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Contrasting ERP infusion and absorption capacities between transition and developed economies from the CEE region

Article (Draft)

Contrasting ERP infusion and absorption capacities between transition and developed economies from the CEE region

(Short title: ERP capacities in transition economies)

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Abstract

This paper investigates IT value creation in transition and developed economies in Central and Eastern Europe. Using absorptive capacity theory and data envelopment analysis, we view business process transformation in ERP adoption as an economic production process. Data analysis suggests that the "sum of history" shapes adoption performance of firms, meaning that transition economies may suffer from less developed absorptive capacities in regard to IT and therefore face a greater challenge in ERP utilisation.

Keywords

Transition Economies; IT adoption and diffusion; Cross-country survey; Absorptive Capacity; Data Envelopment Analysis

1. Introduction

Transition economies as a special subgroup of emerging economies include countries in transition from a communistic central planning system to a free market system, and represent about one-third of the total world population (Roztocki & Weistroffer, 2008). The economic liberalisation since the early 90ies exposed transition economies to increased competition and globalisation (Gertha & Rothman, 2007; Harindranath, 2008) while facing specific local conditions resulting from both environmental/market and internal/organisational factors (Huang & Palvia, 2001). Information and Communication Technology (ICT) is regarded by many as an opportunity and catalyst for change in transition economies (Murugesan, 2010), but there is scarcity of literature on ICT issues in these post-communist, transition economies (Piatkowski, 2006). More specifically, it seems important to understand if and why the specific situation in transition economies impacts on a firm's progress and success in IT adoption in their attempt to increase productivity, engage in collaborations, and shift to high-value adding activities. This paper focuses on understanding differences in Enterprise Resource Planning (ERP) value creation on the firm level. We seek to compare transition economies, exemplified by Slovakia and Slovenia, and one developed economy represented by Austria, and therefore attempt a three country study into ERP infusion, absorption efficiency, and adoption strategy. Austria is well developed member of the EU since 1995. Slovakia and Slovenia constitute newly formed states and were among the ten countries from the first-wave accession countries joining the EU in May 2004. Slovakia separated from the former Eastern bloc country Czechoslovakia in 1993, and Slovenia emerged from the break up of communistic Yugoslavia in 1992.

Theoretically we draw on ideas from Absorptive Capacity (ACAP) theory and upon validated relationships in IT success models (DeLone & McLean, 2003), and use Data Envelopment Analysis (DEA) as a tool to classify efficient and non-efficient firms among the gathered primary data sets. In this paper we refer to ACAP as the dynamic capability to adapt, integrate and use ERP in business processes to match the requirements of a changing environment (Teece, Pisano, & Shuen, 1997; Wang & Ahmed, 2007). It has been shown that the ability to effectively apply such IT capabilities directly affects a firm's competitive positioning (Doherty & Terry, 2009) and recent research highlights the importance of capability building for firm performance in transition economies in the context of high technology ventures (Lau & Bruton, 2010). We expect, however, that this "organisational update capacity" is less developed in transition economies. This is the first study to contrast

ERP infusion and absorption between those countries based on a primary survey method, and to our knowledge the first study to refer to DEA efficiency in the internalisation of ERP and conversion in business processes, which is based on the transformation and exploitation dimensions of ACAP in its 2002 re-conceptualisation (Zahra, George, 2002).

Specifically, this paper seeks to answer the following research questions in a cross-country comparison considering transition economies in the EU:

(1) What are the current ERP infusion rates across the considered three economies?

(2) Are there differences in the effectiveness (2a) and efficiency (2b) of ERP absorption?

(3) How do transformation approaches and the reliance on vendors differ?

All three countries considerd, Slovakia, Slovenia and Austria, can be placed into the Central and Eastern Europe (CEE) region but can be classified into two different groups. While Austria is seen as developed economy, the former Eastern Bloc countries are seen as emerging and transition economies with different standards of living. Regarding question (1) we will highlight current ERP software infusion rates across those countries and explore differences based on a system lifecycle view. This view allows a more in-depth comparison on ERP stages than regularly found in simpler diffusion studies. Relating to question (2) we are interested in the capacity of firms to absorb ERP and consequently transform the enterprise in a cross-country comparison. We use Data Envelopment Analysis (DEA) as a non-parametric performance and efficiency analysis tool to classify efficient and non-efficient cases. In regard to question (3) we seek to highlight different implementation strategies and the role of vendor/application characteristics to show whether ERP absorption is special in transition economies in those aspects. In general we were guided by the hypothesis that enterprises in transition economies suffer from less developed absorptive capacities and dynamic capabilities and therefore face a greater challenge in system utilisation.

The article is structured as follows. The next section presents more theoretical background and further motivates our research and measurement approach. Subsequently, we present our empirical research methodology. This is followed by results from data analyses. The final section summarises the article, and discusses the main findings and contributions.

2. Theoretical background

2.1. Absorptive Capacity

The concept of absorptive capacity (ACAP) was originally termed as "Ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990) and later described as "a set of organizational routines and processes by which firms acquire, assimilate, transforms and exploit knowledge ..." (Zahra & George, 2002). The absorptive capacity of a firm therefore reflects its learning and development capability and is essentially a dynamic capability geared towards organisational change with intellectual roots going back to Schumpeter. Dynamic capabilities also known as "capacity to renew" are crucial for firms which need to innovate or introduce new technologies, therefore adapt and change existing routines. These capacities are strategic in nature and impact on the layout path of evolution and development. "History matters" in this context (Teece, et al., 1997), meaning that there is a path dependency where a firm's previous decisions and investments and its current developed portfolio of dynamic capabilities constrain its future behaviour. Central is this cumulativeness of the concept and the according notion that innovation capacity is a function of prior knowledge in the firm. This implies that firms, which have not invested in absorptive capacity in a quickly moving environment, may never be able to assimilate and exploit new information regardless of its value. Applied to the IT field, which is known to be dynamic and fast moving, companies with underdeveloped IT related absorptive capacities should not be able to perform in the same way as peers who regularly update their IT applications and infrastructures. In the light of transition economies, it stands to question whether or by what degree market protection and centralised command economy models led to underdeveloped absorptive capacities and dynamic IT capabilities. We know that the process of market transition has affected every economic sector in these countries, including ICT (Dyker, 1997), but it remains unclear how the concept of path dependency has affected their capability to renew, and in the context of this study, to successfully absorb IT solutions and transform the dependent business processes and routines. Research indicated that absorptive capacities are ineffective at generating change in the context of "give-away" privatisations in transition economies (Filatotchev, Wright, Uhlenbruck, Tihanyi, & Hoskisson, 2003). In a broader context it was reported that management in state owned firms were frequently not concerned about efficiency, maybe due to subsidies (Bertocchi & Spagat, 1997) or soft budget constraints (Kornai, 1986), which seem to have a broadly negative effect on firm performance (Carlin, Fries, Schaffer, &

Seabright, 2001; Moore, 2009). Historically, innovations were less common in firms from central planning systems with e.g. significantly less development of new products (Carlin, et al., 2001). We therefore hypothesise that a developed economy should exhibit more developed absorptive capacities on the firm level and explain this theoretic prediction with the concept of path dependency in absorptive capacity and dynamic capability literature.

2.2. Measurement related thinking

A significant number of prior studies on ACAP use R&D intensity, defined as R&D expenditure divided by sales, as proxy of absorptive capacity (Tsai, 2001). The concept is, however, more complex (Jaider, Antonio, & Ignacio, 2008), and therefore very difficult to operationalise (Lane, Koka, & Pathak, 2002). There still is limited consensus among researchers on how to measure ACAP. The re-conceptualisation from (Zahra & George, 2002) clearly defines absorptive capability as a multidimensional construct and extends the original suggestions by adding a realised ACAP dimension. This clear procedural component includes four factors of the absorptive capability construct: knowledge acquisition; assimilation; transformation; and exploitation. However, to our knowledge there are no empirical studies which have developed and validated a multidimensional construct of absorptive capability in particular in the context of IT (Ramamurthy, Sen, & Sinha, 2008; Wang & Ahmed, 2007). In this paper we focus on the transformation and exploitation dimensions of ACAP, which describes a firm's capacity to develop and refine the processes that use the innovation (Zahra & George, 2002). In the context of IT, transformation involves combining and re-interpreting existing and new knowledge and its application in business processes. Existing competences are therefore refined, extended, and leveraged to form new ones by incorporating acquired and transformed knowledge into business routines. In the context of ERP, this may result in new competencies to interface with external sale or procurement systems or to apply contemporary financial or management accounting procedures.

2.3. Data Envelopment Analysis

Data envelopment analysis (DEA) was traditionally applied to assess the relative efficiency among different organizational decision making units (DMUs) such as governmental organizations (Bowlin, 1986), bank branches (Boufounou, 1995), European SMEs (Lytrasa, Castillo-Merinob, & Serradell-Lopez, 2010) or universities (Reichmann & Sommersguter-Reichmann, 2006). The method has successfully spread into many different domains with

various extensions and adaptations to the original model (Cook & Seiford, 2009). The original DEA model by Charnes, Cooper and Rhodes (Charnes, Cooper, & Rhodes, 1978) referred to as CCR-model, optimizes the fractional output per input (efficiency measure) defined by multiple inputs and outputs subject to input and output weights. These are optimally selected for each alternative. The resulting efficiency measure defined by multiple inputs x_i and outputs y_i is used to assess n different DMUs without the need to know their production function. Each DMU is defined with m input attribute values represented through the $m \times n$ matrix X and s output attributes values stored in the $s \times n$ matrix Y. This non-parametric approach optimizes one LP per DMU yielding optimal weights with respect to the chosen inputs and outputs for every DMU. The vectors v and u are the weight vectors for input- and output-attributes, respectively and are the decision variables of the LP. Consequently, the optimized relative efficiency rating calculated by DEA is defined as the ratio of the weighted sum of its outputs to the weighted sum of its inputs. Through solving the LP, each DMU is free to choose its optimal weights in order to make itself "look best". Constraints ensure that the efficiency (weighted output per weighted input) cannot exceed 1. This is enforced for the one DMU under consideration as well as for all other DMUs using the same weight vectors. All DMUs which are able to achieve 100% efficiency form a Pareto frontier, which form an envelope of all alternatives. Each alternative is either part of the envelope or has a DEA efficiency rating below 100%. The latter one is called an inefficient DMU and means that there exists no combination of weights under which not at least one competing DMU is already 100% efficient. For a complete introduction into DEA we refer to (Cooper, Seiford, & Tone, 2000) or (Thanassoulis, 2001). A taxonomy of DEA approaches is ready available (Gattoufi, Oral, & Reisman, 2004), and also an update on how DEA developed in the last three decades (Cook & Seiford, 2009).

2.4. Research and measurement approach

In this article we think of ERP adoption as an economic production process following the route provided by ACAP theory, where multiple inputs with regard to efforts into system implementation are converted or transformed into outputs related to improved or new business process capacities. This causal view is also support by the popular Delone and McLean IS success model (DeLone & McLean, 2003; DeLone & McLean, 1992). This taxonomical success and procedural model suggests that enterprises need to achieve technical quality (system, service and information dimensions), which is seen to indirectly drive net benefits on the individual and organisational level via use/intention to use as middle

dimension. Numerous empirical studies of IT adoption have validated this causal process model (Iivari, 2005; Leal & Roldan, 2003; Petter, Delone, & McLean, 2008; Seddon & Kiew, 1996). Contempory IS research seems to be consistently stating that value from IT is reaped from a transformation of business processes (Sila, 2010). The process view in the DeLone and McLean IS success model suggests a relationship between technical inputs and organisational outputs, which we used as the foundation of the applied non-parametric DEA based production model in this article. While one reason for the success of DEA is its use in cases where the nature of this relationship between inputs and outputs is unknown, one issue that remains is the scale relationship between the inputs and outputs. Different scale assumptions are generally employed to DEA: Constant returns to scale (CRS); Non-increasing returns to scale (NIRS); or variable returns to scale (VRS) including both increasing and decreasing returns to scale. While the original CCR model works with CRS, a second basic DEA model, named BCC (Rajiv D. Banker, Cooper, Seiford, Thrall, & Zhu, 2004) is based on VRS. If an increase in a DMU input does not produce a proportional change in its outputs, then the DMU exhibits VRS. Literature has suggested the existence of both economies and diseconomies of scale in software development (Rajiv D Banker, Chang, & Kemerer, 1994) and of scale economies in software maintenance (Rajiv D. Banker & Slaughter, 1997). ERP adoption has similarities to software development in the sense that a usual implementation includes extensive programming and customisation efforts (Chou & Chang, 2008; Haines, 2009). We therefore selected an input oriented VRS model (BCC-I), which reflects that ERP adoption may exhibit increasing, constant and decreasing returns to scale (Rajiv D. Banker, et al., 2004). We also calculated the super-efficiency variant (Anderson & Peterson, 1993), which allowed us to further discriminate between efficient projects. The specification of the DEA model(s) are summarised in Table 1. We used a radial measure which indicates the necessary improvements when all relevant factors, either inputs or outputs are improved by the same factor equiproportionally. The input orientation aims to minimise inputs while satisfying at least the given levels of output.

Table 1. Specification of standard and super-efficiency DEA models

Decision Making Units (DMUs)	ERP projects
Inputs x_i	Technical/system related quality
Outputs y_i	Business Process capacities
DEA orientation	Input oriented
DEA measure	Radial
Scale assumption	Variable return to scales

3. Research Methodology

3.1. Empirical surveys

This paper draws on three different primary empirical surveys targeting small to medium sized enterprises (SMEs) and large enterprises (LEs) in Slovakia, Slovenia and Austria. The recent economic situation is shown in Table 2. World Bank's main criterion for classifying economies is their gross national income (GNI) per capita with the high income threshold set to US $ 12,196 (World-Bank, 2010). While both transition economies exhibit relatively lower GNI per capita compared to Austria, all three countries can be classified into the high income level on global terms. Viewed within the European Union however, the lower GNI per capita typically indicate, e.g., a relative shortage of skilled and highly paid labour and infrastructure deficiencies in transition economies (Roztocki & Weistroffer, 2008).

Table 2. Economic comparison of countries (2008)

Figures	Austria	Slovakia	Slovenia
Population, total (million)	8.3	5.4	2.0
Life expectancy at birth	80	75	79
GNI per capita (Atlas method)	$ 45,900	$ 16,590	$ 24,230
GDP (billion)	$ 413.5	$ 98.4	$ 54.6
Classification of income level	High income	High income	High income

Following a commission recommendation of the European Communities concerning the definition of micro, small and medium-sized enterprises, this research classified as SME an enterprise which employs fewer than 250 persons. Additionally, we used turnover for the Austrian survey to classify enterprise as LEs with a turnover exceeding € 50 million. To avoid under representing the LEs in the samples, all studies used a stratified and disproportional sample with subgroups according to company size. The Austrian companies

were randomly selected from firms listed in a comprehensive, pan-European database (Bureau-van-Dijk, 2009). The Slovak and Slovenian enterprises were randomly selected from the lists of firms provided by respective Statistical Bureaus. Table 3 presents the independent empirical surveys with their key characteristics.

Table 3. Sample characteristics

	Austria		Slovakia		Slovenia	
Stage	N (un-weighted)	% (weighted)	N (un-weighted)	% (weighted)	N (un-weighted)	% (weighted)
Industry sector						
Trade (42,44-45)	58	22.6	5	7.9	25	22.1
Manufacturing (31-33)	60	21.0	11	8.3	58	21.2
Construction (23)	20	20.5	11	22.8	7	10.3
Services (54)	30	15.7	22	31.7	12	16.4
Information (51)	8	4.5	3	4.3	7	15.2
Other	32	15.6	33	24.9	21	14.8
Organisational size						
Small to medium enterprises	130	92.8	61	97.6	63	96.1
Large enterprises	79	7.2	51	2.4	68	3.9
Total	209	100	112	100	131	100

The questionnaire was guided by descriptive and analytical research goals, in particular, concentrating on ERP system selection, absorption and use. The instrument was derived from previous empirical research on ERP. Following an empirical design method, a research panel was asked to critique the questionnaire for content validity (Dillman, 1978). According to their suggestions, the questionnaire was revised and used in Pre-Tests applied in Austria. Responses were examined to optimise the formulation of each question and ensure consistency in the way they were answered. To avoid biased estimates, this work uses a SPSS module called Complex Samples where adjusted tests including chi-square (χ^2) are provided. However, since the range of procedures is limited, analysis was also conducted with the use of sampling weights (Purdon & Pickering, 2001). Non-response bias analysis revealed no significantly different characteristics between non-respondents and respondents for the Austrian survey in terms of legal form (e.g., limited or public companies), number of employees and number of subsidiaries as measured by chi-square (χ^2) and two-sample unpaired t tests. We cannot give insights into potential non-response bias for Slovenia and Slovakia as we lacked the necessary data concerning non-respondents for both countries.

3.2. Measurement scales

Respondents were asked to assess the given questions on different scales, either on dichotomous scales (yes=1, no=0), on metric scales (e.g., for the number of employees), or on interval scales (either percentages from 0 to 100%, or 5-point interval scales). To avoid misconceptions, the orientation of the 5-point interval scales was applied uniformly: Low scores were attributed to negative settings, while high scores account for favourable situations. However, no uniform scale description was applicable to all variables. Business process and system related benefits were assessed according to the level of perceived expectations on a scale ranging from fell short (1) to exceeded (5).

3.3. Common method bias

A common concern in organisational research using a single method to assess all constructs especially in self-report surveys is common method bias or common method variance (CMV) (Malhotra, Kim, & Patil, 2006). This concern refers to the amount of covariance shared among indicators due to mono-method research designs. To address this issue, we applied Harman's single-factor test, which is one of the most often used approaches to test for CMV (e.g. Jarvenpaa & Majchrzak, 2008). This diagnostic technique requires loading all the indicators in a study into an exploratory factor analysis, with the assumption that the presence of CMV is shown by the emergence of either a single factor or a general factor accounting for the majority of covariance among measures (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). We conducted the Harman's one-factor test by entering all the principal constructs into a principal components factor analysis (Podsakoff & Organ, 1986). Eleven factors resulted. The first accounted for 36% of the variance. The other ten (with eigenvalues greater than one) contributed to the remaining 55% of the 92% variance explained by the set, each accounting for 2%–13%. This suggests that while there is likely to be some CMV, the effect is small.

4. Data analysis

4.1. ERP infusion

ERP infusion along the system's lifecycle stages across all three economies is denoted in Table 4. Only potential ERP adopters were analysed to see how ERP is currently infused in enterprises. We therefore target our first research question to what extent ERP is actually used, and therefore how far the concept has moved along the system's lifecycle. While the

majority of firms interested in ERP are already using or extending the system in the developed economy (Austria), a minority proportion in both transition economies (Slovenia and Slovakia) have achieved to move up to these stages in the system's lifecycle. In comparison with Slovakia, Slovenian firms seem to be more advanced when it comes to ERP usage. These differences in the distribution of ERP stages are statistically significant based on the Kruskal Wallis Test ($\chi 2 = 107.62$, $p < .01$). We therefore see strong evidence for an ERP infusion gap between developed and transition economies in the European Union. To reflect the actual data support we included the absolute numbers in unweighted terms, which, however, cannot be used to directly calculate the given proportions due to the disproportional design of the sample and the use of sampling weights.

Table 4. ERP diffusion among SMEs and LEs

	Austria			Slovakia			Slovenia		
Stage	%	cum. %	Unw. N	%	cum. %	Unw. N	%	cum. %	Unw. N
Consideration	25.1	25.1	10	34.2	34.2	26	27.6	27.6	21
Evaluation	1.8	26.9	3	8.3	42.5	9	5.0	32.6	10
Implementation	4.4	31.3	9	17.4	59.9	15	7.6	40.2	10
Stabilisation	7.0	38.3	4	7.8	67.7	8	40.8	81.0	43
Usage & maintenance	50.8	89.1	59	23.3	91.0	41	12.2	93.2	34
Extension/replacement	11.0	100	23	9.0	100	4	6.7	100	10
Total	100		108	100		103	1		128

4.2. ERP adoption effectiveness

Table 5 shows business process and organisational benefits (y_j), which in our theoretical view result from utilising system related achievements (x_i). Each criterion was measured on self-reported 5-level satisfaction interval scales measured against expectations. Higher numbers represent higher satisfaction levels. The table shows that Austrian firms achieved more favourable results in almost every aspect compared to their Slovakia and Slovenian counterparts. Austria "wins" in 14 out of 17 categories when it comes to realised benefits measured against expectations. Comparing Slovenia and Slovakia only, ERP adoption seems to be more effective in the former country with 11 out of 17 wins for Slovenia. Based on this selection rule, a clear ranking emerges it terms of mean ERP adoption effectiveness based on those 17 dimensions (AUT > SLO > SVK). Table 5 also shows the statistically significant

differences between distributions from different economies, which refer to four system related and four business process related dimensions (Kruskal-Wallis Test). In overall, data suggests less effective ERP adoption projects in transition economies.

Table 5. ERP system quality and transformed business routines per country

Item	Description	Austria		Slovakia		Slovenia	
		Mean	SE	Mean	SE	Mean	SE
x_1	**System functionality	3.88	0.99	3.00	1.17	3.66	0.69
x_2	**System flexibility	3.87	1.04	3.18	1.01	3.57	0.83
x_3	**Systems reliability	4.16	0.70	3.20	0.97	3.77	0.74
x_4	*Operating system independency	3.24	1.39	2.84	0.71	3.40	0.87
x_5	**System interoperability	3.68	0.87	2.95	0.71	3.47	0.78
x_6	Internationality of Software	3.37	1.45	3.34	1.04	3.22	0.96
x_7	System usability	3.68	1.05	3.48	0.91	3.47	0.71
y_1	Reduced cycle times	3.48	1.11	3.22	0.52	3.36	0.71
y_2	Enhanced decision making	3.62	0.95	3.47	0.74	3.35	0.80
y_3	Improved service quality	3.75	0.90	3.52	0.64	3.52	0.65
y_4	Incorporation of business best practices	3.60	1.15	3.38	0.77	3.41	0.70
y_5	**Business process improvement	3.77	0.90	3.37	0.83	3.68	0.83
y_6	Integrated and better quality of information	3.74	1.19	3.68	0.73	3.91	0.76
y_7	**Increased flexibility	3.63	0.88	3.15	0.67	3.39	0.79
y_8	T Increased customer satisfaction	3.39	0.79	3.02	0.99	3.46	0.84
y_9	Improved innovation capabilities	3.20	1.07	3.16	0.84	3.07	0.76
y_{10}	*Enabler for desired business processes	3.84	0.92	3.43	0.88	3.31	0.82

T $p < .1$; * $p < .05$; ** $p < .01$ (Kruskal-Wallis Test)
$x_i \in \{1;2;3;4;5\}, y_j \in \{1;2;3;4;5\}$

4.3. ERP adoption efficiency

In our next step of analyses we turn to DEA to estimate DEA efficiency for the transformation of system related benefits into business process capacities. As an input vector we therefore used the achievements on system level (X) and as an output vector we reverted to the organisational benefits on process level (Y). We prepared the data by imputing missing values with mean responses per country resulting in 74 single value imputations for the Austrian case, 52 for Slovenia, and 58 for Slovakia. Finally, we were able to work with 248 data sets and 4,216 single achievement estimates across all economies and dimensions. To study their relative ERP absorption performance, all enterprises from all three countries had to compete against each other in the optimisation runs. We first present in Figure 1 the

efficiency scores calculated from the 248 cases with information regarding inputs and outputs for the DEA calculation. The efficiency scores were ordered in descending order of magnitude. As we can see about one third of the ERP adoptions were DEA efficient in enterprises from all three economies. The super-efficiency model provides further discrimination between efficient enterprises.

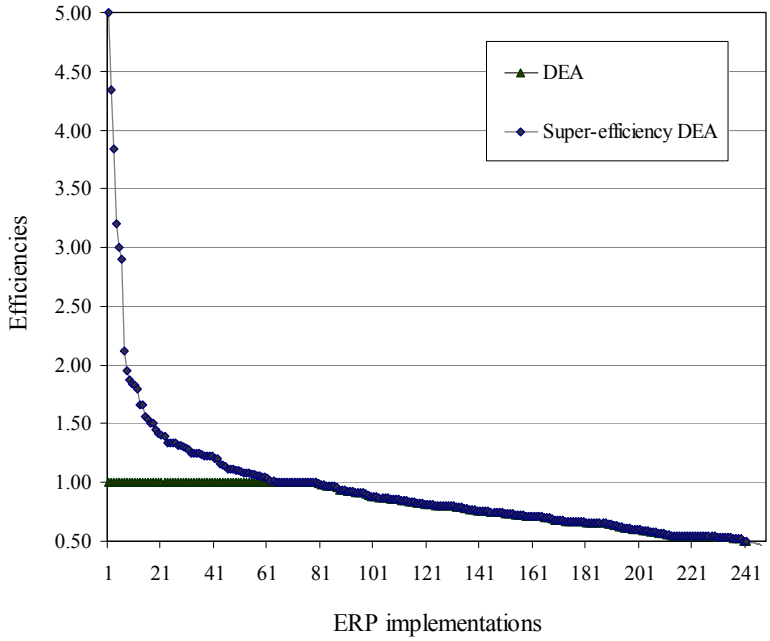

Figure 1. DEA efficiency frequency distributions

Next, we broke down the group of all firms into individual economies and compared the mean efficiency scores and ranks and, again, applied the Kruskal Wallis Test to investigate differences between the independent samples. Figure 2 shows the clear differences with regard to the classification into efficient and in-efficient firms which is the same for both DEA models, which clearly suggests that based on our ERP absorption model the two transition economies trail behind the developed case. In our statistical analyses we first tested both transition economies taken together against the Austrian case. Results show that transition economies exhibit statistically significant lower DEA efficiency scores in both DEA models (Mann-Whitney U Test, $p < .01$) and the proportion of enterprises with efficient ERP projects is also significantly lower (Mann-Whitney U Test, $p < .05$). When separating the two transition economies, the significant findings remain (Kruskal-Wallis Test, $p < .05$). In paired country comparisons (AUT vs SLO, AUT vs SVK), the developed economy

consistently exhibits significantly higher DEA efficiency scores (Mann-Whitney U Test, $p < .05$). With regard to our second research question, we therefore find that firms in Austria seem to be more efficient in their ERP absorption processes relative to their counterparts in both transition economies Slovenian and Slovakia.

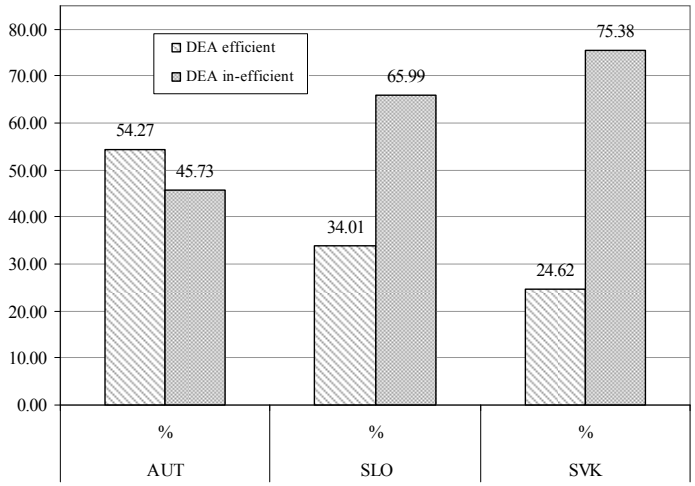

Figure 2. DEA efficient and non-efficient firms

4.4. ERP absorption approach

Data revealed significant differences in ERP absorption approaches between economies (see Table 6). The dominating strategy in Austria and Slovenia is a big bang with a simultaneous implementation of all ERP modules, which can be considered as the most demanding approach when it comes to involved project management complexity. In Slovak firms there seems to be a dominance of more cautious approaches based on a stepwise implementation of all considered modules. This approach facilitates organisational learning and allows for more precautions and preparations in a careful rollout of the system into the whole organisation.

Table 6. ERP implementation strategies across economies

	Austria (%)	Slovenia (%)	Slovakia (%)	Pearson Chi-Square		
				Value	df	p
Slow phased-in implementation approach supported – one module at a time	28.2	20.4	49.5	11.0	2	.00
Pilot project implementing one module, all other modules following in a single step	16.6	28.7	11.4	5.3	2	.07
A Big Bang implementation of all ERP software modules at once	55.2	50.9	39.0	2.75	2	.25

Next we turn to the role of vendors and specific industry solutions for system adoption. Table 7 shows that while the importance ratings attached to vendor and industry focused solutions are about the same across the economies (maybe with an exception in regard to the market position of the vendor), the satisfaction ratings are significantly different between economies (Kruskal Wallis Test, $p < .01$). Most notably Slovak firms fall short in terms of their expectations and Slovenian enterprises again take a middle position. These findings point to very specific environmental conditions in transition economies when it comes to the relatively less developed support gained from vendors and tailored ERP solutions in their adoption projects limiting firms in their attempts to maximise returns of IT investments.

Table 7 Vendors and specific industry solutions for system adoption

	Mean			Kruskal Wallis Test		
Criterion	AUT	SLO	SVK	$\chi 2$	df	p
Importance						
Vendor support	4.31	4.30	4.14	.84	2	.657
Market position of vendor	3.32	3.49	3.10	5.77	2	.056
Vendor reputation	3.22	3.43	3.35	1.268	2	.530
Industry focused solutions	3.44	3.75	3.93	1.801	2	.406
Satisfaction						
Received vendor support	3.93	3.53	2.99	14.003	2	.001
Industry focused solution	3.91	3.50	3.23	9.486	2	.009

5. Summary and discussion

In our analyses we have relied on the popular view that IT value is achieved through exploitation of IT in business processes (Sila, 2010). The ability to update the organisation is a dynamic capability and should be dependent on the history of IT changes in firms (Teece, et

al., 1997; Wang & Ahmed, 2007). Our according assumption that firms in developed economies which had to more frequently adapt, integrate and use IT in business processes exhibit more effective and efficient ERP transformations than their peers in transition economies was largely supported by our analyses. We will now specifically summarise and discuss the findings for each considered research question in turn.

Question (1) was concerned with the current ERP infusion rates across the considered three economies. The data showed that there is a clear infusion gap meaning that the majority of firms from Austria are concerned with using and maintaining their ERP solutions, while the majority in Slovenia is focusing on stabilising their recent implementation and the majority in Slovakia are considering possible ERP strategies. Slovenia seems to be more advanced in terms of ERP in comparison with Slovakia.

Question (2a) considered differences in single-item achievements for system and business process related criteria and question (2b) referred to absorption efficiency. Both views support our assumption that ERP adoption faces greater challenges and difficulties in transition economies. More specifically while Austria seems to outperform both Slovakia and Slovenia, the latter seems to have relative advantages over the former. In a paired comparison, Slovenia is viewed by many as one of most developed countries within the CEE region, which may explain this relative advantage over Slovakia. Our DEA models were used to investigate the efficiency of business process transformation as an economic production process with achieved system qualities as inputs with results corroborating the findings from multi-dimensional effectiveness analyses. The Austrian firms exhibit significantly more efficient transformation in comparison with both transition economies. Again, Slovenian enterprises seem to be more efficient than their Slovak counterparts. We therefore find broad support for our assumption that IT related capacities to renew and transform business routines is relatively less developed in transition economies when compared to a developed case. Viewed from absorptive capacity theory (Cohen & Levinthal, 1990; Zahra & George, 2002) we explain this with their unique “sum of history” in learning and innovation, which includes among other limiting factors frequently experienced soft budget constraints (Kornai, 1986), less needs to innovate (Carlin, et al., 2001), or regular subsidies (Bertocchi & Spagat, 1997).

Finally question (3) provided characteristics of transformation approaches to yield some insights into the background of ERP adoption in transition economies. The results indicate that the internal and external environment in transition economies has impacted on their preferred implementation approaches and the importance of support provided by vendors and tailored industry solutions. More cautious approaches to adoption are used in

Slovenia and Slovakia, where companies seem to suffer from less support from vendors and tailored industry solutions. This finding is of some concern as research reported that firms in transition economies seek to maximise returns from investments by relying on external best practices (here exemplified with industry focuses solutions) and experience a lack of IT-related skills in their internal workforce (Indjikian & Siegel, 2005; Soja, 2008).

Considering our findings, Friedman's controversial notion of a flat world (Friedman, 2005) does not seem to apply to absorptive IT capacities in transition economies. It is true that firms in transition economies certainly are exposed to globalisation (Harindranath, 2008) but our analysis points to differently developed dynamic IT capabilities grown from very specific internal and external environments (Huang & Palvia, 2001). In our view the world as it presents itself to firms from different economies even viewed within the domain of transition economies is certainly not flat at present. While firms may need similar standardised IT services in certain areas (Gertha & Rothman, 2007), the dynamic IT capabilities needed to adopt and maintain those services seem to be very different across economies. This general impression is supported by our data analyses with regard to all three considered research questions.

6. Contributions

This paper makes a contribution to understanding IT absorption in transition economies in several aspects. First, this paper is the first to empirically highlight differences in ERP absorption between transition and developed economies within Central and Eastern Europe (CEE). Additionally, to our knowledge there is no comparable quantitative ERP adoption paper in other cross-country compositions with transition and developed cases. Second, we provided a new methodological approach to consider ERP adoption efficiency by applying a non-parametric DEA approach. While the method is well regarded in Operations Research, it was very scarcely applied to IT projects as decision making units. Third, this is also the first study to introduce the process of innovation absorption in absorptive capacity into an economic production function to investigate the efficiency of business transformation. While we also appreciate other possible model designs, our specification provided clear evidence for significant differences between economies. Further insights from non-parametric statistical tests corroborate our findings with effectiveness views and adoption approach analyses.

Our study suggests that firms in transition economies indeed face greater challenges in ERP system utilisation, suggesting that, on the whole, ERP projects are less efficient and

effective, and require more cautious adoption projects. These findings are expected to be very interesting to research focusing on absorptive capacity and dynamic IT capabilities. IT management maybe interested to see the importance of knowledge transfer and learning in the context of IT adoption in transition economies. While external gatekeepers such as consultants and vendors or service providers are invited to further engage transition economies as growth markets based on the identified lagging ERP infusion rates, more support in particular in regard to customized industry solutions seem to be needed by respective firms. As dynamic IT capabilities seem to be very different across economies, specific support and not, e.g. standardised global ERP roll outs, seem to be needed to foster efficient and effective IT changes in firms from transition economies.

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Appendix

Table A1. Research instrument

Section	Question	Scale	Scale Format / Items	Code
General back-ground	Function of Interviewee?	Nominal	Text	Q01
	What has been the economic development of your organization over the years 2004-2006?	Ordinal	Reduction in turnover Stable Growth of 0-5% Growth of 5-10% Higher growth	Q02
	Industry?	Nominal	Text	Q03
	Number of white collar employees?	Ordinal	0 <50 50-99 100-199 200-499 500+	Q04
IT strategy	Is your IS/IT division represented at board level?	Binary	Yes / No	Q05
	Do you have a formal IS/IT strategy?	Binary	Yes / No	Q06
	How well is your corporate strategy and corporate structure aligned with the IT-strategy and IT – infrastructure?	Interval	(1-5) (very bad to very good)	Q07
ERP lifecycle	What is the current stage of Enterprise Resource Planning (ERP) system in your organisation?	Ordinal	ERP system is being considered. ERP system is being evaluated for the selection of a specific solution. ERP system is being configured and implemented. An ERP system was recently implemented and is now being stabilised. An ERP system is being used and maintained. We have substituted our ERP system.	Q08
	The system was implemented in (*dependent on Q08)*:	Interval	Year	Q08b
	The new ERP system is *(dependent on Q08)*:	Nominal	Text	Q08c
Selection process	Considered ERP software vendors in decision making?	Nominal	SSA/Baan. Oracle/Peoplesoft/J.D. Edwards/Siebel SAP Microsoft Dynamics products AX/NAV (former Navision/Axapta). Other vendors?	Q09
	In case you have not yet chosen any ERP system, please go to question 17a.			
	Chosen ERP system?	Nominal	SSA/Baan. Oracle/Peoplesoft/J.D. Edwards/Siebel SAP MS Dynamics AX/NAV (former Navision/Axapta). Other vendors?	Q10
	In case you have not yet started implementing an ERP system, please go to question 17a.			
Implementation process	Which ERP modules were implemented?	Nominal	Finance/Controlling Human Resources Manufacturing and Logistics Sales & Distribution Other	Q11
	Chosen implementation strategy?	Nominal	Slow phased-in impl. approach, one module at a time A pilot project impl. one module followed by all other modules in one step Big Bang impl. of all ERP software modules	Q12
	In case you have not yet completed implementing an ERP system, please go to question 17a.			

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Efforts for Implementation	What was the actual total cost of implementation?	Ordinal	Lower than estimated Equal Higher than estimated		Q13
	How was the total cost of implementation divided?	Interval	Software licence Programming of changes Organizational implementation Hardware costs		Q14a b c d
Impact of ERP adoption	Please estimate the impact of ERP compared to the situation prior to ERP implementation?	Interval (1-5) (poor rating to good rating)	Overall IS/IT costs Proportion of costs attributed to the IT department out of overall IS/IT costs Proportion of costs attributed to functional departments out of overall IS/IT costs Efficiency/Profitability Effectiveness/Productivity Availability of IS/IT services		Q15_1 _2 _3 _4 _5 _6
	Can you estimate the % of the implemented ERP system functionality that is being used?	Interval	Percent		Q16
ERP adoption and success criteria	Please answer for every considered criterion only? a) Of what importance where these criteria? (1=very little to 5=very high importance) b) Were the expectations achieved? (1=not reached to 5=exceeded)	Interval	Reduced cycle times Enhanced decision making Improved service levels/quality Incorporation of business best practices Business Process Improvement Integrated and better quality of information E-business enablement Increased flexibility Increased customer satisfaction Improved innovation capabilities Enabler for desired business processes		Q17[ab]_1 _2 _3 _4 _5 _6 _7 _8 _9 _10 _11
	Vendor/system related criteria		Organizational fit of system Software costs (licenses, maintenance) Functionality of the system System flexibility Systems reliability Advanced technology Operating system independency System interoperability Internationality of Software System usability Vendor reputation Vendor support Market position of vendor Availability of a industry focused solution Short implementation time Enabling technology for CRM, SCM, etc. Connectivity (Intra/Extranet, Mobile Comp., ...)		_12 _13 _14 _15 _16 _17 _18 _19 _20 _21 _22 _23 _24 _25 _26 _27 _28

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