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# A EUROPEAN STUDY OF E-BUSINESS MATURITY AND ICT-BENEFITS: IS THERE A CONDITIONAL RELATIONSHIP?

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## Abstract

The present study explores the relationship between the e-business maturity and the perceived benefits from (Information and Communication Technologies) ICT at the firm level. We aim to debunk this relationship in terms of its strength and stability, and to explore the conditions which may influence it. Taking an economic approach, we hypothesise that the relation between e-business maturity and perceived benefits from ICT adoption will be influenced by the costs of intra-organisational adaptations due to ICT. Using data from an European survey on ICT adoption and e-business maturity of the firms (N=7,072) we show that the correlation between the e-business maturity and the perceived benefits from ICT adoption is indeed positive, significant and stable over countries, industries, firm size and age. Further, the findings confirm the hypothesis that intra-organisational adaptations due to ICT moderate the positive correlation between a firms' e-business maturity and perceived benefits from ICT.

*Keywords: e-Business maturity, ICT adoption, perceived benefits, European survey.*

## 1 INTRODUCTION

Recent international studies reveal that European countries are in the highest ranks of e-readiness and ICT growth rates (Economist Intelligence Unit, 2006; Economist Intelligence Unit, 2008; EITO, 2007). Still, the adoption of ICT within Europe strongly varies between countries and sectors. Over the last decade, the European and national policies particularly focus on stimulating ICT adoption by the small and medium sized enterprises, the SMEs (Castaings and Tarantola, 2008; Castaings et al., 2007; European Commission, 2002; Nardo et al., 2004; Renner et al., 2008). This sector structurally lags behind the ICT diffusion rates of large firms. Although from a scale perspective this might not seem a problem *per se*, the more fundamental problem observed is the low awareness, or even mistrust, of SME firms about the potential benefits of IT (Lucchetti and Sterlacchini, 2004). The problem, an over-critical and sceptical attitude towards the potential benefits of ICT, is not only a matter by SME firms. It actually draws back to the many uncertainties when investing in ICT, both at the costs and benefits side. Although the 'productivity paradox' (Solow) and 'IT doesn't matter' (Carr) discussions have passed, still the number of studies that report failure of the ICT adoption and implementations remain large (cf. Ward and Peppard, 2003). Quite ironically, the national governments that firmly stimulate the uptake of ICT, represent organizations that particularly seem to fail in getting value from ICT. The Dutch government for example, struggle with several public examples of ICT disasters and mis-planning (Court of Audit, 2008).

So from both a policy and scientific perspective, a key challenge within area of IS adoption and uptake is to improve the understanding of how managers actually *perceive* the benefits from ICT adoption, and how this relates to their *actual* investments in ICT, e.g. e-business applications. It seems obvious that the firms which have invested much in ICT may perceive more benefits from these investments than the others, but this relationship is not trivial. There are firms which might have 'under-invested'

in ICT, while there are other firms which might have over-invested in ICT. In the context of IS adoption research, the current market observations raise some questions about the nature of the relationship between the investment (i.e. ICT maturity) and the perceived benefits for the different types of firms.

The present study builds upon the increasing knowledge about organisational adoption of ICT (for a thorough review see Venkatesh et al., 2003), and economic analysis of ICT in the organisational context (Zhu and Kraemer, 2005). Motivated by these two perspectives, we conduct a comparative analysis of European firms' perceptions of benefits and impacts of ICT and their e-business maturity. Empirical data from the e-Business W@tch project, a cross-national survey sponsored by the European Commission among 7,000 firms from 10 different EU-countries, are used. The main research objective is addressed by two research questions:

- How do the perceived benefits of ICT adoption relate the e-business maturity of the different types of European firms?
- How does intra-organisational impact of ICT affect the relation between the perceived benefits of ICT and the e-business maturity?

In order to answer these research questions we develop hypothesis and measurements that enable us to describe and explain the European landscape of e-business maturity. The study contributes to the IS adoption research by shedding some light on the relationship between perceived benefit of ICT and e-business maturity, while exploring potential differences in the relationship for firms from different countries, industries as well as firms of different size and age. The study results indicate a positive relationship between the e-business maturity and perceived benefits from ICT adoption which is moderated by the intra-organisational adaptations due to ICT. The positive relationship is stable across firms from different countries and industries and despite their different size and age.

The paper is structured as follows. The next section presents a brief literature review of the adoption theories and models and the economic elements used in the proposed research. Then the data and measurements of the study are described. The following section presents results from the bivariate and the multivariate analysis. The paper concludes underlining the main findings, limitations and proposing some future research directions.

## **2 THEORETICAL CONTEXT**

### **2.1 Some basic theoretical insights on the adoption of ICT**

One of the most widely used theories in the Information Systems, which attempts to explain the reasons behind innovation adoption, is diffusion of innovation (DoI) (Rogers, 1995; 2003). DoI (1995) has been used to study the adoption of many computer-related technologies. The model contains four main elements: innovation, communication channels, time, and the social system. Rogers' model is prominent in addressing the role of change agents, individuals who influence clients' innovation-decisions in a direction deemed desirable by the change agency (2003).

Since e-business systems involve high costs for the organisation, the adoption decision is an authority innovation-decision type. This means that the decision to adopt or reject the system is made by a relatively few individuals in the organisation who possess status, power, or technical expertise (Rogers, 1995). The top management in the organisation is mostly involved in the selection of e-business systems and in charge of providing the resources for its implementation. They delegate other decision-making tasks to other members of the organisation. Besides, they can influence the way the rest of the organisation views the system and its changes.

According to Rogers (2003), and other rational diffusion theorists (Agarwal and Prasad, 1997; Moore and Benbasat, 1991), there are certain characteristics of innovations which affect their rate of adoption. These characteristics can be applied to e-business. First, the relative advantage of e-business solutions relates to cost savings in time and effort by improving business processes. Second,

compatibility of e-business solutions may relate to synchronization of data with suppliers and customers and increases the adoption probabilities. Third, e-business solutions may be characterised by complexity which decreases the adoption probability because of the high cost of implementation and customisation. Fourth, e-business solutions have a very limited trialability since they can only be seen in other adopter organisations, and this in turn decreases the adoption probability. Finally, observability is low for e-business solutions and this decreases the adoption probability. Most observations of e-business come from indirect paths such as media and hearsay. These sources usually give evaluations of e-business which are used in the decision making process.

Diffusion of innovation theory has been criticized for not taking into account the particularities of complex information technologies (Lyytinen and Damsgaard, 2001). The different approaches in the study of ICT diffusion (such as Baskerville and Pries-Heje, 2001; Cooper and Zmud, 1990; Edquist, 1997) seem to take a narrow perspective while emphasising specific topics of interest with no single theory being able to explain the particularities of the different technologies (Jones and Myers, 2001). Besides, researchers used theories from social psychology to investigate organisational adoption of the innovation. The most commonly used theories are Technology Acceptance Model (TAM) (Davis, 1989), the Decomposed Theory of Planned Behaviour (Taylor and Todd, 1995) and the Unified Theory of the Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). These models aim to explore the user attitudes or intentions, and thus technology adoption and use through various social, personal and technical constructs. However, they do not investigate the value elements affecting the adoption decision process or the economic implications from ICT adoption to the organisation.

The present study focuses on e-business applications and it uses theoretical insights from industrial economics to get further insight into ICT diffusion and the perceived value of ICT (Wilkins and Swatman, 2006). In particular, it builds upon the notion of relative advantage as postulated by Rogers and it investigates the firms' perceptions of the benefits from ICT adoption and the relationship with e-business maturity.

## 2.2 An economic approach to ICT adoption and its perceived benefits

Most of the research on the adoption of an inter-organisational system (IOS) focuses on the expected operational benefits (e.g. Zhu and Kraemer, 2002). The firm using the Internet infrastructure to connect with other partners is expected to increase its operation efficiency, which in turn leads to more efficient information processing and a decrease in the transaction costs, search costs and other direct and indirect costs involved. These costs savings have been depicted as some of the expected benefits from the adoption of EDI systems as well (e.g. Zhu and Kraemer, 2002). Recently this theoretical discussion has been extended to include open standards IOS. In such case, additional benefits for the firm include the ability to find new partners and to exchange information, reaching new customers and expanding to new markets as well as the improvement of the value chain co-ordination (Zhu et al., 2006b).

The adoption of ICT products also involves network-related value (Kauffman et al., 2000). Research on industrial economics has highlighted the importance of increasing returns in the adoption of a new system (Arthur, 1989; Davis, 1992). In particular, there are positive network effects when the user's value from the use of the system increases as the number of users at the same or compatible systems' users increases, since the firm can exchange information with them (Katz and Shapiro, 1994). Network effects may accelerate or impede the diffusion process. For example a user of a legacy system, enjoying the benefits of network effects by exchanging data with other firms which adopted the old system, would expect to be able to maintain those benefits when using a new system. The adoption of a new incompatible technology may limit network effects for users of the old technology (Farrell and Saloner, 1986). Further, the compatibility between systems shifts the focus of attention from the overall services package, which includes the network size, to specific component cost and

performance characteristics (Economides, 1989; Katz and Shapiro, 1994; Matutes and Regibeau, 1988).

As firms gradually invest in e-business applications and they climb the e-business maturity ladder, they may increasingly experience the advantages and benefits from ICT adoption. Eventually, it has become a basic notion that it takes time to actually ‘see’ the benefits of ICT – especially with major ICT-investments such as ERP (cf. Poston and Grabski 2001). We expect that the same holds for e-business as a next wave in terms of ICT maturity (Ward and Peppard 2003). According to this notion the first hypothesis we propose for the present study is:

*H<sup>1</sup>: There is a positive relationship between firm’s perceived benefits from ICT and the level of e-business maturity.*

ICT adoption may change business activities and it may create new opportunities or new needs for the firm. This in turn generates significant costs to the firm. Apart from the financial costs involved in the investment decision for the new system (e.g. Zhu et al., 2006a), the adoption costs are related to the managerial complexity and the risks involved for the firm changing processes when adopting the new system. We can refer to numerous studies that report about misinvestments because of underestimation of the organisational consequences of ICT (cf. for ERP: Hong and Kim, 2002; Rajagopal, 2002).

In a classic study, Brynjolfsson and Hitt (1995) show that firms only benefit from IT investments if they align these investments with their organisational structure. Specifically, they demonstrate that the firms which invested in computers and they decentralised organisational structure at the same time, outperformed other firms in terms of their market value. In line with these findings an extensive stream of literature on business/IT alignment emerged in the nineties, highlighting the importance of mutually adjusting the organisational/business domain and the IT domain (Henderson and Venkatraman, 1993; Luftman and Brier, 1999; Luftman and Kempaiah, 2007; Papp, 1998; Papp et al., 1995). Following the basic argument of Brynjolfsson and Hitt (1995), we expect that the relation between the perceived ICT benefits and the e-business maturity will be at least ‘blurred’ if firms experience intra-organisational changes due to the adoption of ICT. Intra-organisational adaptation may put a hold on the potential benefits of ICT. The firms that grow in ICT or e-business maturity without intra-organisational changes are likely to be those who had their processes and structures already in place. These firms may benefit relatively more and/or earlier from ICT, compared to those that are forced to execute significant intra-organisational adaptation. Hence the second hypothesis of the present study is:

*H<sup>2</sup>: The positive relationship between the perceived benefits and e-business maturity is negatively influenced by the perceptions of the intra-organisational impact of ICT*

### **3 RESEARCH APPROACH: DATA AND MEASUREMENTS**

#### **3.1 The dataset**

The data used for this study were collected by Empirica that coordinates the e-Business W@tch project of which a number of European wide surveys is an important part (Selhofer *et al*, 2008). The data collection was based on telephone (CATI) interviews with IT managers employed at firms from 15 different sectors. The e-Business W@tch survey project started in 2002 in the 15 EU member states at that time. New EU member states were included in latter waves along with additional questions. Besides, the survey expanded to include additional industrial sectors.

Field work of the E-Business W@tch project was executed by national market research organisations. The standard procedure for each country was to sample enterprises that “were active at the national territory of the country”, “have their primary business activity in one of the sectors specified by NACE categories” and “can be defined as a business organisation of one or more establishments comprised as

one legal unit” (European Commission, 2008). Each national sample was drawn from “acknowledged business directories and databases” and stratified by economic activity (one or more of the NACE-defined economic sectors) and employee size. Size was of specific importance for stratification because the e-Business W@tch survey particularly aimed to estimate the accurate level of usage and adoption of IT for countries and industries. The company size was strongly correlated with the IT investments because of scale and scope of activities. In practice, three employee size strata were defined for each country and industry: to include a share of at least 10% of large companies (250 employees or more), 30% of medium sized enterprises (50-249 employees) and 25% of small enterprises (10-49 employees). Besides, the so-called “micro enterprises” with less than 10 employees were also included (by 35%).

This study used the 2006 e-business w@tch dataset. As country and sector are important variables for the analysis. Thus, it was ensured that the sectors surveyed in the 2006 wave were equally represented in each country. Besides, firms with 10 employees were selected. This resulted in a pre-selection (see Table 1) of 7,237 firms, from 10 different countries and 10 different sectors (i.e. Food = Food and beverages, Foot = Footwear, Pulp = Pulp and Paper, ICT = ICT Manufacturing, Elec = Consumer electronics, Ship = Shipbuilding and repair, Cons = Construction, Tour = Tourism, Tele = Telecommunications, Hosp = Hospital activities).

	Food	Foot	Pulp	ICT	Elect	Ship	Cons	Tour	Tele	Hosp	Total
France	78	26	132	190	20	8	75	70	72	80	751
Germany	53	68	163	169	66	15	51	54	60	101	800
Italy	50	200	85	182	30	21	50	48	50	40	756
Poland	50	135	75	76	141	3	50	50	75	97	752
Spain	49	181	117	132	17	23	49	46	103	37	754
UK	59	20	140	167	59	8	59	57	147	34	750
Czech Rep.	74	70	105	99	130	2	75	75	70	50	750
Finland	149	18	66	104	9	4	141	134	95	32	752
Hungary	153	40	50	95	19	2	152	141	60	60	772
Netherlands	60	11	31	63	16	12	52	50	97	8	400
Total	775	769	964	1,277	507	98	754	725	829	539	7,237

*Table 1. Country and industry composition of the 2006 e-Business W@tch dataset used for this study*

According to Table 1, the spectrum of countries and industries seems to be sufficiently diverse to cover different national level of economic development, geographical spread, including a relevant spread of manufacturing versus service-oriented industries.

### 3.2 The measurements

#### 3.2.1 E-business maturity

From the e-Business W@tch survey we selected 11 questions which addressed the use of ICT (web) applications to support inter-organisational (B2B) activities. The questions explored the inter-firm collaboration in general, or specific processes such as invoicing. The response scale was categorical including “Yes”, “No” or “Don’t know”. The latter category appeared in a small number of the cases (less than 2%), which were removed from the dataset. The 11 dichotomous variables were analysed on their inter-correlations, but as the different e-business applications were not logically interrelated, (e.g. firms might invest in one type of e-business without investing in another type) we did not aim at exploring the scalability or a latent factor model for this set of 11 dummy variables.

“Does your company use online technologies or specific IT solutions”	% “yes”	2	3	4	5	6	7	8	9	10	11	Factor loading
1. to collaborate with business partners to forecast product or service demand	16.6	.510	.219	.263	.228	.179	.186	.151	.223	.206	.182	.587
2. to collaborate with business partners in the design of new products or services	14.7	1	.180	.228	.236	.177	.176	.138	.214	.192	.158	.558
3. to send e-invoices to customers in the public sector	16.6		1	.602	.426	.164	.173	.111	.163	.155	.207	.630
4. to send e-invoices to customers in the private sector	17.6			1	.498	.163	.197	.139	.198	.183	.212	.687
5. to receive e-invoices from suppliers	20.4				1	.205	.200	.151	.198	.193	.150	.639
6. to place orders for goods or services online	60.9					1	.140	.218	.165	.157	.118	.422
7. to support the selection of suppliers or procurement processes	12.5						1	.097	.286	.190	.112	.370
8. to order goods or book services online	29.2							1	.215	.166	.092	.497
9. to support marketing or sales processes	14.0								1	.220	.145	.497
10. to link to the ICT system of suppliers	11.1									1	.383	.498
11. to link to the ICT system of customers	11.3										1	.449

*Table 2. Measurement of the E-business maturity concept: frequencies, inter-correlations and factor loadings of 11 indicators (N=7,237)*

We added the scores of the 11 indicators to create one construct, which we labelled ‘e-business maturity’. Factor loadings from the PCA were used to allocate weights for the 11 indicators. According to Table 2, most of the e-business application were used by a minority of the firms (‘yes’ varies between 11% and 29%), except from the use of online ordering. This means that the constructed factor was skewed to the left-hand side of the distribution as nearly half of the firms answered ‘yes’ to none or only one of the 11 indicators (skewness=1.38, kurtosis=1.49).

### 3.2.2 Perceived ICT benefits

The e-Business w@tch questionnaire included questions asking the respondents’ perceptions of ICT benefits for their business on six different performance areas: (1) revenue growth, (2) business processes efficiency, (3) internal work organisation, (4) procurement costs of supply goods, (5) products and services quality, (6) customer service and (7) productivity. We considered these items as

indicators of one latent concept, and we explored whether they could be aggregated to a single e-business maturity scale. Principal Component Analysis (PCA) was first applied to test construct validity. The Kaiser-Meyer-Olkin test and the Bartlett's Test of Sphericity were used to determine whether the sample size was sufficient relative to the number of items, and the correlation matrix was not an identity matrix. Both tests were passed (KMO statistic is 0.894, Bartlett's Test is significant,  $p < .001$ ). As a result of the PCA, the one factor solution holds an eigenvalue of 3.75, while all factor loadings were above 0.50 and all inter-correlations were significant at the 1%-level (see Table 3 below). In addition, the Cronbach's Alpha over the 11-item set, by 0.86, supported scale reliability (Nunnally and Burnstien, 1994).

"All in all (...) Please tell us for each of the following areas whether ICT has a positive, negative, or no influence"	% "positive"	2	3	4	5	6	7	Factor loading
1. Revenue growth	43.2	.505	.375	.383	.433	.464	.516	.718
2. Business process efficiency	58.1	1	.563	.388	.409	.491	.566	.774
3. internal work organisation	55.7		1	.367	.394	.458	.527	.721
4. procurement costs of supply goods	40.2			1	.422	.388	.418	.641
5. product/service quality	38.8				1	.515	.489	.712
6. customer service	53.7					1	.515	.752
7. productivity	53.4						1	.797

Table 3. Measurement of the ICT benefits concept: frequencies, inter-correlations and factor loadings of 7 indicators (N=7,237)

### 3.2.3 Intra-organisational impact of ICT

The respondents were asked about the importance of ICT on four organisational aspects of their company: (1) the organisational structure, (2) task and job descriptions, (3) education and training of employees, and (4) outsourcing decisions. Categorical responses of "yes" and "no" were collected and analysed; while responses in the category "don't know" were excluded. Again PCA, correlation and scale analysis were executed to explore whether these dichotomous items could be aggregated to one factor. Based the results (eigenvalue of the 1-factor model is 2.42, Cronbach's Alpha is 0.78) a sum score factor was subsequently constructed (see Table 4).

"Would you say that ICT had an important influence on the following organisational aspects in your company ..."	% "yes"	2	3	4	Factor loading
1. The organisational structure	35.2	.592	.424	.411	.787
2. Task and job descriptions	35.2	1	.535	.440	.838
3. Education and training of employees	36.5		1	.418	.764
4. Outsourcing decisions	26.1			1	.715

Table 4. Measurement of the intra-organisational impact of ICT concept: frequencies, inter-correlations and factor loadings of 4 indicators (N=7,237)

### 3.2.4 Control variables

Control variables were treated as background characteristics of a firm which might potentially influenced either e-business maturity, or perceived ICT-benefits, or both. The control variables were:

- Industry type including 9 categories or branches (see Table 1);



- Country of firm's location including the 9 countries represented in the dataset (see Table 1);
- Firm's size, measured by the number of employees
- Firm's age, measured by four categories including foundation before 1981, between 1981 and 1996, between 1987 and 2002, and between 2003 and 2006.

The size indicated the 'scale' of a firm, which might be positively correlated with e-business maturity. The firm's age might be correlated to e-business maturity, because the 'older' organisations might be restricted by earlier investments in pre-Internet technologies, and they probably employed older and less e-skilled employees. With regard to the relationship between industry and country on one hand, and e-business adoption on the other e-Business W@tch reports (European Commission, 2008) revealed Scandinavian countries and the UK were front-runners in e-business application. This might be related to the cultural differences and the public policies developed to stimulate technology and innovation. However, the effects of culture on the ICT adoption should be investigated by cross-national analyses (e.g. Miller et al., 2006; Van Everdingen and Waarts, 2003). Besides, industries such as the ICT manufacturing and telecommunications were known as early adopters of e-business because they involved products and services which were inherent to their own business domains (European Commission, 2008).

#### 4 ANALYSIS: RESULTS AND FINDINGS

We first explore the relationship between e-business maturity and perceived ICT-benefits to test the first hypothesis (H<sup>1</sup>). Table 6 shows the (Pearson) correlations, controlling for country and industry by split sampling, and controlling for size and age by calculating partial correlations.

	Pearson correlation	Partial correlation, controlled for size	Partial correlation, controlled for age	N
Total sample	.40	.38	.40	7,237
France	.40	.35	.39	751
Germany	.44	.42	.44	800
Italy	.32	.28	.33	756
Poland	.43	.42	.43	752
Spain	.42	.41	.44	754
UK	.44	.43	.44	750
Czech Rep.	.36	.32	.36	750
Finland	.41	.35	.41	752
Hungary	.36	.36	.37	772
Netherlands	.50	.47	.50	400
Food and beverages	.39	.33	.39	775
Footwear	.36	.34	.36	769
Pulp and paper	.36	.32	.36	964
ICT Manufacturing	.36	.33	.36	1,277
Consumer electronics	.35	.33	.35	507
Shipbuilding and repair	.38	.36	.39	98
Construction	.37	.35	.37	754
Tourism	.45	.40	.45	725
Telecommunications	.38	.36	.38	829
Hospital activities	.21	.16	.22	539

Table 6. Results from correlation analysis testing hypothesis H<sup>1</sup> (N=7,072)

All correlations are significant (p<.001). Controlling for firm size and age does not change the size of the correlation coefficient, nor does country and industry. These findings support the first hypothesis H<sup>1</sup> indicating that there is a positive correlation between perceived benefits from ICT adoption and e-business maturity of the firm.

Table 7 presents the results from the regression analysis, including the same variables. From the total sample column, we can conclude that hypothesis H<sup>1</sup> is confirmed again (beta=0.327, p<0.001). To test the second hypothesis (H<sup>2</sup>), we explore the influence of the intra-organisational changes due to ICT on the relationship between the perceived benefits and the e-business maturity. We primarily aim to test whether this influence is a moderator that affects the strength of the relationship between perceived ICT benefits and e-business maturity (Gonzalez-Benito, 2007). To this end we compare the explanatory power of the regression model for different stages of the moderator – i.e. the level of perceived intra-organisational impact of ICT. The dataset is split into three groups of equal size, distinguishing between organisations with relative low, medium and relative scores on the variable that measures the intra-organisational changes due to ICT. Table 7 presents the results.

	Subsamples: intra-organisational impact of ICT is <sup>a</sup> :							
	Total sample		Low		Medium		High	
Independent variable	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig
E-business maturity	.327	***	.263	***	.199	***	.178	***
Industry <sup>b</sup>								
Food and beverages	-.131	***	-.132	***	-.113	***	-.115	***
Footwear	-.148	***	-.124	***	-.134	***	-.087	***
Pulp and Paper	-.079	***	-.066	***	-.082	***	-.038	
Consumer electronics	.004		-.006		.024		-.005	
Shipbuilding and repair	-.030	***	-.019		-.028		-.014	
Construction	-.110	***	-.115	***	-.088	***	-.095	***
Tourism	-.056	***	-.072	***	-.041		-.001	
Telecommunications	.044	***	.040	**	.044		.016	
Hospital activities	-.069	***	-.022		-.118	***	-.135	
Country <sup>c</sup>								
France	-.107	***	-.099	***	-.123	***	-.141	***
Germany	-.029		.006		-.104		-.068	
Italy	.036		-.041		-.038		.031	
Poland	-.009		-.038		-.080	**	-.101	
Spain	.024		-.029		-.031		-.037	
UK	.008		.031		-.019		.002	
Czech Republic	.032		.049		-.002		.041	
Finland	.022	**	.093	***	-.003		-.055	
Hungary	-.081	***	-.024		-.015		-.016	
Employee size (log transformed) <sup>d</sup>	.167	***	.106	***	.045		.014	
Firm's age <sup>e</sup>	-.009		-.026		.006		.006	
N	7,071		3,097		2,232		1,741	
R2	.234		.150		.130		.099	

Table 7. Results of OLS regression analysis testing hypothesis H<sup>1</sup> and H<sup>2</sup> (N=7,071)

\*\*\* p<.001; \*\* p<.0

<sup>a</sup> Low = mentioned none of the four intra-organisational domains (see section 3.2.3); medium = mentioned one or two; high = mentioned three or four

<sup>b</sup> ICT manufacturing = category of reference, all other categories coded 0/1

<sup>c</sup> The Netherlands = category of reference, all other categories are coded 0/1

<sup>d</sup> log transformed

<sup>e</sup> Coding: 4=founded before 1981, 3= founded between 1981 and 1996, 2= founded between 1987 and 2002, 1 = founded between 2003 and 2006.

The three subsample analyses shows that with the three subsequent categories of intra-organisational impact of ICT, the strength of the relationship between the e-business maturity and the perceived ICT-benefits decreases (beta drop from +.26 to +.18). These findings support the hypothesis H<sup>2</sup>. It should

also be noted that the explained variance of the total model decreases along the three groups (from 15% to 10%). Thus, the intra-organisational influence of ICT creates costs (e.g. due to the technology complexity), which moderates or counterbalances the perceived benefits of e-business maturity.

## 5 DISCUSSION AND CONCLUSION

The present study used survey data from over 7,000 European firms, to demonstrate that the organisations which have invested on ICT and display e-business maturity perceived more benefits from ICT than the firms with lower e-business maturity. This result is remarkably stable over 10 different European countries and 10 different industries. It also remains stable when controlling for age and the size of the firm. However, there might be firms which experience small benefits from ICT while having invested heavily in e-business. Those firms are a minority. Overall we can derive a quite a 'positive message' with regard to e-business development from the study's results.

In this study we also found indications that when the ICT strongly influences intra-organisational domains of a firm the perceived benefits from ICT hold a weak relation with e-business maturity. This implies that firms should be made aware of the necessary organisational changes when adopting e-business applications. Depending on the 'as it is' intra-organization situation, the benefits from ICT may not be evident from the start, as they require resources, investments and –in terms of attitude – patience. Hence, the public policies should be focused on facilitating firms in handling both the respective benefits *and* costs from ICT adoption. In turn, if firms' perceptions of the benefits related to ICT become more positive, this may further stimulate investments, ICT adoption and increase e-business maturity.

### *Limitations and further research*

The empirical part of this research is based on a secondary analysis of an existing dataset (i.e. data from the organized 2006 E-business w@tch survey). A limitation is therefore that the measurements do not fully match the intended concepts from our hypotheses. This applies, for instance, to the limited number answer categories in measuring ICT adoption ('yes', 'no') and the general formulation of 'ICT' in measuring their perceived benefits. In further research these measurements could be improved by specifying the type of software or applications used, the history, intensity and goal of usage, and so on. Related to this, it is recommended to further validate scales to measure e-business maturity, perceived benefits from ICT and intra-organisational changes. As European firms become more mature in terms of ICT and e-business, this requires new maturity measurements and likewise new explanatory research frameworks (cf. Aryee et al, 2008).

In addition, also our results are subject to limitations, but provide drivers for further investigation. Table 6 showed that European countries only slightly differ in the correlation between e-business maturity and ICT benefits, but Table 7 displays different levels of perceived ICT benefits by country. This is an interesting subject to explore further, e.g. on the fact that e-business measurement is rightly assumed to be generic. It might be the case that respondents from different countries do differ in their level of technical knowledge to answer technology specific questions properly. Extending this study through cross-national comparison implies the analysis of other cultural and socio-economic factors on e-business adoption (Miller et al. 2006), maturity and perceived benefits from ICT (Agourram and Ingham, 2003).

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