs), and based on their principal activity, there are 132 computer retailers and 55 mobile phone retailers. 60 companies operate in the capital (Budapest) while the other 127 are located in the countryside. The sample contained 118 traditional brick-and-mortar retailers and 69 companies which used a mixed sales model (with in-store sales and e-commerce) – but no pure virtual e-tailer was included. Descriptive statistics (see Table 2) clearly show that the year 2009 was not the period of growth for the ICT retail sector – more than half of the enterprises had to face a decrease in sales revenue.

Table 2. Descriptive Statistics for Some General Business Metrics
(values in thousand Euro, using the exchange rate of 31.12.2009: 270,84 HUF/EUR)

		Number of employees	Number of locations, stored	Equity		Sales revenue		Operating profit	
		2009	2009	2009	2010	2009	2010	2009	2010
N	Valid	187	187	187	175	187	175	187	175
	Missing	-	-	-	12	-	12	-	12
Mean		8	2	140	174	631	672	18	30
Median		5	2	48	59	362	373	7	7
Standard deviation		9	2	332	384	768	894	89	155
Minimum		-	1	- 292	- 137	-	-	- 258	- 181
Maximum		79	14	3 179	3 563	6 332	6 192	934	1 935

Methodology

To decrease the number of independent variables the use of factor and principal component analyses can be an obvious solution. This method is objective, retains much of the variance of original variables, and in our case it resulted in the construction of nine e-commerce factors (see Appendix 1).

In related literature, the most common tool for examining similar relationships is regression analysis [e.g. Zhu – Kraemer, 2002; Zhu, 2004 and Merono-Cerdan – Soto-Acosta, 2007], which serves as a basis of the analytical toolkit of the present paper. We did best to construct a model which enables our results to be compared in space and time. However, in order to be able to understand the deeper relationships between our variables, cluster analysis was used as well.

Analysis and Discussion

Table 3 shows the significant correlations between the variables, using Spearman's rho coefficient as correlation indicator. The table covers only the first five principal components, since the other (terms of service 1 and 2, products and online communication) showed no significant relationship with any of the performance indicators. Also, although market performance shows a minimum extent of co-movement with e-commerce capabilities in a direction identical with that of profitability rates, that relationship is not significant.

The strongest positive relationship is shown by per sales revenue per employee and the webshop factor. Their correlation suggests that transactional e-commerce capabilities do have a beneficial effect on retail labor efficiency, even if this positive effect is less demonstrable at the level of profitability and market performance. This could be the first sign

disproving the e-commerce productivity paradox as we already can see technology's effects in the productivity statistics.

Table 3. Correlation between E-commerce Factors and Corporate Performance Indicators
(Spearman's rho; significance: * p<0.01; ** 0.01<p<0.05; based on a two-tailed significance test)

		Sales growth	ROIC	CFROI	ROE	ROA	Sales per employee	Profit margin	Inventory turnover
webshop	Correlation	,093	,030	,021	,005	,016	,250**	,037	-,091
	Sig. (2-tailed)	,206	,681	,774	,947	,825	,001	,619	,228
	N	187	187	187	173	187	187	185	178
easy find	Correlation	-,135	-,006	-,165*	-,050	-,009	-,022	,013	,060
	Sig. (2-tailed)	,065	,936	,024	,510	,905	,762	,863	,424
	N	187	187	187	173	187	187	185	178
interactivity	Correlation	,023	,144*	,044	,123	,154*	,071	,102	,125
	Sig. (2-tailed)	,751	,050	,546	,106	,035	,336	,166	,097
	N	187	187	187	173	187	187	185	178
customer value	Correlation	,043	,103	,107	,061	,016	,148*	-,024	-,073
	Sig. (2-tailed)	,560	,162	,145	,427	,829	,044	,748	,333
	N	187	187	187	173	187	187	185	178
reliable company info	Correlation	-,012	-,146*	-,023	-,076	-,144*	,050	-,177*	-,033
	Sig. (2-tailed)	,871	,047	,755	,320	,050	,500	,016	,665
	N	187	187	187	173	187	187	185	178

Surprisingly, however, most positive profitability relationships (ROIC, ROA) are shown by the interactivity factor. That is to say, ITC retailers that had been more open to interaction with their audience and had not been afraid to hear their opinion became more successful by 2009. It appears, therefore, that interactivity could be the factor by which retailers can distinguish themselves from their competitors, rather than the more widespread informational or transactional functions.

Interestingly, the "easy find" factor blending some special functions (map, add to favorites and privacy) is in a negative relationship with almost every performance indicator, i.e. these e-commerce functions are typical mainly of companies characterized by poorer performance. Since all three functions are more frequent in the group of traditional shop-based retailers, they are more strongly affected by the negative performance effect.

In summary, the correlation coefficients showed significant relationships between e-commerce capabilities and corporate performance. Knowledge of these e-commerce capabilities reduces the uncertainties concerning corporate performance by 2-6 per cent. This relationship is

therefore weak – but not insignificant –, which is not surprising considering the indirect nature of the relationship.

Regression Model

The fundamental economic correlation under study is expressed by the following equation:

$$VT = \alpha + \sum \beta_i * E_i + Control\ variables\ (Size, Industry\ segment, VT_{t-1}) + \varepsilon$$

where VT is the value of the corporate performance index representing the dependent variable; α is a constant (inclusion is justified by both statistical and professional considerations); E_i is one of the nine e-commerce factors and VT_{t-1} is the value of the performance variable for the previous year. After filtering out companies with missing data or outliers regression analysis will be based on 151 company data.

Table 4 summarizes the regression results and compares them to earlier empirical data. The e-commerce variables included reduce the uncertainty concerning corporate performance indicators by 2.9 to 11.6%. This explanatory power is consistent with what was experienced in similar studies: Zhu [2004] only found R^2 improvement exceeding 3% concerning the inventory turnover of American retailers, whereas in our case as many as three indicators' effects exceed that. Hence, it remains obvious that the effect of e-commerce on corporate performance is demonstrable but weak and therefore it explains performance differences to a small extent only. Nor can we expect a much stronger effect, since e-commerce decisions represent only a minor subset of the strategic portfolios of companies.

Interestingly enough, other similar studies found no e-capability with a significantly negative beta, while in our case the informational capability "special functions" had a significant negative effect on return on assets (ROA). In other words, if this e-commerce capability of a company is strong, that will be concurrent with a poorer profitability index. The same e-capability deteriorates the profit margin indicator even more, i.e. it has a dampening effect on profitability at operational as well as corporate level.

Since this capability is associated mainly with traditional retailers, the negative effect may conceal a business model relying heavily on in-store sales.

Table 4. Comparison of Regression Analysis results from Different Studies

significance: * p<0.01; ** 0.01<p<0.05; *** 0.05<p<0.1

1 Results of this study; e-commerce variables entered with stepwise method at an F value of 0.05<p<0.1; the values shown here are standardized betas 2 The size indicator here is the logarithm not of number of employees but of total assets; only one of the eight industrial variables is significant 3The table includes the results of the high-tech industrial sub-sample

		This study[1]				**Zhu, 2004[2]**			**Zhu - Kraemer, 2002[3]**	**Merono-Cerdan - Soto-Acosta, 2007**
		ROA	**Sales per employee**	**Inventory turnover**	**Profit margin**	**ROA**	**Sales per employee**	**Inventory turnover**	**Inventory turnover**	**EVA**
Sample		Hungarian ICT retailers (N = 151)				USA retailers (N = 114)			USA production industry (N = 260)	Spanish SME-s (N = 288)
Model										
R^2		0,141*	0,473*	0,625*	0,276*	0,361*	0,379*	0,312*	0,556*	0,570
p value		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,002	
Constant		0,031**	15,519*	5,886**	0,012**					
E-commerce variables – Betas										
I2	reliable company info				-0,107					0,065
I1	special functions	-0,200*			-0,300*					
IT1	customer value		0,118***			0,104	0,251**	0,129***		
IT2	terms of service 1								0.029	-0,036

IT3	products, services									
IT4	terms of service 2			0,021						
T1	Webshop		0,134**						0.097***	0,129*
N1	Interactivity								0.104	
N2	online commu-nication									0,076**
E-commerce incremental R^2		0,045	0,074	0,029	0,116	0,026	0,029	0,117		0,021
Control variables – Betas										
Size (number of employee)		0,062	-0,035	0,004	0,025	0,011***	0,044	-0,013***		0,692*
Industry segment		-0,031	-0,094	0,185*	0,035	-	-	-		0,029
Prior year's perform.		0,303*	0,610*	0,735*	0,388*	0,686**	0,013***	-		

In case of other operational indicators typical to retail industry we did find e-commerce capabilities with significant positive effect as well. Hungarian ICT retailers, that not only offer the option of online shopping, but also support the customer's decision-making with appropriate information and services (customer value creation factor: prices, shops, servicing, consumer credit) can actually produce higher per capita sales revenues. Zhu and Kreamer [2002] and Merno-Cerdan and Soto-Acosta [2007] also found the strongest positive effect on corporate performance in the case of transactional e-commerce capabilities. This also means, that the problem of "productivity paradox" is not existent on the Hungarian ICT retail market: e-commerce does indeed has a positive effect on human resource productivity, e-tailers do indeed sell more with the same number of employees.

In regard to operational performance indicators, both Zhu [2004] and Zhu and Kraemer [2002] found that the relationship between e-commerce capabilities and corporate performance was the strongest for inventory turnover. The situation is quite the opposite with the Hungarian e-tailers: Practically, in the case of inventory turnover the beta of neither e-commerce capability under study differs significantly from zero in the regression model. In other words, whereas in similar studies the positive relationship between inventory efficiency and (primarily transactional) e-commerce capabilities was obvious, this effect could not be demonstrated here with a similarly structured regression model. A reason for this can be that these successful e-tailers promise fast and flexible delivery, which may however require larger inventories.

In summary, by reproducing earlier regression analyzes, the empirical results were possible to reproduce in part only. The explanatory power of e-commerce variables is similar in the Hungarian sample to that in the American or Spanish studies, and better transactional e-commerce capabilities exert a significant positive effect also on the sales per employee revenue indicator. It is equally true of Hungarian ICT retailers that the explanatory power of e-commerce indicators is less significant for bottom-line profitability measures. But contrary to previous research, negative correlation was also found in some cases and the significant positive effect on inventory efficiency could not be observed at all on the Hungarian market.

Cluster Analysis

We relied on the method of cluster analysis in order to gain a deeper understanding of connections between company performance and e-commerce capabilities.

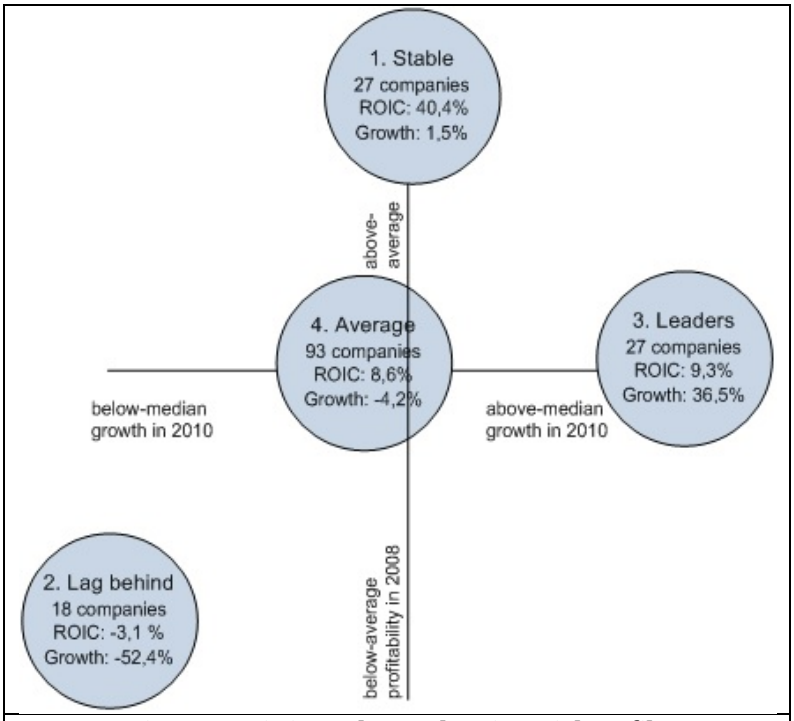

Figure 2. Distinct Clusters by Financial Profile

We took into consideration the fact that in the year of the research, 2009, the protracted effects of the economic crisis exerted a significant influence on domestic retailers' performance [e.g. Salamonné Huszty, 2011], and so we formed clusters by financial indicators accordingly. Thus, one of the criteria of forming the groups was profitability (ROIC) in 2008, an indicator showing the pre-crisis business profitability relatively clearly. In addition, we took market performance into account by using a sales revenue growth indicator for 2010 clearly showing which businesses were able to increase or at least retain their market share even in the years of the crisis. Based on these two financial indicators, four distinct clusters were assembled within the sample (see Figure 2).

One group of high-performing enterprises (see Table 5, cluster 3) with slightly above-average profitability in 2008 showed market stagnation and losses in 2009. But they gathered strength by 2010 and produced not only an extraordinary sales revenue increase, but also higher-than-average profits. Performance in another successful cluster (cluster 1) took a different course of development: The companies concerned had profitability rates well above the average in all three years under review, but the crisis weakened their market position. They recorded a 15% drop on average in terms of revenues and suffered significant market share losses in 2009, but they managed to retain their shrunk markets in 2010.

More than half of the retailers can be assigned to a mediocre cluster (cluster 4) in every respect. The rest of the companies – in cluster 2 were already loss-makers in 2008, they produced passable but weak indicator values in 2009, but finally lost half their revenues and generated a definite deficit in 2010.

Table 5. Key Differences Between Clusters Formed on the Basis of Financial Performance
(including only cluster features showing significant differences based on ANOVA (α<5%) and chi-square tests (α<10%); averages and, for individual e-functions, ratios; above-average values are highlighted)

		Cluster averages					
		1. Stable	2. Lag behind	3. Leaders	4. Average	Total average	Sig. Level
Cluster features	N	27	18	27	93		
	ROIC 2008	40,4%	-3,1%	9,3%	8,6%	6,3%	
	Sales growth 2010	1,5%	-52,4%	36,5%	-4,2%	7,6%	
Performance features	ROA 2008	31,8%	-1,0%	7,1%	7,0%	10,2%	0,000
	Profit margin 2008	9,2%	-0,2%	2,4%	2,7%	3,4%	0,000
	Sales per employee 2008	34,0	59,2	29,4	30,1	33,7	0,013
	ROIC 2009	44,9%	3,8%	-1,4%	15,5%	16,3%	0,006
	ROA 2009	16,6%	4,9%	4,1%	5,7%	7,1%	0,002
	Profit margin 2009	6,4%	-1,0%	2,1%	2,1%	2,5%	0,014
	ROA 2010	10,0%	-11,7%	11,6%	3,4%	4,2%	0,000
	Profit margin 2010	8,1%	-56,2%	3,9%	2,0%	-2,7%	0,006
	Usage 1	-,394	-,139	,226	-,013	-,050	0,105
E-commerce factors 2009	interactivity	,576	-,188	,058	-,117	,018	0,019
	customer value	-,187	-,438	-,212	,104	-,054	0,061
	terms of service 2	-,132	-,017	,321	-,032	,011	0,043
E-commerce functions	rating 2009	11%	0%	0%	1%	2%	0,015
	forum 2009	7%	0%	7%	0%	2%	0,038
	commercial credit 2009	0%	0%	0%	11%	6%	0,041
	prices 2010	19%	6%	22%	33%	26%	0,058
	online help 2010	4%	0%	15%	2%	4%	0,026

Having identified the ICT retailer clusters characterized by different financial profiles, we were able to examine the distinctive e-commerce capabilities of each group (see Table 6). Fact is that the clusters characterized by different financial profiles did not differ significantly – contrary to any expectation – in the areas of transactional capabilities or even company and product information functions. The e-commerce capability distinguishing the financially successful clusters (1 and 3) from their under-performing peers in 2009 is the factor of interactivity. That is, sales revenue growth in 2010 and high profitability performance are clearly associated with

businesses which use the Internet not only as a one-way communication channel, but also for interaction with possible clients.

It is also interesting, however, that the members of the same two successful clusters paid below-average attention to the factor of "customer value creation" (i.e. prices, shops, servicing and consumer credit functions). These functions were more in the focus of attention of the cluster of average performers, and their choice resulted is stagnation. Thus it seems that easier access to consumer credits in the crisis years no longer represented sufficient attraction for consumers, whereas previously it used to be quite effective on the ICT retail market.

It can also be seen that in each of the e-functions – apart from the customer value creation factor mentioned above – the cluster characterized by outstanding profitability (1) performs best and the loss-making and market-losing cluster (2) worst (i.e. nearly the total absence of e-capabilities). The two profitability extremes thus go with a clearly opposing e-commerce strategy. It is quite possible that the profit leader cluster (3) was saved from market losses in the crisis years exactly by their advanced e-commerce capabilities.

Conclusion

Our research focused on the relationship between e-commerce capabilities and corporate performance. The assumed relationships could be interpreted along two dimensions: by the type of e-commerce capability (informational, transactional, interactional) and by the type of corporate performance measured (market performance, profitability, operational efficiency).

The relationship between company-level profitability and e-commerce capabilities has been confirmed by several tests, although the results are mixed in respect of the direction of the relationship. Special functions (map, add to favorites) typical mainly of traditional retailers show a significant negative relationship with profitability indicators; whereas retailers with stronger interactional capabilities have a profitability advantage. In other words, in connection with this hypothesis (H1), the results are ambiguous, depending on the type of the e-capability.

We were not able to confirm the H2 hypothesis referring to a positive relationship between e-commerce capabilities and market performance with the traditional regression analysis. Yet, the cluster analysis suggested, that as a lag effect, only those ICT retailer clusters managed to increase their sales revenue in 2010 which significantly outperformed their rivals in rare interactional functions.

As we have seen week or no relationship between e-commerce capabilities and bottom-line company performance we should focus on the operational productivity effects. As far as the anticipated closer relationship

between operational efficiency indicators and e-commerce capabilities (H3) is concerned, the results are again ambiguous. On one hand, the inventory turnover of Hungarian ICT retailers is obviously not connected to their e-commerce capabilities – whereas in international research this was the strongest demonstrated positive relationship. On the other hand, looking at the sales revenue per capita indicator we get the reassuring result: The online transactional capability – and the product information functions supporting it – have a significant positive effect on Hungarian retail labor efficiency. In other words, the hypothesis could thus be confirmed only with a more narrow focus: to the relationship between the labor efficiency indicator and transactional e-capabilities. That is, for Hungarian ICT webshops, we have managed to disconfirm the classical productivity paradox by demonstrating that although webshops are abound on the Internet, their positive productivity effect is still demonstrable.

As for future research we still have to explore and explain some of our less intuitive and geographically unique results: like the negative effect of some e-capabilities or the lack of relationship between online sales and inventory efficiency. The ambiguous bottom-line effect of e-commerce on profitability could be the result of the trade-off between Hungarian e-tailers' more efficient human resource use and less efficient inventory politics.

If I was to formulate a few pieces of practical advice for ICT retailers considering online developments these would be the following: Traditional shop retailers are also recommended to build up some kind of online presence filled with high-quality information, also offering the opportunity to interact with potential buyers. One step forward, online transactional capabilities may enable their companies to increase market share or improve labor efficiency, but if they try to attract buyers by offering fast availability, some of the extra profit might be eroded by the need for a higher inventory level. We are aware that the contents and tools of various e-capabilities are changing rapidly – but not necessarily the basic conclusions. But to prove the last one too, we should examine the effects of e-commerce capabilities in a longitudinal context.

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Appendix 1: Principal Component Analysis of E-commerce Capabilities

Table 3. Principal Component Analysis of E-commerce Capabilities - Component Matrix
(2009, 23 e-capabilities, eigenvalues >1, Varimax rotation, displaying only values > 0,4)

	Principal Components								
Nr.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Capability type	Trans-action	Infor-mation	Inter-action 1	Product info 1	Company info	Trans-action info 1	Product info 2	Inter-action 2	Trans-action info 2
Name	web-shop	easy find	inter-activity	customer value	reliable company info	terms of service 1	products, services	online commu ni-cation	terms of service 2
webshop	,615								
registration	,780								
newsletter	,651								
map		,602							
add to favorites		,849							
privacy		,801							
rating			,814						
forum			,787						
prices				,402					
stores				,584					
service				,580					
commercial credit				,615					
contacts					,669				
legal note					,452				
company information					,718				
customer service						,822			
delivery options						,655			
products and services							,732		
home delivery							,440		
instant messaging								,514	
chat								,787	
terms of contract									,595
FAQ									,723