

THE EFFECT OF GENERALIZED COMPETITION AND STRATEGY ON THE BUSINESS VALUE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

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Abstract

In this paper is presented an empirical study of the effect of two external environment factors: i) the 'generalized' competition the organization faces, which, according to M. Porter's 'Five Forces Model' of competition, consists of the bargaining power of its suppliers, the bargaining power of its buyers, the competitive rivalry from its competitors, the threat of new entrants and the threat of substitute products or services, and ii) the strategy the organization follows for responding to pressures of its external environment, on the business value generated by ICT investment. The study is based on firm-level data from Greek companies, which have been collected through a survey using a structured questionnaire in cooperation with ICAP, one of the largest business information and consulting companies of Greece. Using these data are constructed econometric models of output, based on the microeconomic production theory, and in particular on the Cobb Douglas production function. From these models concerning the above generalized competition dimensions it is concluded that higher level of bargaining power of suppliers results in higher ICT business value. Also concerning strategy it is concluded that organizations following a strategy of frequent introduction of new innovative products and services enjoy higher ICT business value.

Keywords: information systems (or information and communication technologies) investment, information systems (or information and communication technologies) business value, competition, Porter's Five Forces Framework, strategy.

1 INTRODUCTION

The business value generated by the significant financial resources invested by organizations in information and communication technologies (ICT) has been a major research topic in the area of information systems (IS) for long time (for more than 20 years), due to its critical importance for the ICT industry, the IS practitioners and the public policy makers. In the first period of this research until the mid 1990s the results concerning the relation between ICT investment and business performance were mixed or inconclusive, posing critical questions concerning the business value generated by the significant investments that organizations made in ICT, and giving rise to the 'ICT Productivity Paradox' (Solow 1987, Brynjolfsson 1993). However, subsequent research after the mid 1990s provided considerable empirical evidence of positive and statistically significant contribution of ICT investment to some measures of business performance (e.g. Brynjolfsson and Hitt 1996; OECD 2003, OECD 2004, Loukis and Sapounas 2004), even through there are still studies resulting in mixed or

inconclusive results concerning the impact of ICT investment on business performance (e.g. Stiroh 1998, Carr 2003).

The extensive research conducted in this area has also concluded that the magnitude of the business value ICT generate for an organization is affected to a large extent by a number of ‘internal factors’, which are related to the internal functions of the organization, such as new work practices, new business processes, new human skills, innovation, new IS management structures, etc. (e.g. Brynjolfsson, Hitt and Yang 2000, Ramirez 2003, Arvanitis 2003 and 2005, Loukis and Sapounas 2004, Hempell 2005). However, limited research has been conducted on the effect of ‘external’ factors, which are related to the external environment of the organization, on the business value generated by its ICT investment. Melville, Kraemer and Gurbaxani (2004) in their literature review conclude that ‘We know very little about how industry characteristics moderate the degree of IT business value’ and suggest that empirical research is required in this direction and especially for investigating the effects of competition on the efficiency gains achieved via ICT. Therefore the effect of external environment factors on the business value generated by ICT should be researched as well, in order to find out whether there are external environment conditions leading to systematically higher or lower ICT business value and also understand the underlying reasons, so that organizations can take them into account in planning their ICT investment.

In this direction our paper describes an empirical study of the effect of two external environment related factors, the ‘generalized’ competition an organization faces, as it is conceptualised by the well established ‘Five Forces Model’ of industry structure developed by M. Porter (Porter 1980), and the strategies an organization follows in order to respond to pressures of its external environment, on the business value generated by its ICT investment. Our research objective is to investigate whether:

- the intensity of each of the ‘five forces’ of M. Porter’s model of industry structure (bargaining power of suppliers, bargaining power of buyers, competitive rivalry from competitors, threat of new entrants and threat of substitute products or services), which constitute the basic dimensions of the generalised competition an organization faces,
- and the degree of following each of the six fundamental strategies according to the relevant literature (cost leadership, quality differentiation, specialised products/services, frequent introduction of new products/services, expansion to markets of other countries and expansion to new activities)

affect systematically (positively or negatively) the business value generated by the ICT investment of an organization, which is quantified as the contribution of its ICT investment to output. The above research questions have not been addressed by the literature despite their significance for ICT planning in organizations. In the following sections initially the relevant literature is reviewed (section 2); then the methodology and the data of this study are described (section 3), and the results are presented and discussed (section 4); the final section contains the conclusions and directions for future research.

2 LITERATURE REVIEW

Extensive research has been conducted on the business value that ICT investment generates, aiming mainly at the assessment and understanding of the impact of ICT investment on business performance, and also at the identification of factors affecting the magnitude of this impact. This research can be broadly divided into two periods. The first period of this research, from the mid 1980s until the mid 1990s (Roach 1987, Strassman 1990, Yosri 1992, Weill 1992, Loveman 1994, Barua, Kriebel and Mukhopadhyay 1995, Hitt and Brynjolfsson 1996, Rai, Patnayakuni R. and Patnayakuni N. 1996, Rai, Patnayakuni R. and Patnayakuni N. 1997, Strassman 1997), contrary to theoretical arguments and professional beliefs, provided very little empirical evidence of a positive and statistically significant relation between ICT investment and business performance. These counter intuitive results posed to

the academic and the management community critical questions concerning the practical usefulness and the productivity of the ICT investments, giving rise to the 'ICT Productivity Paradox' (Solow 1987, Brynjolfsson 1993). On the contrary, the second period of this research, from the mid 1990s until today, provided considerable empirical evidence of positive and statistically significant contribution of ICT investment to several measures of business performance, such as output, labour productivity, etc. (Lichtenberg 1995, Brynjolfsson and Hitt 1996, Dewan and Min 1997, Gurbaxani, Melville and Kraemer 1998, Stolarick 1999, Lehr and Lichtenberg 1999, Gilchrist, Gurbaxani and Towne 2001, Devaraj and Kohli 2000, OECD 2003, Sigala 2003, Loukis and Sapounas 2004). These results reflect the improvements in the ways organizations used and managed ICT after the mid 1990s, and also the adjustment and the restructuring that had taken place at the firm level between the mid 1980s and the mid 1990s, which enabled a higher level of benefits from ICT; also they reflect improvements in the research methodology (e.g. in data collection and analysis methods). However, in this second period there are still studies resulting in mixed or inconclusive evidence concerning the impact of ICT investment on business performance (e.g. Stroh 1998, Hartman 2002, Carr 2003).

Another important conclusion of the whole research on ICT business value is that the magnitude of the business value organizations get from their ICT investment varies considerably, depending to a large extent on several 'internal' factors, i.e. to several factors related to the internal functions of the organization. For this reason since the late 1990s considerable research has been conducted for the identification of complementary actions and factors, which, in combination with ICT investment, can increase its positive impact on business performance. In this direction Devaraj and Kohli (2000) from an empirical study concluded that the combination of ICT investment with business processes reengineering increases its positive effect on output. Tallon, Kraemer and Gurbaxani (2000), based on a survey of business executives, found that the strategic alignment of ICT investment with business strategy results in higher business value from the ICT investment. Bharadwaj (2000), adopting a resource-based view of the firm, found that it is not simply the investment in ICT infrastructure, but the creation of unique ICT-related capabilities, that leads to higher firm performance. Brynjolfsson, Hitt and Yang (2000) concluded that the combination of decentralisation practices with ICT has a disproportionately large positive effect on firm market value. Ramirez (2003), based on data from large USA enterprises, concluded that there is complementarity between ICT investment and employee involvement: their combination results in additional output and labour productivity increase beyond the individual effects of these two factors; similar were his conclusions for the total quality management. Arvanitis (2003 and 2005), based on data from Swiss firms, provides evidence of a similar complementarity between ICT capital and human capital with respect to labour productivity. Loukis and Sapounas (2004), based on data from Greek companies, found that there is complementarity between IS investment and a set of IS management factors with respect to firm output and labour productivity. Hempell (2005), based on firm-level panel data covering a five years' period, concluded that ICT investment is more productive in firms with experience in innovations.

However, limited research has been conducted about the effect of factors related to the external environment of the organization on the business value generated by its ICT investment. One of the most important factors of the external environment of an organization is the competition it faces. The economic literature has been emphasizing for long time (e.g. Primeaux 1977) that higher competition results in more efficient utilization of resources; so we can expect that higher competition could result in more efficient utilization of ICT resources and therefore higher levels of ICT business value. On the contrary, Brynjolfsson and Hitt (1996) argue that higher competition may 'compete away' part of the business value generated by ICT, by putting pressure on the organization to transfer part of this business value to the consumers of its products/services and increase consumer surplus, but at the same time decreasing the business value the organization gets from its ICT investment; so, based on this argument, we can expect that higher competition could reduce the magnitude of the business value an organization finally gets from its ICT investment. These mixed expectations are also stressed by Melville, Kraemer and Gurbaxani (2004) in their literature review of the ICT business value research, who mention that 'Although in highly competitive markets firms may apply IT more efficiently,

profitability may suffer as gains to IT application are competed away' and suggest that empirical research is required in this direction. It is also worth noting that even this limited literature on this topic focuses on only one of the dimensions of the competition an organization faces: the competitive rivalry from its competitors. However, strategic management literature has emphasized long time ago the need to adopt a wider and multidimensional view of competition. According to the 'Five Forces Model' of industry structure developed by M. Porter (Porter 1980), there are five different competitive forces an organization faces, which all in combination determine its competitive position and profitability potential: bargaining power of suppliers, bargaining power of buyers, competitive rivalry from competitors, threat of new entrants and threat of substitute products or services. Therefore empirical research is required, based on 'real-life' data, in order to investigate the effects of the above five dimensions of the 'generalized competition' organizations face on the business value they get from their ICT investment.

Also, limited is the research that has been conducted on the effect of the strategies an organization follows, in order to respond to pressures from its external environment, on the business value generated by its ICT investment. According to strategic management literature (e.g. Porter 1980, Porter 1985, Wheelen and Hunger 2004, Johnson and Scholes 2005) there are some fundamental strategies that an organization may decide to follow in order to respond to pressures of its external environment: cost leadership, quality differentiation, specialised products/services, frequent introduction of new products/ services, expansion to markets of other countries and expansion to new activities. Each of these strategies necessitates a different way of using ICT, with different objectives and focus; for example a cost leadership strategy necessitates a quite different way of using ICT, with quite different objectives and focus, than a quality differentiation strategy. The mutual relation between strategy and ICT has been extensively emphasized by the relevant literature (e.g. Porter and Millar 1985, Galliers 2004) concluding that ICT can be of critical importance both for supporting the strategy of an organization, and also for redefining and enriching it with new ICT-based ways of generating revenue and achieving competitive advantages. Therefore it is interesting to investigate empirically, based on 'real-life' data, the effect of following each of the above fundamental strategies on the business value organizations get from their ICT investment.

3 METHOD AND DATA

Based on the conclusions of the above literature review, the research objective of this study is to investigate the effect of:

a) each of the five dimensions of the 'generalized competition' an organization faces according to M. Porter's 'Five Forces Model' of competition (Porter 1980), namely of the bargaining power of suppliers, the bargaining power of buyers, the competitive rivalry from competitors, the threat of new entrants and the threat of substitute products or services,

b) and of following each of the abovementioned six basic strategies, namely cost leadership, quality differentiation, specialised products/services, frequent introduction of new products/services, expansion to markets of other countries and expansion to new activities,

on the business value organizations get from their ICT investment, and in particular on the contribution of ICT to output.

For this purpose the following eleven research hypotheses H1 to H11 were tested:

H1: the level of bargaining power of suppliers affects the contribution of ICT to firm output

H2: the level of bargaining power of buyers affects the contribution of ICT to firm output

H3: the level of competitive rivalry from competitors affects the contribution of ICT to firm output

H4: the level of threat of new entrants affects the contribution of ICT to firm output

H5: the level of threat of substitute products or services affects the contribution of ICT to firm output

H6: the degree of following a cost leadership strategy affects the contribution of ICT to firm output

H7: the degree of following a quality differentiation strategy affects the contribution of ICT to firm output

H8: the degree of following a specialised product/services strategy affects the contribution of ICT to firm output

H9: the degree of following a strategy of frequent introduction of new products/services affects the contribution of ICT to firm output

H10: the degree of following a strategy of expansion to markets of other countries affects the contribution of ICT to firm output

H11: the degree of following a strategy of expansion to new activities affects the contribution of ICT to firm output

For testing the above eleven hypotheses, econometric models for firm output were constructed, based on the microeconomic production theory, and in particular on the Cobb Douglas production function, which has been extensively used in the past in economic studies as basis for the estimation of the contribution to firm output of various firm inputs, including ICT investment (e.g. Brynjolfsson & Hitt 1996, Stolarick 1999, OECD 2003, Ramirez 2003, OECD 2004). In particular, we used as our basis the following extended form of the Cobb Douglas production function, in which the capital is divided into computer capital and non-computer capital:

$$VA = e^{\beta_0} L^{\beta_1} K^{\beta_2} CK^{\beta_3} \quad (3.1)$$

where VA is the yearly firm value added (which is equal to yearly sales revenue minus yearly expenses for buying materials and services), and L, K and CK are the yearly labour expenses, the non-computer capital and the computer capital respectively, while the $\beta_1 - \beta_3$ are the corresponding output elasticities with respect to these three inputs. By log-transforming this model, we obtain the following linear model:

$$\ln VA = \beta_0 + \beta_1 \ln(L) + \beta_2 \ln(K) + \beta_3 \ln(CK) \quad (3.2)$$

In order to investigate the effect of each of the above eleven factors of hypotheses H1 to H11 (level of bargaining power of suppliers, level of bargaining power of buyers, etc.) on the contribution of ICT to output, we added to this model one more 'interaction term', which is equal to the product of the corresponding factor F to the $\ln(CK)$:

$$\ln VA = \beta_0 + \beta_1 \ln(L) + \beta_2 \ln(K) + \beta_3 \ln(CK) + \beta_4 \ln(CK) \cdot F \quad (3.3)$$

The data we used in this study for constructing the econometric models were collected through a survey among Greek companies, titled 'Usage of information and communication technologies, modern organization forms and innovation in the Greek companies', in cooperation with ICAP, one of the largest business information and consulting companies of Greece. This survey was based on a structured questionnaire, which included questions about the basic financial data of the company for the year 2004 (sales revenue, expenses for materials and services, labour expenses, value of capital, value of computer capital, etc.), and also questions asking them to assess in a five levels scale: a) how intensive is for them each of the abovementioned five forces of M. Porter's model, b) to what degree they follow each of six abovementioned strategies; additionally, it included questions about innovative activity, new forms of work organization, new forms of human resources management, redesign of processes and organizational practices, quality, usage of various kinds of IS and IS management

practices and processes (the processing and analysis of the responses to these additional questions is still in progress). The sample of the survey was randomly selected from the database of ICAP, which includes financial and other business information for approximately 135,000 Greek firms, and consisted of 304 Greek companies from the 27 most important sectors of Greek economy; there was equal representation in the sample of the small, the medium and the large companies (according to the relevant definitions of the European Union): in particular, 103 of these companies were small (with more than 10 and less than 50 employees), 103 were medium (with more than or equal to 50 and less than 250 employees) and 98 were large (with more than or equal to 250 employees). The questionnaire was sent by mail to the Managing Directors of these 304 companies; the recipients were asked to fill in the questionnaire and return it by fax or mail within one month. After one month all the recipients who had not responded were contacted by phone again and reminded of the questionnaire. For most of the companies of the sample several phone calls were required, in order to have the questionnaire filled in completely and correctly; in general there are big difficulties in collecting such data, because many companies regard them as confidential. Finally were received answered questionnaires from 176 companies (64 small, 65 medium and 47 large ones), so the response rate was 57.9%; their average number of employees is 493 and their average sales revenue in 2004 was 183,7 million Euro.

4 RESULTS

Initially we estimated the model of equation (3.2) of the previous section, and the results are shown in Table 1. We remark that the coefficients of labour, non-computer capital and computer capital are all positive and statistically significant, so we conclude that all these three inputs make a positive contribution to firm output. These results confirm the relevant conclusion we had drawn in our previous study (Loukis and Sapounas 2004), which based on a different dataset collected in a survey among Greek companies, that ICT investments of Greek companies make a positive and statistically significant contribution to their output.

Dependent variable : ln (VA)		
Independent variable	Coefficient	Significance
constant	2.677	0.003
ln (L)	0,558	0.000
ln (K)	0,155	0.030
ln (CK)	0,219	0.009
R-squared : 0.60		

Table 1 Regression results for the impact of labour, non-computer capital and computer capital on output

Proceeding to the basic research questions of this study, in order to examine the effect of each of the abovementioned five dimensions of the generalized competition on the contribution of ICT to output, we estimated the model of equation (3.3) for each of the five factors of the research hypotheses H1 to H5 (level of bargaining power of suppliers (SP), level of bargaining power of buyers (BP), etc.). From these five models, only the model for the bargaining power of suppliers (factor SP), which is shown in Table 2, had an interaction term with a statistically significant coefficient; in the other four models the coefficient of the interaction term was not statistically significant. These findings support hypothesis H1, but provide no support for hypotheses H2 to H5. From the positive and statistically significant value of the interaction term in this model of Table 2 it is concluded that higher levels of bargaining power of suppliers result in higher contribution of ICT to output. These results can be explained taking into account the basic characteristics of the Greek economy, which is characterised by small markets and small numbers of competitors in most sectors (since the total population of Greece is 10.9 million

people). For this reason the competitive rivalry, the threat of new entrants and the threat of substitute products or services and the bargaining power of buyers are not so intensive as to create big pressures on the Greek companies for a more efficient utilization of their ICT resources and finally result in higher levels of contribution of ICT to output. However, in such small markets very often the number of potential suppliers of basic inputs in some sectors is limited (in many cases we have practically monopolies or oligopolies), resulting in high levels of bargaining power of these suppliers and therefore in high levels of prices for basic inputs, putting quite big pressures on the Greek companies for a more efficient utilization of their ICT resources for supporting an efficient management of these expensive inputs; for this purpose they have to develop mainly 'efficiency-oriented' applications, which support the efficient planning and monitoring of their operations and of the consumption and transformation of their inputs (e.g. inventory and warehouse management systems, master production planning/monitoring systems, material requirements planning/monitoring systems, etc.). These critical applications increase the contribution of ICT investment to output, and in general the business value it creates.

Dependent variable : $\ln(LP = VA)$		
Independent variable	Coefficient	Significance
constant	2.348	0.010
$\ln(L)$	0.569	0.000
$\ln(K)$	0.158	0.025
$\ln(CK)$	0.167	0.049
$\ln(CK)*SP$	0.019	0.014
R-squared : 0.63		

Table 2. Regression results for the impact of labour, non-computer capital, computer capital and interaction between computer capital and bargaining power of suppliers on output

In order to examine the effect of following each of the six basic strategies mentioned in the previous section on the contribution of ICT to output, we estimated the model of equation (3.3) for each of the six factors of the research hypotheses H6 to H11 (degree of following a cost leadership strategy (CL), degree of following a quality differentiation strategy (QD), etc.). From these six models, only the one corresponding to the strategy of frequent introduction of new products/services (factor NPS), which is shown in Table 3, had an interaction term with a statistically significant coefficient (at the 10% significance level); in the other five models the coefficient of the interaction term was not statistically significant. These findings support hypothesis H9, but provide no support for hypotheses H6, H7, H8, H10 and H11. From the positive and statistically significant value of the interaction term in this model it is concluded that following to a high degree a strategy of frequent introduction of new products/services results in higher levels of contribution of ICT to output. This conclusion can be explained taking into account that such a strategy necessitates both 'innovation-oriented' applications (for supporting the analysis of market research data, the design of new products/services and of their production and delivery processes, marketing plans, etc.) and 'efficiency-oriented' applications (for supporting the efficient planning and monitoring of the production and delivery processes of many new products/services, which usually have to share production and delivery resources with many older products/services, creating high levels of complexity, which can be efficiently managed only using ICT). Such innovation-oriented and efficiency-oriented applications increase the contribution of ICT investment to output, and in general the business value it creates. Moreover, following a strategy of frequent introduction of new products/services often necessitates devising innovative ways of using ICT, which further increase their contribution to output and in general the business value they create.

Dependent variable : ln (LP = VA)		
Independent variable	Coefficient	Significance
Constant	2.603	0.004
ln (L)	0.554	0.000
ln (K)	0.182	0.013
ln (CK)	0.153	0.092
ln (CK)*NPS	0.013	0.082
R-squared : 0.63		

Table 3. Regression results for the impact of labour, non-computer capital, computer capital and interaction between computer capital and strategy of frequent introduction of new products/services on output

5 CONCLUSIONS

In this paper is presented an empirical study of the effect of the ‘generalized’ competition, which is measured in accordance with M. Porter’s ‘Five Forces Model’, and also of six fundamental strategies for responding to environmental pressures, on the business value generated by ICT investment, and in particular on the contribution of the ICT investment to output. It has been concluded that from the ‘Five Forces’ of M. Porter’s model, only the bargaining power of suppliers affects ICT business value; in particular, it has been concluded that higher levels of bargaining power of suppliers create big pressures for the development of mainly ‘efficiency-oriented’ applications, and in general for a more efficient utilization of ICT resources, increasing the contribution of ICT investment to output. These findings can be explained taking into account the basic characteristics of the Greek economy, which is characterised by small markets and small numbers of competitors in most sectors, resulting in low levels of competitive rivalry, threat of new entrants, threat of substitute products or services and bargaining power of buyers; however, in many sectors there are small numbers of potential suppliers of basic inputs, so these suppliers have very high levels of bargaining power, which results in high prices for basic inputs, creating big pressures for ‘efficiency-oriented’ applications and in general for a more efficient utilization of ICT resources. Also it has been concluded that following a strategy of frequent introduction of new products/services creates big pressures for the development of both ‘innovation-oriented’ and ‘efficiency-oriented’ applications, and in general for more innovative and more efficient utilization of ICT resources, resulting in an increase of the contribution of ICT investment to output.

The central conclusion drawn from this study based on ‘real-life’ data is that there are specific external environment conditions leading systematically to the generation of higher business value from ICT investment, by pressurising organisations to use ICT more efficiently and effectively; such a conclusion is quite useful for ICT planning in organizations; also it would be useful to analyse and disseminate broadly the best practices of these highly efficient and effective ICT users. Another important conclusion drawn from this study ‘real-life’ data is that there are specific strategies for responding to the pressures of the external environment, which are characterised by frequent products/services innovations, leading systematically to higher business value from ICT investment; in such innovation strategies the relation between strategy and ICT seems to be much stronger than in the other types of strategies: ICT are much more important both for enabling and enriching innovations strategies, and also for supporting their implementation. Further research is required for testing the above conclusions both in similar national contexts (characterised by small markets and similar levels of economic development) and in different national contexts (characterised by bigger markets and different levels of economic development). Moreover, further research is required in order to investigate the effect of other external environment related factors, e.g. various sectoral characteristics, such as degree of technological change, regulation, workforce composition, etc., on the business value that ICT generate for organizations.

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