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Full Length Research Paper

An empirical research of the effect of internet-based innovation on business value

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In recent years, much debate about the value of information technology (IT) in general and e-business in particular and has been raised. Aiming to contribute to the investigation of whether and how Internet/WWW technologies create business value, this paper develops a conceptual model, grounded on a well established theoretical foundation from the strategic management domain, the resource-based view (RBV) of the firm, which analyzes web infrastructure and internet-based innovation as sources of business value. The methodology involved a large data source collected by the European e-Business Market Watch, an established e-business observatory organization sponsored by the European Commission. Results show that web infrastructure is not significantly related to business value, while on the contrary Internet-based innovation has a positive significant impact on business value. In addition, results show no significant complementarities between web infrastructure and internet-based innovation. These findings indicate that firms should be very careful when they decide to make this kind of investments, since they have to combine 'hard' investments in web infrastructure with 'soft' investments for the development of new products, services and processes exploiting the capabilities of this infrastructure.

Key words: e-Business, information technology, resource-based theory, Internet, innovation, business value.

INTRODUCTION

Firms all over the world have to make important investment decisions concerning the development or enhancement of costly World Wide Web (WWW) related technological infrastructures aiming to benefit from the connectivity, transaction and collaboration capabilities provided by the internet, and to conduct various types of e-business activities (Al-Mabrouk and Soar, 2010; OECD, 2009; Turban et al., 2008). This kind of investment results in the creation of a very special kind of assets, which are much more flexible, adaptable and innovation enabling than the other 'usual' fixed assets (e.g. production equipment), belonging to the so-called 'general purpose technologies' (Bresnahan and Trajtenberg 1995; Melville et al., 2007). Therefore, it is quite important to understand whether and how such web-related infrastructures create business value, so that appropriate guidance can be provided to firms for making rationally these important investment decisions and defining appropriately their scope and composition.

Recently, much debate about the business value of Information Technology (IT) in general and e-business in particular has been raised. It has been argued that the technology itself is available to all firms (including competitors), so it will rarely create superiority, while at the same time empirical studies have found that IT spending rarely correlates to superior performance (Brynjolfsson and Hitt, 2000; Carr, 2003; Gonzálvez-Gallego et al, 2010; Mata et al., 1995; Powell and Dent-Micallef, 1997; Soto-Acosta and Merono-Cerdan, 2008).

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However, even though competitors may copy an IT infrastructure, relative advantage can be created and sustained in cases where the technology leverages some other critical resource. A number of such complementary resources have been proposed by previous literature, such as size, structure, skills, culture, work practices and so on, that could make it difficult for competitors to copy the total effect of the technology (Arvanitis 2005; Loukis et al., 2009; Kettinger et al., 1994; Hempel, 2003). This concept of complementarity of resources is based on a well established theoretical foundation from the strategic management domain, the Resource- Based View (RBV) of the firm (Barney, 1991; Hoopes et al., 2003), and has been used for offering as an explanation of how IT has largely overcome its paradoxical nature and is contributing to business value (Bharadwaj, 2000; Bhatt and Grover, 2005; Clemons and Row, 1991; Mata et al., 1995; Santhanam and Hartono, 2003, Wang and Hsu, 2010).

Innovation has been another important IT complement proposed by the literature, mainly based on various theoretical arguments and case studies, which in combination with IT (IT-enabled innovation) has the potential to generate competitive advantages and result in superior performance. Innovation can be defined as the search for, the discovery and development of new technologies, new products and/or services, new processes and new organizational structures (Carneiro, 2000). For long time there has been extensive theoretical argumentation concerning the capabilities of IT to drive significant innovations in business processes, products and services of firms, and through them result in big improvements of their business performance (Bresnahan et al., 2002; Bresnahan and Trajtenberg, 1995; Brynjolfsson and Hitt, 2000; Colomo Palacios et al., 2010; Davenport, 1993; Gunasekaran and Nath, 1997; Hammer, 1990). Especially for e-business, there has been considerable literature arguing that it enables and drives significant transformations in business models, value propositions, products, and services of firms and also their internal processes and structures, which can offer substantial benefits (Amit and Zott, 2001; Tavlaki and Loukis, 2005; Timmers, 1998; Zwass, 2003; Wu and Hisa, 2004 and 2008). However, the above arguments and expectations have not been sufficiently investigated empirically using large samples of firms.

Consequently, to respond to these challenges, this paper develops a conceptual model, grounded on a well established theoretical framework from the strategic management domain, the RBV of the firm (Barney, 1991; Hoopes et al, 2003), for analyzing Web infrastructure and Internet-based innovation as sources of business value at the level of an individual firm. The analysis employs a large sample of firms from different industries for hypothesis testing. The results of this analysis are interesting to researchers, firms' managers of various levels and consultants dealing with e-business and/or innovation.

BACKGROUND

IT, e-business and innovation

Previous literature has recognised and analysed, based mainly on theoretical arguments, the great potential of IT to drive significant innovations in business processes, products and services of firms, and through them improvements of business performance (Bresnahan et al., 2002; Bresnahan and Trajtenberg, 1995; Brynjolfsson and Hitt, 2000; Davenport, 1993; Gunasekaran and Nath, 1997; Hammer, 1990). Hammer (1990) argues that firms should not simply embed outdated processes in 'silicon and software', but on the contrary should exploit the innovation capabilities offered by IT for totally redesigning their processes so that they become much more efficient, and finally summarizes his recommendations in a widely cited dictum 'don't automate, obliterate'. Davenport (1993) argues that IT is 'the cornerstone to process innovation', which is 'a revolutionary new approach that fuses information technology and human resources management that can dramatically improve business performance'; in this direction he proposes nine modes of using IT for supporting a substantial process innovation which can be quite beneficial: automational, informational, sequential, tracking, analytical, geographical, integrative, intellectual and disintermediating. Bresnahan and Trajtenberg (1995) identified a fundamental difference between the IT capital (assets) and the non-ICT (regular) capital (assets): the former is a 'general purpose technology', which is highly flexible and adaptable, so it can be used in many different ways and for various purposes, and enable many innovations in processes, products and services, while on the contrary the latter is much less flexible and adaptable to different uses, so it can serve much fewer functions and has a much lower potential as innovations enabler.

Gunasekaran and Nath (1997) argue that ICTs can be very useful for simplifying most business process and reducing considerably the number of their activities, and for achieving cross-functional process level optimization rather than departmental level optimization. Also, they propose ways of using ICTs for reengineering the basic business processes: order flow, strategic process, product design and production, marketing/sales, services, accounting and personnel management. Brynjolfsson and Hitt (2000) argue that most of the existing work practices and business processes have been developed in the past and reflect the historically high cost of communication and information processing; since modern IT can reduce dramatically these costs. Thus, IT can be a key enabler and facilitator of new enhanced business processes and work practices, which lead to big productivity increases, initially by reducing costs and, subsequently, by enabling firms to increase output quality through the design of new products or the improvement of important intangible aspects of existing products, such as convenience,

timeliness, quality, etc. In the same direction, Bresnahan et al. (2002) emphasized that IT enables a radical restructuring of work that allocates routine, well-defined tasks associated with symbols processing to computers and separate and redesign tasks that require human skills; furthermore, ICTs enable an individual worker to have all the required information for completing a bigger part of a process, so historical fragmentation of many processes can be dramatically reduced resulting in large efficiency gains.

Moreover, there has been considerable literature analyzing the innovative potential of the Internet/e-business in particular, also based mainly on theoretical arguments, which concludes that e-business enables and drives significant transformations in business models, value propositions, products and services of firms, and also their internal processes and structures, which can offer substantial benefits (Amit and Zott, 2001; Tavlaki and Loukis, 2005; Timmers, 1998; Wu and Hisa, 2004, 2008; Zwass, 2003). Timmers (1998) argues that internet gives rise to new business models, and describes the most important of them: e-shop, e-procurement, e-auction, e-mall, third party marketplace, virtual community, value chain service provider, value chain integrator, collaboration platform, information brokerage and trust services. Amit and Zott (2001), from a broad theoretical foundation concerning virtual markets, value chain analysis, Schumpeterian innovation, resource-based view of the firm, strategic networks and transaction cost economics, proposed four dimensions of innovation and value creation in e-business: transaction efficiency, novelty, complementarities (between various products and services, on-line and off-line assets, activities) and customers lock-in. Zwass (2003) argues that the WWW/Internet compound enables significant innovations in the way organizations arrange their business processes, address their marketplaces and partner with other organizations; also, he proposes a large number of innovation opportunities grouped in eleven categories associated with marketplace, universal supply-chain linkage, network of relationships, collaboration, use of forum, interactive media, goods and services delivery, anytime-anywhere connectivity, development platforms, universal telecommunications networks and computing utility.

Wu and Hisa (2004, 2008) categorise the innovations caused by e-commerce based on the extent of change in product's core components (defined as 'the distinct portions of the product that embody the core design concept and perform a well-defined function') and on the extent of change in the business model (defined as 'the way in which the components are integrated and linked into a coherent whole') into four groups: incremental innovation (no significant changes in core components and business models), modular innovation (considerable changes in core components but not in business model), architectural innovation (considerable changes in business model but not in core components) and radical innovation (considerable changes in both core components and business model). Tavlaki and Loukis (2005) propose a methodology for designing new 'digital business models', which consists of six stages: design of value proposition, design of production architecture (value chain), definition of value chain actors, analysis of competition, design of economic model and elaboration of relations among actors. Another research stream focuses on analysing how the web supports 'distributed' collaborative innovation creation both within and among firms (e.g. Sawhney and Prandelli, 2000). Therefore, an extensive theoretical foundation has been developed concerning the potential of ICT in general and e-business in particular to enable and drive innovation in products, services and processes, and through them improve significantly business performance, which, however, has not been sufficiently investigated empirically using large samples of firms. This study aims to contribute to filling this gap.

The Resource-Based View (RBV) of the firm

The RBV of the firm (Barney, 1991; Hoopes et al., 2003) is a well established theoretical framework from the strategic management domain which provides a solid foundation to differentiate between IT resources and IT capabilities and study their separate influences on performance (Santhanam and Hartono, 2003). According to the RBV, firms can obtain competitive advantages on the basis of resources that are valuable, rare and difficult to imitate and substitute. Grant (1991) extend this by arguing that firms create competitive advantages by assembling these resources and building superior organizational capabilities in performing important tasks and functions, which provide them competitive advantage. Subsequently, several scholars have used these frameworks for investigating which aspects and attributes of IT, and under what conditions, can provide competitive advantages and performance improvement (e.g. Bharadwaj, 2000; Mata et al., 1995; Bhatt and Grover, 2005; Santhanam and Hartono, 2003).

This concept of IT capability has been developed by IS researchers because competition may easily result in imitation of an IT infrastructure that provides competitive advantage, since competitors can purchase the same hardware and software in order to reduce and finally eliminate this competitive advantage; on the contrary, it is much more difficult to imitate IT capabilities created though combination of many different IT and non-IT resources (Santhanam and Hartono, 2003). In general, IT resources are not difficult to imitate, since physical technology is by nature imitable. If one firm can purchase some physical technologies and thereby implement some strategies, then, other firms should also be able to purchase the same technologies, and thus such technological tools should not be a source of competitive advantage (Barney, 1991). However, firms may obtain

competitive advantages from exploiting their physical technologies (possibly in combination with other tangible and intangible resources) in a better (and/or different) way than other firms, even though competing firms do not vary in terms of the physical technology they possess. IT resources are a necessary, but not sufficient, condition for competitive advantages (Clemons and Row, 1991). IT resources rarely contribute directly to competitive advantage; instead, they form part of a complex chain of assets that through an appropriate combination may lead to better performance. Thus, some researchers have described this in terms of IT capabilities and argue that IT capabilities can create uniqueness and provide organizations a competitive advantage (Bhardwaj, 2000; Bhatt and Grover, 2005; Mata et al., 1995; Santhanam and Hartono, 2003). This framework of analysis is very useful for our study, because it enables us to distinguish between web infrastructure (an IT resource) on one hand and the capability of using it for making innovations in products, services and processes on the other, and then examine the effect of each on business performance.

The impact of e-business on organizational performance

There have been several empirical studies of the impact of e-business on organizational performance. With respect to performance measurement, these studies can be divided into two categories: in the first of them the organizational performance has been measured using subjective measures (mainly firms' management perceptions concerning various measures of performance) (Lederer et al., 2001; Devaraj et al., 2007; Soto-Acosta and Meroño-Cerdan 2008; Soto-Acosta et al., 2010; Zhu and Kraemer, 2005), while in the second objective financial measures have been used (Barua et al., 2004; Meroño-Cerdan and Soto-Acosta, 2007; Zhu and Kraemer 2002). From these studies has been produced considerable evidence that e-business has a positive impact on various non-financial and financial measures of organizational performance. However, none of these studies has dealt with Internet-based innovation and its impact on performance. It should be noted that in the first category of studies senior executives are used as the key informants on various subjective measures of firm performance, while in the second are used data from firms' key financial statements (e.g. income statements, balance sheets). Given the fact that IT investments may provide benefits after a certain time period, while they increase operating costs in the short term, in order to study the business value of IT investments it is preferable to use business process as the primary level of analysis. For this reason, many researchers do not correlate financial results with IT investments, and suggest focusing on the actual business processes that IT is supposed to support and enhance, and correlating their performance with IT investments (Mukhopadhyayet et al., 1995; Soto-Acosta and Meroño- Cerdan, 2008; Subramaniam and Shaw, 2002). These arguments lead to the conclusion that it is preferable to adopt a process-level approach for investigating and explaining the generation of IT value from a resource-based perspective, and such an approach has been adopted in the present study.

In particular, the present research uses the effectiveness of online sales as a measure of e-business value. Selling online can potentially provide distinct value propositions to the firm. These come from its positive impact on the volume of sales, the number of customers and the quality of customer service. The internet enables information provision with high reach and richness (Evans and Wruster, 1999) and connects firms to consumers or potential consumers in geographic areas that would be costly to reach otherwise (Steinfield et al., 1999). Also, virtual communities enable frequent interactions with customers on a wide range of topics and thereby create a loyalty and enhance transaction frequency (Amit and Zott, 2001). These can result in increasing sales and number of customers. At the same time, e-business allows innovation in the way firms do business (new business models) and also in their products and services (earlier described in more detail), which may again influence sales and number of customers. In addition, selling online can provide value through the automation of the sales processes, which reduces overall load on staff supporting the customer and allows staff to focus on more complex tasks or on exceptions instead of routine tasks.

DEVELOPMENT OF RESEARCH HYPOTHESES

Web infrastructure and business value

Firms obtain competitive advantages on the basis of corporate resources that are firm specific, valuable, rare, imperfectly imitable, and not strategically substitutable by other resources (Barney, 1991). IT resources are easy to duplicate, and, hence, IT resources per se do not provide competitive advantages (Mata et al., 1995; Santhanam and Hartono, 2003). Although IT infrastructure is argued to be valuable, it is not a source of competitive advantage (Bhatt and Grover, 2005). Thus, IT infrastructure will rarely lead to superior performance. Similarly, web infrastructure is not difficult to imitate; in general, Internet technology is by itself imitable. If one firm can purchase certain internet technologies and thereby implement some strategies, then other firms should also be able to purchase these technologies and implement similar strategies, thus such tools should not be a source of competitive advantage. Furthermore, as the diffusion of the internet continues, the ability of proprietary IT to be a source of competitive advantage continues to be eroded. These arguments suggest that Web infrastructure may

not have a significant impact on e-business value. Thus, the following hypothesis is proposed:

H_1: There is no relationship between Web infrastructure and e-business value

Internet-based innovation and business value

Investing in IT is neither a necessary nor sufficient condition for improving firm performance, since IT investments might be misused (Tallon et al., 2000). In this sense, IT assets cannot improve organizational performance if they are not used appropriately. However, when used appropriately IT is expected to create intermediary effects, such as IT being embedded in products and services and streamlined business processes (Ravichandran and Lertwongsatien, 2005; Hernández-López et al., 2010). That is, IT may facilitate product/ service innovation and process innovation, in this way become a source of competitive advantage and create significant business value. Especially web- based tools enable and drive significant transformations in business models, value propositions, products and services of firms, and also their internal processes and structures (e.g. Timmers, 1998; Zwass, 2003; Wu and Hisa, 2004 and 2008), they facilitate innovation through information and knowledge exchange, as well as work execution by integrating information, documents and employees (Meroño-Cerdan et al., 2008) . Therefore web-based tools can significantly contribute to the generation of e-business value, so the following hypothesis is formulated:

H_2: There is a positive relationship between Internet-based innovation and e-business value

The complementarity of web infrastructure and internet-based innovation

Although there is research that posit a direct relationship between IT and firm performance (Bharadwaj, 2000; Santhanam and Hartono, 2003), others have questioned the direct-effect argument and emphasized that ITs are likely to affect firm performance only when they are deployed to create unique complementarities with other firm resources (Clemons and Row, 1991; Powell and Dent-Micallef, 1997). The RBV highlights the role of complementarity as a source of value creation in e-business, though it is not the only source as suggested by Amit and Zott (2001). As mentioned earlier, web infrastructure is not difficult to imitate and *per se* does not provide competitive advantages. However, having a proper web infrastructure, in combination with a capability of using it for making innovations in products, services and processes, may influence positively firm performance. The fact of possessing an adequate Web infrastructure can be critical for efficient information and knowledge sharing as well as for the formation of virtual teams for designing and implementing innovations (Adamides and Karacapilidis, 2006; Kessler, 2003). The following hypothesis incorporates these expectations:

H_3: The complementarity between Web infrastructure and Internet-based innovations explains variations in e-business value

METHODOLOGY

Data

The data source for the present study is the European e-Business Market Watch (www.ebusiness-watch.org), an initiative launched by the European Commission for monitoring the adoption of IT and e-business activity in Europe. The field work of the survey was conducted by Ipsos Eco Consulting on behalf of the e-business watch and was carried out using computer-aided telephone interview (CATI) technology. Telephone interviews with decision-makers in firms were conducted. The decision-maker targeted by the survey was normally the person responsible for IT within each firm, typically the IT manager. Alternatively, particularly in small firms not having a separate IT unit, the managing director or owner was interviewed.

The population considered in this study was the set of all firms which are active at the national territory of Spain and which have their primary business activity in one of ten highly important sectors considered (Table 1). The sample drawn was a random sample of firms from the respective sector population with the objective of fulfilling strata with respect to business size. A share of 10% of large companies (250+ employees), 30% of medium sized enterprises (50 - 249 employees) and 25% of small enterprises (10 - 49 employees) was intended. The final number of firms totalled 1,010. As shown in Table 1, 91.1% of firms were small or medium-sized, and each sector considered had a share of around 10% of the total sample.

With regard to respondents' positions, 54.4% were IS managers, nearly 20% were managing directors, and 12.1% were owners. The data set was examined for potential bias in terms of the respondents' positions. Since respondents included both IT managers and non-IT managers, one could argue that IT managers may overestimate e-business value. To test this possible bias, the sample was divided into two groups: responses from IS managers (heads of IT/DP and other IT senior managers) versus responses from non-IS managers (owners, managing directors and others). One-way ANOVA was used to compare the means of factor scores between the two groups. No significant differences were found, suggesting that the role of the respondents did not cause any survey biases.

Measures of variables

Our three main variables, web infrastructure, internet-based innovation and e-business value were measured using multi-item scales. Measurement items were introduced on the basis of a careful literature review. Confirmatory factor analysis (CFA) was used to test the validity of the constructs. Based on the CFA assessment, the constructs were further refined and then fitted again. Constructs are discussed thus:

(i) E-Business value: As discussed earlier, the present research uses the effectiveness of online sales (its impact on the volume of sales, the number of customers, the quality of customer service and the costs of logistics and inventory) for measuring e-business value.

Table 1. Sample characteristics (N= 1,010).

Sample characteristics by sector, size and respondent					
Sector name	**%**	**N**	**Number of employees**	**%**	**N**
Manufacture of textiles and leather	10	101	1 - 9	38.4	338
Manufacture of chemicals	9.9	100	10-49	25.8	261
Manufacture of electrical machinery	9.9	100	50 - 249	26.8	271
Manufacture of transport equipment	9.9	100	More than 249	8,9	90
Crafts and Trade	10.7	108	Respondent title	%	N
Retail	9.9	100	Owner/proprietor	12.1	122
Tourism	9.9	100	Managing director	19.6	198
Business services	9.9	100	Strategy development	1.9	19
Telecommunications and computer serv.	9.9	100	Head of IT/DP	22	222
Health and social services	10	101	Other IT senior member	32.4	327
			Others	12.1	122

Table 2. Measurement Model: Factor loadings, reliability and validity.

Construct	Indicators	Loadings	CV (t-value)	Composite reliability
Web Infrastructure (WI)	WI1	0.506	--	SCR = 0.909 AVE = 0.716
	WI2	0.722	11.508***	
	WI3	0.560	10.792***	
	WI4	0.576	10.959***	
Internet-based innovation (IBI)	IBI1	0.700	--	SCR = 0.960 AVE = 0.923
	IBI2	0.860	4.855**	
E-business value (e-Sales effectiveness)	ES1	0.655	--	SCR = 0.830 AVE = 0.621
	ES2	0.827	5.157***	
	ES3	0.683	5.311***	

p<0.1*; p<0.05**; p<0.01***; Insignificant factors are dropped (WI5 and ES4); CV: Convergent validity; SCR: Scale composite reliability; AVE: Average variance extracted; (--): Fixed items in the scale.

It was measured by 4 items following previous literature (Soto-Acosta and Meroño-Cerdan, 2008; Wu et al., 2003; Wu and Hisa, 2008; Zhu and Kraemer, 2005).
(ii) Web infrastructure: This construct represents the adoption of physical internet technologies. In this sense, respondents were required to assess the presence various internet technologies. These indicators were obtained from the literature on e-business adoption (Kowtha and Choon, 2001; Soto-Acosta and Meroño-Cerdan, 2008; Wu and Hisa, 2008; Zhu and Kraemer, 2005).
(iii)Internet-based innovation: This construct assessed whether firm made innovations in product/services and processes directly related to or enabled by internet-based technology. Indicators were extracted from the literature on e-innovation (Adamides and Karacapilidis, 2006; Hamel, 2002; Kessler, 2003).

Instrument validation

CFA using AMOS 7.0 was conducted to assess empirically the above constructs theorized. Multiple tests on construct validity and reliability were performed. Model fit was evaluated using the maximum likelihood (ML) method. The measurement properties are reported in Table 2.

(i) Construct reliability: It measures the degree to which measures are free from random error, and therefore yield consistent results. In the measurement model (Table 2), all constructs had a composite reliability over the cut-off of 0.70 (Straub, 1989), and also the average variance extracted for all exceeded the preferred level of 0.5 (Churchill, 1979).
(ii) Content and construct validity: Content validity is the degree to which items in an instrument reflect the content universe to which the instrument will be generalized (Boudreau et al., 2001).

This validity was verified by checking the meanings of indicators and by a careful literature review. Construct validity is the extent to which a construct measures the concepts that it purports to measure (Straub, 1989). It has two components: convergent and discriminant validity. After dropping insignificant items, all estimated standard loadings were significant (Table 2), suggesting good convergent validity. To assess the discriminant validity, Fornell and Larcker's (1981) criterion (that average variance extracted for each construct should be greater than the squared correlation between constructs), was used. All constructs met this criterion.

Table 3. Regression of e-Business value on web infrastructure, internet-based innovation.

	Model 1	Model 2	Model 3
Manufacturing industry	-0.148	-0.100	-0.094
Commercial industry	0.016	0.059	0.064
Number of employees	0.115	0.077	0.075
Web Infrastructure (WI)		0.104	0.177
Internet-Based Innovation (IBI)		0.302**	0.372**
Interaction (WI * IBI)			-0.218
F-value	2.363	4.119**	3.500**
Adjusted R^2	0.019	0.068	0.091
ΔR^2		0.057**	0.002

Significance levels: *0.01<p 0.05;**p 0.01.

The insignificant p-value (p = 0.187) for the chi-square statistics implied good absolute fit. The root mean square error of approximation (RMSEA) is the square root of the mean of the population discrepancy per degree of freedom: Small RMSEA values mean low residual variance and, therefore, a good fit in the model. RMSEA was below the cut-off value 0.08 suggested by Browne and Cudeck (1993). Five incremental fit indices were all above the preferred level of 0.9 (Gefen et al., 2000). In conclusion, the overall fit statistics, validity, and reliability measures shown in the above Tables 2 and 3 allow the confirmation of the proposed constructs.

RESULTS

In order to test the research hypotheses formulated in section 3, econometric models were estimated using the data described in section 4, having as dependent variable the e-sales effectiveness (our e-business value measure), and as independent variables the web infrastructure, Internet-based innovation and the interaction between them. Also, the industry and business size were introduced as control variables in order to avoid unexpected effects of them on e-business value. The former identified whether the business was operating at the manufacturing, services or commercial industry and was coded as a dummy variable. The latter was measured by the total number of employees and was coded as a continuous variable.

The analysis was performed in 3 steps. The dependent variable was initially regressed on the control variables in step 1. Then, in step 2, Web infrastructure and Internet-based innovation were entered as additional independent variables. Finally, in step 3 the interaction effect was included. To examine the adequacy of using regression analysis, tests were conducted to assess the normality of residuals and the homogeneity of variance of residuals (Hair et al., 1998). No significant violations of these assumptions were observed.

Regression results are summarized in Table 3 and represented diagrammatically in Figure 1. Results in Model 1 shows that the control variables do not have significant effects on the dependent variable. Model 2 indicates that the direct effect of Web infrastructure and Internet-based innovation upon e-business value is significant as the increment in the squared multiple correlation coefficient (R^2) is statistically significant. The effect for Internet-based innovation upon e-business value was positive and statistically significant, while for Web infrastructure the relationship was not significant. Finally, Model 3 showed no significant interaction between Web infrastructure and Internet-based innovation (the increment in R^2 was not significant). Thus, support for H_1 and H_2 was provided, whereas hypothesis H_3 was rejected.

DISCUSSION

Firms all over the world have to make a new kind of investment decisions, which concern the development or enhancement of costly WWW related technological infrastructures, and are quite different from the 'traditional' investment decisions that firms have been making for long time in 'regular assets' (e.g. production equipment) . The main difference is that this new kind of investment aims to create a very special kind of assets, which are characterised as 'general purpose technologies' based on IT/Internet, and are much more flexible, adaptable and innovation enabling than the other 'usual' fixed assets (Bresnahan and Trajtenberg 1995; Melville et al, 2007). In order to support firms for making rationally these important investment decisions and defining appropriately their scope and composition, it is quite important to understand whether and how such web-related infrastructures create business value. Previous literature has recognised and analysed, based mainly on theoretical arguments, the great potential of the Internet/e-business to enable and drive significant transformations in business models, value propositions, products and services of firms, and also their internal processes and structures, which can offer substantial business benefits. However, these theoretical arguments and expectations of the literature have not been sufficiently investigated empirically using large samples of firms.

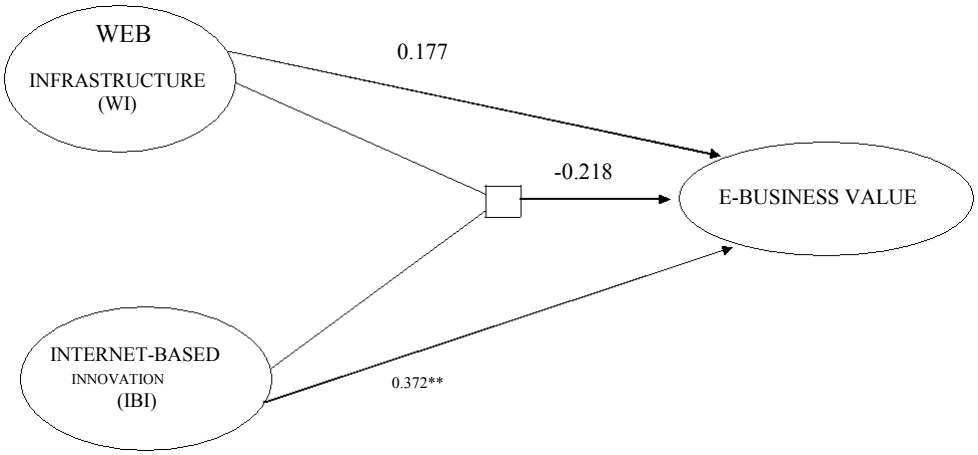

Figure 1. Empirical model (Significance levels: 00.01 p 0.05; p 0.01).

This paper, aiming to contribute to filling these research gaps, develops a conceptual model, grounded on a well established theoretical framework from the strategic management domain, the RBV of the firm (Barney, 1991; Hoopes et al, 2003), for analyzing Web infrastructure and Internet-based innovation as sources of business value at the level of an individual firm. Moreover, it is intended to offer results more widely applicable than the ones of the e-business case studies of Internet leaders or IT industry companies appearing in the previous literature. In this sense, this study attempts to offer an explanation to why there are cases where firms engage in e-business without deriving any benefits (or even having losses), while, on the contrary, some others obtain significant benefits.

The results showed that Web infrastructure does not contribute significantly to e-business value. This finding indicates that, since competitors may easily duplicate investments in IT resources (including the web infrastructure) by purchasing the same hardware and software, IT resources *per se* do not provide better performance. This can be explained through the RBV, because IT is not a resource that is difficult to imitate, since IT is widely available and at declining prices. This result is in agreement with the findings of recent research, such as the study of Bhatt and Grover (2005), which did not find evidence of a positive link between IT infrastructure quality and firm performance. Similarly, Powell and Dent-Micallef (1997) found that IT by itself cannot be a source of competitive advantage. Thus, our results extend for the WWW/Internet technologies the conclusion of previous research that technology by itself will rarely create business value.

Furthermore, results demonstrate that Internet-based innovation makes a significant positive contribution to e-business value. This finding is in agreement with conclusions of previous empirical research (e.g. Bharadwaj, 2000; Santhanam and Hartono, 2003), which found that firms create competitive advantages through developing IT capabilities (by combining various IT and non-IT organizational resources); at the same time, it expands these previous findings by shedding light on the business value of this important IT capability of using the web infrastructure for making innovations in products, services and processes. The above conclusions of this study provide an explanation for the inconsistent/conflicting e-business case studies appearing in previous literature: there are both 'success stories' of firms obtaining significant benefits from their e-business investments, and also 'failure stories' in which firms engaged in e-business without deriving any benefits or even having losses. Our conclusions suggest that probably the former managed to develop a collective capability of exploiting their technological web infrastructure for making beneficial innovations in their business models, products, services and business processes, while the latter did not develop such a capability.

Finally, the empirical results did not offer support for the complementarity of web infrastructure and Internet-based innovation. The RBV highlights the role of complementarities between resources as a source of business value. In this direction researchers such as Steinfield et al. (1999) suggest that business value can come from synergies between online and offline presences, though they find that these opportunities are not sufficiently exploited by SMEs. However, this paper shows that the complementarity argument of the RBV as a source of business value is not confirmed for the case of Web infrastructure and Internet-based innovation. Therefore, it can be concluded that having a more complete Web infrastructure is not critical for the impact of Internet-based innovation on e-business value.

CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

In recent years, there has been much debate about the value of IT in general and e-business in particular, due to

the gap between IT/e-business investments and the resulting business value perceived by many firms' management, which influences their investment policies. Thus, today IS researchers face pressure to answer the question of whether and how IT/e-business creates value, in order to support such investment decisions. In this vein, the present study developed a conceptual model, grounded on the RBV of the firm, to analyze Web infrastructure and Internet-based innovation as source of business value at the level of an individual firm. The analysis employed for hypothesis testing data from a large sample of companies from different industries, which have been collected by the European e-Business Market Watch, an established e-business observatory organization sponsored by the European Commission. Using these data econometric models having e-business value (e-sales effectiveness) as dependent variable, and Web infrastructure and Internet-based innovation as main independent variables. This research makes several interesting contributions: (1) it applies the RBV logic in e-business, examining separately a basic IT resource (Web infrastructure) and a critical IT capability (using Web infrastructure for innovation) as a business value generator; (2) it demonstrates that Web infrastructure is not significantly associated with e-business value, while Internet-based innovation is significantly and positively related to e-business value; (3) it shows that the interaction effect between Web infrastructure and Internet-based innovation with respect to e-business value is not significant.

This study provides interesting implications for firms' management. This new kind of Internet/WWW-related investments that many firms make today in order to be beneficial should have an appropriate 'composition': they should include not only 'hard investments' in web infrastructure, but also 'soft investments' as well in designing and implementing appropriate innovations in their business models, products, services and internal business processes, as it is the latter that mainly generate business value. This was not the case with the 'traditional' investments in 'regular assets' (e.g. production equipment) that firms have been making for long time, so most firms are not familiar with this new approach of 'mixed' (both hard and soft) interventions. It should be noted that these 'soft investments' might be much more difficult than the 'hard' ones (involving mainly the construction of various types of web infrastructures, for which there is extensive standardisation and experience), as they will probably necessitate: a) new human skills and culture (through training of existing personnel and also hiring new personnel), ii) external support by experienced consulting firms, and iii) change management programs (Trigo et al., 2010).

While this study presents interesting findings, it has some limitations which can be addressed in future research. First, the sample used was only from Spain. It may be possible that the findings could be extrapolated to other countries, since economic and technological development in Spain is similar to other OECD Member countries. However, in future research, a sampling frame that combines firms from different countries could be used in order to provide a more international perspective on the subject. Second, the e-business value measures are subjective in the sense that they were based on Likert-scale responses provided by managers. Thus, it could also be interesting to include objective performance data for measuring e- business value. Third, the key informant method was used for data collection. This method, while having its advantages, also suffers from the limitation that the data reflects the opinions of one person. Future studies could consider research designs that allow data collection from multiple respondents within firms.

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