

ANALYZING THE MEDIATING ROLE OF ICT AND NON-ICT INVESTMENT AND BPR IN THE RELATIONSHIP BETWEEN E-BUSINESS ADOPTION AND PERFORMANCE

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Abstract

The analysis of the relationships among strategy, structure and performance is a major research topic of particular interest to both researchers and management practitioners. This paper develops a research model for investigating these relationships for the case of e-business strategy adoption. A model is developed consisting of several hypotheses concerning the relationships among e-business strategy adoption, information and communication technology (ICT) investment, non-ICT investment, business process reengineering (BPR) and business performance. In order to test the hypotheses, data from a sample comprising 271 Greek firms are used to estimate a structural equation model. The results show that e-business strategy adoption is positively associated with BPR, while it is not related however to ICT and non-ICT investment. Furthermore, BPR, ICT investment and non-ICT investment have significant positive paths leading to the dependent construct (business performance), while e-business strategy adoption has a statistically insignificant coefficient. Therefore, our results show an indirect positive effect of e-business strategy adoption on business performance through BPR.

Keywords: e-Business, Strategy, Information and Communication Technologies (ICTs) Investment, Non-ICT Investment, Business Process reengineering (BPR), Business Performance.

1 INTRODUCTION

Management science has theorized that a firm's structure is adapted to the strategy it adopts, and this adaptation is critical for its performance; for this reason understanding how various elements of a firm's structure are affected by the strategy adopted and what impact they have on business performance is of particular interest to both researchers and management practitioners (Chandler 1962, Miller 1988, Jennings and Seaman 1994, Rhee and Mehra 2006). Porter (1980) has defined generic business strategies and argued that each strategy necessitates particular structural arrangements in order to be successful. Also, the structural contingency (Donaldson 2001) theory posits that organizational effectiveness results from fitting the structure of a firm to some important contingencies, one of them being firm strategy. This paper investigates empirically these theories for the case of e-business strategy adoption. It develops a research model consisting of several hypotheses among i) e-business strategy adoption, ii) two fundamental elements of structure that characterise the modern economy, information and communication technologies (ICT) and business processes, and also a third 'classical' one for comparison purposes, the non-ICT 'regular capital' (e.g.

electromechanical equipment, physical structures, etc.), which constitutes in many sectors the largest part of firms' total investment, and finally iii) business performance. E-business, defined as 'the sale or purchase of goods or services, whether between businesses, house-holds, individuals, governments, and other public or private organisations, conducted over computer-mediated networks' (OECD 2002), is a strategy for growth and development being increasingly adopted by firms all over the world, in order to increase their market share, target new market segments, enter new markets and introduce new products and services (Johnson, G. and Scholes 2006, European Commission 2008, Turban et al 2008). It is therefore important to investigate its impact on business performance, and also the mechanisms and mediators of this impact; identifying and understanding these mediators is very useful for firms adopting e-business strategy, so that they can focus on the appropriate structural adaptations that should be made in order to maximize the impact of this strategy on business performance.

There have been several empirical investigations analyzing the impact of e-business on various non-financial (mainly) and financial measures of business performance, and only few of them dealt with the mechanisms and mediators of this relationship, as will be described in the following literature review section. Furthermore, none of these few studies investigated the mediating role of the two fundamental structural elements of modern economy, namely, ICT and BPR, or the role of 'classical' non-ICT assets, in the relationship between e-business adoption and business performance. The present study attempts to cover these gaps in previous research through an empirical investigation which assesses the whole network of relationships among e-business adoption, ICT investment, BPR, non-ICT investment and financial business performance, through, a sound theoretical foundation from the area of microeconomics, the Cobb-Douglas production function. Also, in order to measure the abstract and multidimensional BPR concept, with high levels of reliability, a multi-item scale is developed through a comprehensive review of the BPR literature, and then validated using the methods proposed by the statistical literature. Another contribution of this study is that it assesses and compares the relationships of the two main types of capital investments, ICT investment and non-ICT investment, with e-business adoption, BPR and business performance. Previous literature (e.g. Bresnahan and Trajtenberg 1995, Melville et al 2007) has emphasized that ICTs are 'general purpose' technologies, so they can be adapted to many different uses and functions and enable important innovations, while non-ICT assets do not have such characteristics. Thus, it is also interesting to examine whether the above fundamental difference between ICT and non-ICT investment results in differences in their relationships with e-business adoption, BPR and business performance.

This paper is structured in six sections. The next section presents a comprehensive literature review. In section 3, the research model and hypotheses are formulated. Following that, The method and the data of this study are described in section 4. Then, data analysis and results are presented and discussed in section 5 and, finally, in section 6 the main conclusions and limitations of the study are outlined and future research directions are proposed.

2 LITERATURE REVIEW

Although several empirical investigations have analyzed the impact of e-business on business performance (using mainly non-financial measures), only few of them have examined the mechanisms and mediators of this relationship. Frohlich (2002) using a sample of 890 companies found that supplier and customer e-integration had a strong effect on e-business performance (percent of procurement and sales revenues conducted using the Internet) and operational performance (respondents perception of delivery times, transaction costs and inventory turnover). Wu et al. (2003) studied the antecedents of e-business adoption, adoption intensity and performance in a dataset of 144 firms. They found that supplier and customer communication positively affected performance outcomes (efficiency, sales performance, customer satisfaction and relationship development), while e-procurement and online order taking did not. Also, they examined environmental uncertainty as a moderating variable in the relationship between e-business adoption and performance, finding that the

positive effect of e-business adoption on sales performance and customer satisfaction is stronger when technological uncertainty is high. Zhu and Kraemer (2005), grounded in the innovation diffusion literature and the resource-based theory, developed a model for assessing the diffusion and consequence of e-business at the firm level, which links technological, organizational and environmental factors to e-business use and value. The model was tested on a dataset of 624 retail companies from 10 countries leading to the conclusion that technology competence, firm size, financial commitment, competitive pressure, and regulatory support are important antecedents of e-business use. In addition, they found that e-business use, front-end capabilities and back-end capabilities had a positive impact on e-business value.

More recently, Devaraj et al. (2007) developed a set of hypotheses to empirically test the pathway from e-business to performance, mediated by information integration with suppliers and customers. Using a sample of 120 companies, they found that e-business technologies do not directly impact operational performance. However, these technologies support integration with customers and suppliers, which in turn impact positively operational performance. Sanders (2007) tested a model of the relationship between the use of e-business technologies and organizational performance (measured by cost reduction, product quality, new products introduction time, delivery time) and also examined the mediating role of the intra- and inter-organizational e-collaboration in this relationship using a dataset of 245 companies; their findings showed that the use of e-business technologies impacts performance both directly and indirectly through promoting intra-organizational and inter-organizational collaboration. More recently, Soto-Acosta and Meroño-Cerdan (2008) using a sample of 1010 firms tested several hypotheses concerning the relationships between Internet resources, e-business capabilities and e-business value, measured by improvement of e-procurement effectiveness (effect of e-business on procurement costs, relations with suppliers and logistics and inventory costs); their results showed that while Internet resources are not directly related to e-business value, they are critical for creating internal and external (with suppliers) e-business capabilities, which in turn are key drivers of e-business value.

A smaller number of empirical studies focus on the effect of e-business on objective measures of financial business performance. In this direction Zhu and Kraemer (2002) investigated empirically the impact of e-commerce on firm performance in the manufacturing sector using financial metrics of firm performance (sales per employee, gross margin, cost of goods sold, inventory turnover); their results suggested the need of e-commerce capability and IT infrastructure alignment for obtaining higher levels of firm performance. Barua et al (2004) investigate empirically whether and how information exchange capabilities with customers and suppliers affect the level of digitization of business activities with them and financial performance. Using data collected from a sample consisting of 1076 firms, they found significant positive relationships between information exchange capabilities and digitization of business activities for both customers and suppliers; also they found that the digitization of business activities with customers' results in improved financial performance, but no significant relationship on the supplier side. Johnson et al (2007) using a combination of cases studies and survey data examined how industry context, firm characteristics and also firm-level strategic resources, such as purchasing teams, influence the exploitation of e-business technologies and the relationship between e-business technology use and firm performance. They reached the conclusion that only some forms of e-business technology use (those designed to reduce coordination costs) can lead to improved financial performance. Other studies have analyzed the effect of specific e-business technologies on firm performance. For instance, Meroño-Cerdan and Soto-Acosta (2007) developed a framework for the evaluation of the external web content of business websites and examined its influence on the firm's financial performance; employing a sample comprising 288 SMEs and using firm's added value as a measure of firm performance, they found a positive relationship between the external web content and firm performance.

In conclusion, previous empirical literature has produced considerable evidence that e-business has a positive impact on various measures of organisational performance, including both non-financial and financial measures. Also, it has revealed a number of mediating factors in the relationship between e-

business and performance, such as intra-organizational and inter-organizational e-collaboration, internal and external e-business capabilities, and information exchange capabilities and digitization of business activities with customers and suppliers. However, previous research has not investigated the mediating role of two fundamental structural elements of modern economy, ICT and BPR, or of the 'classical' non-ICT assets, in the relationship between e-business adoption and business performance.

Regarding the relationships among e-business strategy adoption, ICT investment, BPR, non-ICT investment and business performance, there is research focusing on some of these relationships, but not on the whole network of these relationships. In particular, empirical investigations have analyzed the effect of ICT investment, non-ICT investment and BPR on business performance (e.g. Guimaraes and Bond 1996, Brynjolfsson and Hitt 1996, Stolarick 1999, Bertschek and Kaiser 2001, OECD 2003 and 2004, Black and Lynch 2004, Melville et al 2004, Arvanitis 2005, Altinkemer et al 2007, Wan et al 2007). The studies have produced evidence of a positive impact of these elements on various financial and non-financial measures of business performance. Also, there is considerable literature supporting and analyzing, mainly through theoretical arguments, the innovative potential of ICTs as catalysts and enablers of BPR, which can result in high levels of performance improvements (e.g. Brynjolfsson and Hitt 1996, Brynjolfsson and Hitt 1998, Brynjolfsson and Hitt 2000, Bresnahan et al 2002, Attaran 2004, OECD 2004); however, there are only a very small number of empirical studies analyzing the mediating effect of BPR on the relationship between ICT and business performance (Grover et al 1998, Albadvi et al 2007).

3 RESEARCH MODEL AND HYPOTHESES

This section presents the research model (see Fig. 1) and develops its associated hypotheses.

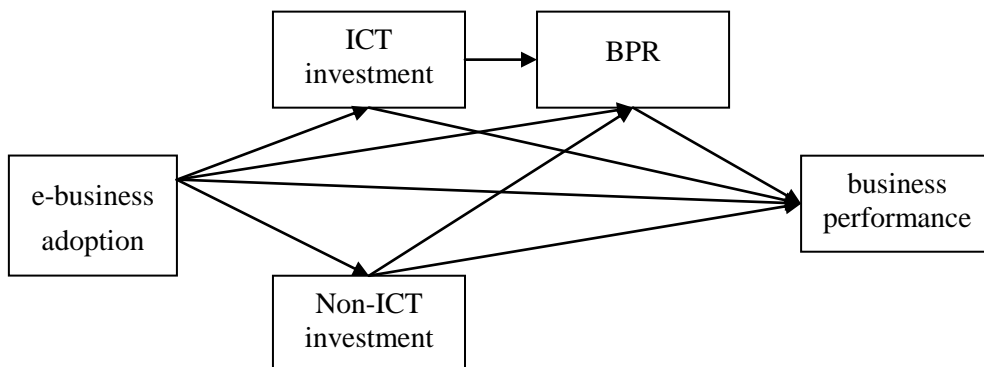


Figure 1. The hypothesized research model.

The study's first hypothesis considers the effect of e-business adoption on business performance. E-business can provide distinct value propositions to the firm, which in turn may result in higher levels of business performance. It enables the creation of different capabilities with customers related to the offering of extensive information online, to current and prospective customers, the establishing of electronic communications and the execution of online transactions (Soto-Acosta and Meroño-Cerdan 2006). With regard to offering information online, firms adopting e-business can use the Internet for providing extensive product/service information, achieving high levels of 'reach and richness' (Evans and Wruster 1999); 'reach' concerns the number of people that are reachable quickly and cheaply through these technologies, while 'richness' relates to the depth and detail of information that can be provided to them. E-business can also be a source of value creation to the firm through building capabilities with customers for efficient and effective communications, which are of critical importance for building and maintaining long-term customer relationships (Cannon and Homburg 2001, Heldal et al 2004). In this direction, many firms today are competent in offering after-sales support through their websites. Moreover, companies are using interactive applications such as loyalty

programs and web forums to facilitate the development of virtual communities (Amit and Zott 2001). Another source of value creation in e-business identified by Amit and Zott (2001) is the transaction efficiency resulting from online transactions such as e-sales and e-procurement. E-sales (or selling online) may increase the volume of sales, the number of customers and the quality of customer service; they connect firms to consumers in geographic areas that would be too costly to reach otherwise (Steinfeld et al 1999). In addition, selling online can provide value through the automation of the sales process, which reduces staff workload and allows them to focus on more complex tasks or on exceptions instead of routine tasks. With regard to e-procurement (or buying online), it can contribute to improvements of business performance through the reduction of procurement and inventory costs, as well as through the establishment of strategic networks with suppliers that allow effective and efficient supply chain management (SCM). Also, Internet technologies can enhance SCM decision making by enabling the collection and analysis of real time information in order to facilitate collaboration between trading partners in a supply chain. In this sense Frohlich and Westbrook (2002) showed the importance of linking customers and suppliers together in tightly integrated networks. As a result of e-procurement, the collection of real-time information on demand is possible and, more importantly, products and services are delivered quickly and reliably when and where they are needed (Frohlich 2002). At the same time, e-business facilitates and enables innovation in the way firms do business through new business models (Timmers 1998, Afuah and Tucci 2001, Tavlaki and Loukis 2005), which might result in much higher numbers of customers and sales. For the above reasons we expect that the adoption of e-business improves business performance, so our first research hypothesis is:

Hypothesis 1: The extent of e-business adoption has a positive effect on business performance

However, a firm adopting e-business, in order to exploit the abovementioned important value proposition it offers, should modify some of its business processes, make them more inter-departmental (horizontal and customer-focused) or even create new business processes, so that it can systematically offer extensive high quality and updated information online to current and prospective customers about its products and services, establish with them new ways of electronic communications and support e-sales and e-procurement. New business processes should be implemented in order to receive electronic orders and payments 24 hours daily and 7 days per week, deliver products to geographically remote and dispersed customers in time as well as to offer after-sales support electronically, etc. Also, new business processes need to be adopted to support the new loyalty programs that firms are implementing through their e-business websites, or to facilitate the development of web forums and virtual communities around their products and services. Furthermore, new business processes, or extensive modifications of the existing ones, are required in order to support the new business models that e-business facilitates and enables. In general, all the capabilities that e-business offers, which have been mentioned in the previous paragraph, necessitate some form of BPR to be exploited. Previous empirical investigations, as mentioned in the literature review section, have produced considerable evidence of a positive relationship between BPR and business performance (e.g. Guimaraes and Bond 1996, Bertschek and Kaiser 2001, Black and Lynch 2004, Arvanitis 2005, Altinkemer et al 2007). E-business provides the electronic means to enable connections among and between business processes in order to take place in fundamentally new ways and at such speeds that it literally opens up the ability to radically reconfigure core operating process. E-business can generate internal efficiency and external coordination through changes in intra- or inter-organizational integrative processes, reducing both fixed and variable costs (Kambil et al 1999, Quan et al 2003). Thus, e-business has a pervasive impact across the entire span of a firm's business processes, from the purchasing department and the supply-chain coordination to the field sales force (Wu et al 2003). Consequently, organisations today frequently integrate e-business to redesign processes in ways that strengthen their competitive advantages (Phan 2003). For the above reasons we expect that BPR has a mediating role in the relationship between e-business adoption and business performance, so our second research hypothesis is:

Hypothesis 2: The BPR mediates the relationship between the extent of e-business adoption and

business performance

Furthermore, firms adopting e-business in order to exploit the abovementioned value proposition usually make additional investments on ICTs and non-ICTs. For instance, in order to use the Internet for offering online information about products and services, establishing with them electronic communications, as well as for e-sales and e-procurement, it is necessary to make additional ICTs investments, e.g. for new web servers, internal information systems (IS) upgrade and applications that allow front-end and back-end integration of IS (Turban et al 2008). Also, the high requirements posed by e-business with respect to receiving and delivering orders 24 hours daily 7 days per week to geographically remote and dispersed customers, with short delivery times, and also the high competition that e-business gives rise to, may lead to the need for additional non-ICT investments (e.g. new production equipment, buildings, warehouses, etc.). Previous empirical investigations, as mentioned in the literature review section, have provided considerable evidence that both ICT and non-ICT investments have a positive impact on business performance (e.g. Brynjolfsson and Hitt 1996, Stolarick 1999, OECD 2003 and 2004, Melville et al 2004, Arvanitis 2005, Wan et al 2007). For the above reasons we expect that both ICT and non-ICT investment have a mediating role in the relationship between e-business adoption and business performance, so our third research hypothesis is:

Hypothesis 3: *The ICT investment mediates the relationship between the extent of e-business adoption and business performance*

while our fourth hypothesis is:

Hypothesis 4: *The non-ICT investment mediates the relationship between the extent of e-business adoption and business performance*

Our next research hypotheses examine two relationships: ICT investment and BPR, and non-ICT investment and BPR. As mentioned in the introduction, ICT are ‘general purpose’ technologies, which can be adapted to many different uses and functions and enable important innovations (Bresnahan and Trajtenberg 1995, Melville et al 2007, etc.). There is considerable literature supporting and analyzing, through a series of theoretical arguments, the innovative potential of ICT as catalysts and enablers of business process redesign (e.g. Brynjolfsson & Hitt 1996, Brynjolfsson and Hitt 1998, Brynjolfsson & Hitt 2000, Bresnahan et al 2002, OECD 2004). On the contrary, non-ICT assets are not characterised by such a high adaptability and multi-functionality, so they are not expected to enable process innovation. Therefore, a significant positive relationship between ICT investment and BPR is anticipated, while there may not be significant relationship between non-ICT investment and BPR. Thus, our next two research hypotheses are as follows:

Hypothesis 5: *ICT investment has a positive and significant effect on the extent of BPR.*

Hypothesis 6: *Non-ICT investment does not have an effect on the extent of BPR.*

4 METHOD AND DATA

The present study uses a well established and mature foundation from the microeconomics domain, the Cobb-Douglas production function (Nicholson, 1998). It posits that firm output, measured by its value added (VA) during a given time period (=sales revenue minus expenses for buying materials and services), is an exponential function of the basic inputs it used in this period, the capital (K) and the labour (L) employed, while it is also affected by the management of the firm that determines how efficiently are these inputs used; if we divide capital into computer capital (CK) and non-computer capital (NCK) it takes the following form:

$$VA = e^{\beta_0} L^{\beta_1} NCK^{\beta_2} CK^{\beta_3} \quad (4.1)$$

and if we log-transform (4.1) we obtain the following linear form of it:

$$\ln VA = \beta_0 + \beta_1 \ln(L) + \beta_2 \ln(NCK) + \beta_3 \ln(CK) + u_i \quad (4.2)$$

This equation, after dividing both sides by the number of firm employees (N), denotes that the log-transformed value added per employee (labour productivity) is a linear function of the log-transformed non-computer capital (regular assets) per employee, the log-transformed computer capital (ICT assets) per employee and also management-related factors (such as the business process redesign and adaptation and the adoption of e-business strategy in our case). Using this as a foundation for our research model shown in Figure 1, we selected the log-transformed value added per employee (labour productivity) as an objective measure of business performance, which has been used as dependent variable in many empirical studies of the effect of ICT and organizational change on business performance (e.g. Bertschek & Kaiser 2001, Black & Lynch 2004, Arvanitis 2005); in the same direction we used the log-transformed computer capital (=value of firm's ICT equipment- hardware, software and networks) per employee and the log-transformed non-computer capital (=value of firms' non-ICT assets) per employee as objective measures of ICT investment and non-ICT investment respectively. Concerning the extent of BPR, since it constitutes a more abstract and multidimensional concept, we decided to measure it as a reflective construct using a nine-item scale, developed through a comprehensive review of the BPR literature (Hammer 1990, Davenport 1990, Hammer and Champy 1993, Davenport 1993, Grover et al 1993, Davenport and Nohria 1994, Martinsons 1995, Gunasekaran and Nath 1997, O'Neill et al 1999, Al Mashari and Zairi 2000, Al Mashari et al 2001, Champy 2002), which is shown in the Appendix. Finally the extent of e-business adoption has been used as a measure of e-business activity.

We tested the abovementioned research hypotheses by estimating the hypothesized research model shown in Figure 1 three times using a covariance-based structural equations modelling (SEM) approach (Kline 2005), which has been implemented through the AMOS 6 software (Byrne, 2001). The data we used have been obtained through a survey among Greek companies conducted in cooperation with ICAP SA, one of the largest business information and consulting companies of Greece. An initial version of the survey instrument was pre-tested by three experienced ICAP employees, and their remarks were used for formulating the final version of it. The formulation and criteria for answering the questionnaire is defined in the appendix. The instrument was sent by mail to the managing directors of a random sample of 304 Greek firms from the 27 most important sectors of Greek economy, with an equal representation of small, medium and large firms (103 small firms with more than 10 and less than 50 employees, 103 medium ones with more than or equal to 50 and less than 250 employees, and 98 large ones with more than or equal to 250 employees). One month later the recipients who had not responded were contacted by phone again and reminded of the questionnaire; firms that refused to participate were replaced by 'similar' ones (i.e. of the same size and industry class) from a second sample that had been created from the database of ICAP with similar proportions of the size and sector classes. Finally we received complete questionnaires from 271 companies (88 small, 105 medium and 78 large ones).

5 DATA ANALYSIS AND RESULTS

The hypothesized research model shown in Figure 1 was estimated through covariance-based SEM (Kline 2005), which allows estimating at the same time both the measurement and the structural part of the model, using the AMOS 6 software (Byrne, 2001). Initially we examined the measurement part of the model assessing the validity and reliability of the BPR construct. Concerning construct validity we assessed its most important dimension, the convergent validity (Straub et al 2004), by examining the loadings of the nine BPR items, which are shown in Table 1; all of them are statistically significant and exceed the cut-off level of 0.6 suggested by Chin (1998), so the BPR construct is characterised by convergent validity and all items should be retained (no 'purification' is required). Next we assessed the reliability of the BPR construct by calculating Cronbach's Alpha using the SPSS 15.0 software, which was found to be 0.914, exceeding the cut-off level of 0.7 recommended by the relevant

literature (Gefen et al 2000, Straub et al 2004), so it was concluded that the BPR construct is characterised by reliability as well.

Item	Loading
BPR_1	.752
BPR_2	.684
BPR_3	.775
BPR_4	.699
BPR_5	.717
BPR_6	.808
BPR_7	.726
BPR_8	.700
BPR_9	.666

Table 1. Loadings of the items of the BPR construct.

Then we assessed the fit of the whole model by examining the values of its basic fit indices shown in Table 2; we can see that we have acceptable values, based on the recommendations of the relevant literature (Gefen et al 2000, Straub et al 2004), for both the incremental fit indexes NFI, RFI, IFI, TLI and CFI (> 0.9) and for the RMSEA (< 0.05), so the model we estimated is characterised by acceptable fit to the data.

Chi-square	NFI	RFI	IFI	TLI	CFI	RMSEA
81.22	.949	.925	.982	.973	.981	.044

Table 2. Model fit indices

Having confirmed acceptable model fit and BPR construct validity and reliability, we finally focused our attention on the structural model, which is shown in Figures 2 (only the standardised coefficients of the statistically significant paths are presented). We remark that the extent of e-business strategy adoption has a statistically significant positive effect on the extent of BPR (standardised coefficient 0.252), while it does not have statistically a significant effect on ICT and non-ICT investment. These results indicate that firms implement e-business strategies mainly through the 'soft action' of redesigning their business processes (e.g. modifying or even abolishing their existing business processes, making them more horizontal and customer-focused or creating new ones), so that they can systematically offer extensive, high quality and updated information online to current and prospective customers about their products and services, establish electronic communications, support e-sales, conduct e-procurement, etc. However, firms implementing e-business strategies do not proceed to the 'hard action' of significant additional ICT or non-ICT investments, probably preferring mainly to adapt and 'align' their existing ICT and non-ICT assets to their e-business strategies (e.g. in a 'strategic alignment' sense (Henderson and Venkatraman 1999, Luftman 2000)).

However, all the investigated internal factors (ICT investment, non-ICT investment and BPR) have positive significant effects on business performance, which is in accordance with the conclusions of the relevant literature mentioned in section 2. The effect of ICT investment is the highest (standardised coefficient 0.328), followed by the one of BPR (standardised coefficient 0.160) and finally the one of the non-ICT investment (standardised coefficient 0.104). These results show a positive significant indirect effect of e-business adoption on business performance through BPR, so hypothesis 2 is supported. On the contrary, the relationship between e-business adoption and business performance is not mediated by ICT and non-ICT investments, so hypotheses 3 and 4 are not supported. This means that e-business adoption is a driver of significant business process adaptation, which in turn results in higher levels of business performance. This provides support for hypothesis 1, since e-business does not have a significant effect on business performance, but has an indirect one through BPR.

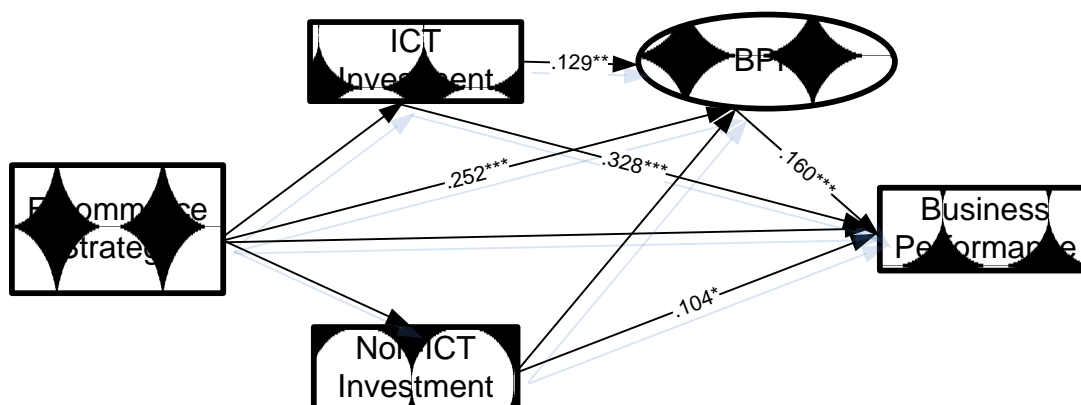


Figure 2. The estimated structural model.

Finally, concerning the relations between the investigated internal factors, we remark that ICT investment has a positive significant effect on BPR (standardised coefficient 0.129), so hypothesis 5 is supported. On the contrary, non-ICT investment does not have a significant effect on BPR, therefore hypothesis 6 is supported. These findings are in line with our initial expectations mentioned in section 3. The above results indicate that the fundamental difference between ICT and non-ICT capital mentioned in the introduction results in fundamental differences in their relation with BPR. In particular, ICT investment, being a ‘general purpose technology’ (Bresnahan and Trajtenberg 1995, Melville et al 2007) with high levels of adaptability to different ways of use, is a significant driver of BPR. On the contrary, the non-ICT investment, which is not a general purpose technology and does not have high adaptability and multi-functionality, is not a significant driver of BPR. From the above results it can be also concluded that the ICT investment has not only a direct effect on business performance, but also an indirect one through BPR. Therefore BPR ‘partially mediates’ (adopting the terminology of Venkatraman (1989)) the relationship between ICT investment and business performance. This conclusion is in line with the findings of two previous empirical studies that have been conducted, as mentioned in the literature review section, with regard to the mediating effect of BPR on the relationship between ICT and business performance (Grover et al 1998, Albadvi et al 2007).

6 CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

The relationships among strategy, structure and performance have been theorized in management science, and their analysis has been a major research topic of particular interest for both researchers and management practitioners. This paper investigates empirically these theories for the case of e-business strategy adoption. In particular, it presents an empirical study of the network of relations between the adoption of e-business strategy (at a first level), ICT investment, BPR, non-ICT investment (at a second level) and financial business performance (at a third level). It develops a research model consisting of several hypothesized relationships among e-business strategy adoption, ICT investment, non-ICT investment, BPR and business performance. In order to measure the abstract and multidimensional BPR concept with high levels of reliability a multi-item scale has been developed through extensive review of the relevant BPR literature, and then validated using the methods proposed by the relevant statistical literature. Also this study compares ICT investment and non-ICT investment as to their relationships with e-business strategy, BPR and business performance. In order to test the above hypotheses data from a sample comprising 271 Greek firms are collected and used to estimate a structural equation model (SEM). From the estimated SEM, which connects the above variables, it is concluded that the adoption of e-business strategy has a positive significant effect on BPR, so it results to business process adaptation, but not on ICT and non-ICT investments. Also, BPR, ICT investment and non-ICT investment all have positive a significant effect on business

performance. These results indicate that firms implement their e-business strategy mainly through the 'soft action' of redesigning their business processes, and not through 'hard actions' of additional ICT or non-ICT investments. Another interesting conclusion is that the positive effect of e-business on performance is fully mediated by the BPR the former drives, which in turn has a positive effect on performance. Furthermore, BPR mediates partially the relationship between ICT investment and business performance.

The paper presents some limitations that will be addressed in future research. The first limitation is that the study used a sample of Greek firms. Therefore it may be possible that the findings could be influenced by the economic, cultural, social, etc. characteristics of the Greek national context. In particular, Greece is characterised by a small size of internal market and small average firm size, which makes economies of scale (being of particular importance for proceeding to investments in ICT and non-ICT assets) more difficult than in other bigger countries. Technologically Greece is characterised by lower ICT usage and investment than most European countries (European Commission 2008), which might result in a lower correlation between e-business adoption and ICT investment. Also, culturally it is characterised by a disposition to uncertainty avoidance, as shown by its higher Uncertainty Avoidance Index (UAI) score in comparison with the other European countries and USA, according to the assessments of Geert Hofstede (<http://www.geert-hofstede.com/>), which might affect negatively the attitudes of firms towards BPR. For the above reasons, it could be interesting to conduct similar empirical studies in other national contexts as well and compare their findings with the ones presented in this study. Another limitation is that in this study we use only one business performance measure, the value added per employee (labour productivity), so it would be interesting to conduct similar empirical studies using other measures of business performance as well.

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Appendix: Survey Questions

- Yearly total sales revenue (without VAT) : _____ Euro
- Yearly total expenses for buying materials and services (without VAT): _____ Euro
- Number of employees : _____
- Value of assets at the end of the year (without VAT) : _____ Euro
- Value of ICT equipment (hardware, software and networks) at the end of the year (without VAT): _____ Euro

Answer the following questions in a scale 1 – 5, where 1 = Not at all, 2 = To a small extent, 3 = To a moderate extent, 4 = To a large extent, 5 = To a very large extent, by clicking the appropriate box in the right of each question

- To what extent have you performed the following business process reengineering (BPR) activities in the last 5 years?

BPR ACTIVITIES	1	2	3	4	5
BPR_1: Creation of new horizontal (inter-departmental) processes (that cross more than one departments)					
BPR_2: Creation of new inter-departmental units/workgroups (e.g. customer or product-focused)					

BPR_3: Creation of new horizontal coordination roles (process coordinators) for monitoring and coordinating the efficient and faster execution of process crossing more than one department.

BPR_4: Simplification of processes

BPR_5: Improvement of processes

BPR_6: Abolition of processes

BPR_7: Redesign of processes so that they become customer-focused

BPR_8: Job enrichment - increase of decision making competences authorization for employees involved in some processes

BPR_9: Decrease of supervision and number of supervisors in some processes

- To what extent has your firm adopted e business?

(1) not at all (2) to a small extent (3) to a moderate extent (4) to a large extent (5) to a very large extent