

# Post-Adoption Variations in Usage and Value of E-Business by Organizations: Cross-Country Evidence from the Retail Industry

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**G**rounded in the innovation diffusion literature and the resource-based theory, this paper develops an integrative research model for assessing the diffusion and consequence of e-business at the firm level. Unlike the typical focus on adoption as found in the literature, we focus on postadoption stages, that is, actual usage and value creation. The model thus moves beyond dichotomous “adoption versus nonadoption” and accounts for the “missing link”—actual usage—as a critical stage of value creation. The model links technological, organizational, and environmental factors to e-business use and value, based on which a series of hypotheses are developed. The theoretical model is tested by using structural equation modeling on a dataset of 624 firms across 10 countries in the retail industry. To probe deeper into whether e-business use and value are influenced by economic environments, two subsamples from developed and developing countries are compared. The study finds that technology competence, firm size, financial commitment, competitive pressure, and regulatory support are important antecedents of e-business use. In addition, the study finds that, while both front-end and back-end capabilities contribute to e-business value, back-end integration has a much stronger impact. While front-end functionalities are becoming commodities, e-businesses are more differentiated by back-end integration. This is consistent with the resource-based theory because back-end integration possesses the value-creating characteristics of resources (e.g., firm specific, difficult to imitate), which are strengthened by the Internet-enabled connectivity. Our study also adds an international dimension to the innovation diffusion literature, showing that careful attention must be paid to the economic and regulatory factors that may affect technology diffusion across different countries.

*Key words:* technology diffusion; innovation; e-business; IT investment; usage; value; back-end integration; firm performance; resource-based view; international perspective

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## 1. Introduction

The adoption, use, and value of electronic business (e-business) has emerged into an active research area in the information systems (IS) discipline (Straub et al. 2002). Drawing on the literature (Barua et al. 2001, Zhu and Kraemer 2002), we define e-business as using the Internet to conduct or support business activities along the value chain (Porter 2001). We focus on marketing/sales, procurement, coordination, and internal operations because we are studying retail firms. However, we recognize that value chain activities for e-business are broader and include

operations/manufacturing, logistics, infrastructure, human resources, and finance as well (Brynjolfsson and Kahin 2000).

Skepticism about the value of e-business and information technology (IT) has been renewed recently, in part due to the gap between substantial firm spending on IT—particularly on Internet-related technologies—and the widespread perception about the lack of value from e-business. Nicholas Carr’s article (2003) “IT Doesn’t Matter” triggered a wave of debate over the new “IT value paradox.” Today more than ever, IS researchers face strong pressure to answer the

question of whether and how e-business investments create business value (Zhu et al. 2004). Answers to this renewed paradox will have important implications for the way firms approach IT investment and management (McKinsey and Company 2002).

To respond to this challenge, some efforts in academia have been devoted to studying e-business adoption (cf. Chatterjee et al. 2002, Teo et al. 2003, Zhu et al. 2003). While these studies significantly improved our understanding of e-business innovation, several gaps can be identified in the literature. First, although innovation diffusion represents a complex process, much of the existing research has focused on the adoption decision and on measures such as “intent to adopt” and “adoption versus non-adoption” (Fichman 2000). Although this is helpful for understanding adoption decisions, we also need a better understanding of the *postadoption variations in usage and value* (Tornatzky and Klein 1982, DeLone and McLean 1992). Thus, we need to view e-business diffusion as a multistage process that starts at adoption and extends to usage and value creation (Fichman 2000, Cooper and Zmud 1990). A recent study has shown that actual usage may be an important link to IT value, but this link seems to be missing in the literature (Devaraj and Kohli 2003).

Second, there is a lack of empirical evidence to gauge e-business usage and its impact on firm performance, partly because of the difficulty of developing measures and collecting data (Zhu and Kraemer 2002). A related issue is the lack of theory to guide empirical research (Benbasat and Weber 1996). Although showing recent signs of advancement, the linkage between theory and measures is still weak in the e-business literature. For example, Martinsons and Martinsons (2002) criticized the McKinsey and Company (2002) study for using a macroeconomic perspective to examine firm-level initiatives involving intangible outcomes. Clearly, there is a need for a theoretically rigorous and empirically relevant framework for examining the use and value of e-business in organizations.

Third, prior research (e.g., Austin 1990) argued that theories developed in the context of mature markets and industrialized economies need to be reexamined in the context of developing countries, because these countries may have very different economic and

regulatory environments (Zhu et al. 2003, Jarvenpaa and Leidner 1998). Rosenzweig (1994) challenges the presumption of conceptual equivalence across cultural and economic barriers in management science research. Despite the fact that the Internet is a global platform and e-business is an international phenomenon, most of the existing studies in this area to date have focused predominantly on the United States (Dedrick et al. 2003). We believe it is important to investigate whether innovation theories can be generalized and empirical findings are applicable in different economic contexts (Zhu et al. 2003). To achieve this, we study e-business in a cross-country setting, extending beyond the United States to encompass the experience of organizations in other developed and developing countries that might represent different stages of e-business transformation.

In summary, these gaps in the literature limit our understanding of the process of e-business innovation and consequently of e-business value. Our study sought to narrow these gaps. Key research questions that motivated our work are: (1) What framework can be used as a theoretical basis for studying e-business use and value? (2) Within this theoretical framework, what factors can be identified as key antecedents of e-business use and value? (3) How would these factors vary across different economic environments (e.g., developed versus developing countries)?

To better understand these issues, we developed a conceptual model for e-business use based on the technology-organization-environment (TOE) framework (Tornatzky and Fleischer 1990). We also analyzed e-business value creation, from a resource-based perspective, that stems from the unique characteristics of the Internet (Zhu 2004a). Then, an integrative model for e-business use and value was developed incorporating six antecedents and two types of e-business capabilities. We tested this model using survey data from 624 firms that had already adopted e-business and were in the retail/wholesale industry. These firms operated from 10 countries (both developed and developing). Data analysis was performed by structural equation modeling. The results identified significant drivers in general but demonstrated differing patterns of these drivers across different economic environments. These results contribute to the continued debate on IT payoffs and the new “IT value paradox” (Martinsons and Martinsons 2002).

## 2. Theoretical Perspectives

Unlike the typical focus on adoption (or intent to adopt) as found in the literature, we focus on post-adoption stages, that is, actual use of e-business and value creation from e-business; both are important stages in the process of conducting business over the Internet. These issues are analyzed on the basis of two theoretical foundations: (1) the TOE framework and (2) the resource-based theory of the firm.

### 2.1. E-Business Use and the TOE Framework

A theoretical model for e-business use needs to take into account factors that affect the propensity to use e-business, which is rooted in the specific technological, organizational, and environmental circumstances of an organization. Reviewing the literature suggests that the TOE framework (Tornatzky and Fleischer 1990) may provide a useful starting point for looking at e-business use. The TOE framework identifies three aspects of a firm's context that influence the process by which it adopts, implements, and uses technological innovations: (a) *Technological context* describes both the existing technologies in use and new technologies relevant to the firm. (b) *Organizational context* refers to descriptive measures about the organization such as scope, size, and the amount of slack resources available internally. (c) *Environmental context* is the arena in which a firm conducts its business—its industry, competitors, and dealings with government (Tornatzky and Fleischer 1990, pp. 152–154). This framework is consistent with the innovation diffusion theory of Rogers (1983, pp. 376–383), in which he emphasized technological characteristics, and both the internal and external characteristics of the organization, as drivers for technology diffusion.

Based on our literature review (Zhu et al. 2003, 2004), we found that the TOE framework has consistent empirical support in various IS domains, such as electronic data interchange (EDI), open systems, and material requirement planning (e.g., Iacovou et al. 1995, Chau and Tam 1997, Thong 1999). As a generic theory of technology diffusion, the TOE framework can be used for studying different types of innovations. According to the typology proposed by Swanson (1994), there are three types of innovations: Type I innovations are technical innovations restricted to the IS functional tasks (such as relational databases, CASE); Type II innovations apply IS

to support administrative tasks of the business (such as financial, accounting, and payroll systems); and Type III innovations integrate IS with the core business where the whole business is potentially affected and the innovation may have strategic relevance to the firm. We consider e-business a Type III innovation, in the sense that e-business is often embedded in a firm's core business processes (e.g., making use of the open standard of the Internet protocol to streamline information sharing among various functional departments); e-business can extend basic business products and services (e.g., leveraging Internet-enabled two-way connectivity to offer real-time customer service); and e-business can streamline the integration with suppliers and customers (e.g., using XML-based communication to increase the capability of exchanging data on product demand and inventory availability throughout the supply chain).

Prior IS research has sought to study Type I and Type II innovations, but relatively limited attention had been devoted to Type III innovations (Swanson 1994) until the recent studies of EDI and enterprise resource planning (ERP) systems (Iacovou et al. 1995, Hart and Saunders 1998). E-business is a new Type III innovation and warrants investigation along with these innovations (Straub et al. 2002, Zhu 2004b). In particular, the migration toward the Internet and the transformation of traditional processes require firms and their subunits to orchestrate the coevolutionary changes to their technologies in use, business processes, and value chain structures to successfully assimilate the Internet technologies into their e-business initiatives (Chatterjee et al. 2002).

Drawing on the empirical evidence combined with literature review and theoretical perspectives discussed above, we believe that the TOE framework is appropriate for studying e-business usage. Based on the TOE framework, the use of e-business in organizations will be influenced by three types of antecedents: *technological* factors, *organizational* factors, and *environmental* factors (Zhu et al. 2004). One might ask why we need to develop a theoretical model for e-business, given that there are already several studies on EDI adoption. To answer this question, we need to articulate how e-business differs from EDI (or other previous Type III innovations) and explain the theoretical necessity of extending TOE to e-business.

While EDI has some features in common with e-business, it also exhibits significant differences, as EDI is typically a more expensive, proprietary technology operating over a private network controlled by one large manufacturer or supplier. In comparison, e-business is based on the open standard protocol of the Internet. It is more tightly integrated to the value chain at both the front end (sales, customer services) and the back end (coordination, procurement), while EDI is more focused on the back end (invoice exchange, order documents, and inventory management), which is why it is popular in the manufacturing industry (Chau and Tam 1997).

More broadly, the economic characteristics of the Internet are quite different from those of pre-Internet Type III innovations (Zhu 2004a). The Internet is characterized by *open standard* (versus proprietary standard), *public network* (versus private network), and *broad connectivity* (back end and front end) (Bakos 1998, Shapiro and Varian 1999). These characteristics may have very different impacts on customer reach and richness of information (Zhu 2004a). The global reach of the Internet enables cost-efficient means of reaching out to new markets, attracting new customers, and delivering products and services, as well as improving coordination with suppliers and business partners (Zhu and Kraemer 2002). On the other hand, the open connectivity of the Internet also brings unique issues such as security, privacy, and legal protection of online transactions (Zhu et al. 2004). These issues are particularly important to the retail industry, as it deals with consumers who are especially sensitive to these issues.

These unique characteristics of e-business imply different antecedents and consequences of its organizational use. For example, while both EDI and e-business may be affected by the technological competence of the user organization, e-business is also influenced by particular organizational factors (such as international scope), environmental factors (such as legal protection of online transactions over the Internet), and website functionalities to serve consumers (while EDI typically does not offer public access). In terms of decision-making processes, EDI use is influenced by a large and powerful company that often requires its suppliers or partners to use EDI (Hart and Saunders 1998). Yet e-business use is more

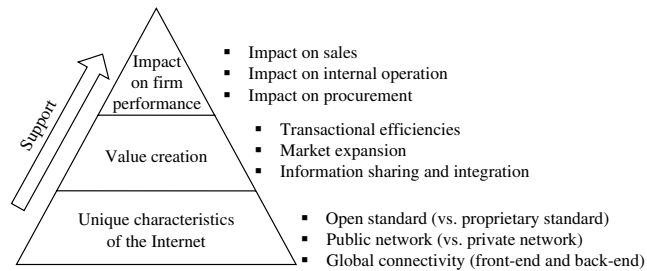
decentralized and is often driven by balanced considerations regarding the organization's technological competence, structural factors (such as size, scope, and resources), and environmental factors related to competition and regulation (Zhu et al. 2003). Combining these factors, we can see that there are significant additional considerations beyond those addressed in the EDI literature. Plus, the EDI literature focuses more on adoption (or intent to adopt) and less on actual use (Iacovou et al. 1995). Thus, we still need a theoretical model for e-business use and value.

## 2.2. E-Business Value and the Resource-Based Theory

**2.2.1. The Resource-Based Theory.** The resource-based view (RBV) provides a theoretical basis for linking e-business use and value. Rooted in the strategic management literature, the RBV of the firm posits that firms create value by combining heterogeneous resources that are economically valuable, difficult to imitate, or imperfectly mobile across firms (Barney 1991, Peteraf 1993). In the IS literature, the RBV has been used to analyze IT capabilities (Mata et al. 1995) and to explain how IT business value resides more in the organization's skills to leverage IT than in the technology itself (Clemons and Row 1991, Soh and Markus 1995, Ross et al. 1996). That is, IT business value depends on the extent to which IT is used in the key activities in the firm's value chain. The greater the use, the more likely the firm is to develop unique capabilities from its core IT infrastructure (Zhu 2004b).<sup>1</sup> Computers, networks, databases, and communication platforms form the core of a firm's overall IT infrastructure. Although the individual components that go into the IT infrastructure are commodity-like, the process of integrating the components to develop a coherent infrastructure tailored to a firm's strategic context is complex and imperfectly understood (Milgrom and Roberts 1990, Weill and Broadbent 1998). Thus, IT-enhanced capabilities that integrate various resources cannot be easily

<sup>1</sup> As pointed out by Soh and Markus (1995), some threshold level of IT use must be achieved before an impact can be observed, but, beyond that level, more use might or might not lead to positive impacts. It depends on whether the use is "appropriate" to the key activities and environment of the firm.

**Figure 1 E-Business Value Hierarchy: From Internet Characteristics to Value Creation**



*Notes.* This value hierarchy depicts the unique characteristics of the Internet and how these characteristics enable value creation via e-business. In contrast to e-business, EDI—with proprietary standard, less connectivity, and a private network configuration—creates business value mainly through improving transactional efficiencies and reducing costs in procurement.

imitated and have the potential to create business value (Bharadwaj 2000, Zhu and Kraemer 2002).<sup>2</sup>

**2.2.2. E-Business Value.** We examined the unique characteristics of the Internet and linked them in three ways through which e-business may create value—transactional efficiencies, market expansion, and information sharing. Combining them with the RBV, we developed an e-business value hierarchy, as shown in Figure 1.

The bottom layer of the value hierarchy shows the unique characteristics of the Internet. As discussed earlier, the Internet is unique in terms of *open standard*, *public network*, and *global connectivity*. Prior to the Internet, firms often used stand-alone, proprietary systems such as EDI to communicate limited data (Straub et al. 2002). It was difficult or costly for a firm to connect to its customers and suppliers. In contrast, the Internet enables a two-way real-time information exchange among a firm, its customers, and its suppliers (Zhu 2004a).

From these Internet characteristics, e-business creates value in three ways, as shown in the middle layer of the value hierarchy. Benefiting from open-standard connectivity, e-business can substantially improve transactional efficiencies (Malone and Laubacher 1998). For instance, information reach and richness can reduce information asymmetry and market friction (Zhu 2004a); Internet-based search capabilities can

lead to a closer match between a firm and its customers in greater reach than before; and connectivity and interactivity enable customers to monitor order fulfillment, which lowers the transactional risks (Welty and Becerra-Fernandez 2001). In addition, e-business can achieve lock-in by leveraging various interactive applications such as loyalty programs, virtual communities, and customization (Amit and Zott 2001). At the same time, the Internet connects e-businesses to consumers in geographic areas that were costly to reach before the Internet (Steinfeld et al. 2002). Such market expansion further increases transactional efficiencies due to the economies of scale.

Furthermore, conducting business on a platform with open standards facilitates information sharing along the value chain (Zhu 2004a). As documented in the supply chain literature (Lee et al. 1997), the poor quality of information exchange among suppliers and manufacturers led to inventory buildup along the supply chain, a phenomenon termed the “bullwhip effect.”<sup>3</sup> Open-standard information exchange can result in a more synchronized information flow (Zhu 2004a), and a better information flow will make materials move more efficiently along the supply chain (Mukhopadhyay et al. 1995), thereby reducing the bullwhip effect. This is the notion of replacing inventory with information (Milgrom and Roberts 1990), which is particularly important for the retail/wholesale industry, since inventories account for a greater portion of total assets for this industry than for other industries.<sup>4</sup>

In sum, the open-standard connectivity and public network characteristics of the Internet enable e-business value creation by improving transactional efficiencies, expanding the markets, and achieving information sharing and integration. Such e-business value may lead to improved firm performance in sales, procurement, and internal operations, as shown in the top layer of the value hierarchy in Figure 1. It also becomes clear that these unique characteristics

<sup>3</sup> The bullwhip effect is defined as the artificial amplification of volatility in supply chains due to information distortion and demand uncertainties (Lee et al. 1997).

<sup>4</sup> For instance, the ratio of inventories to total assets is 21.8% for Target Corporation, 27.1% for Costco, and 20.9% for Albertsons, but only 2.2% for Ford, 4.9% for IBM, and 5.8% for Sun Microsystems (data based on companies’ 2002 financial reports).

<sup>2</sup> As will be elaborated later, this study focuses on technology competence and two types of e-business functionalities, at both the front end and the back end, as IT-enhanced capabilities.

and the value creation of e-business are significantly different from pre-Internet technologies such as EDI.

### 3. The Conceptual Model and Hypotheses

#### 3.1. The Conceptual Model

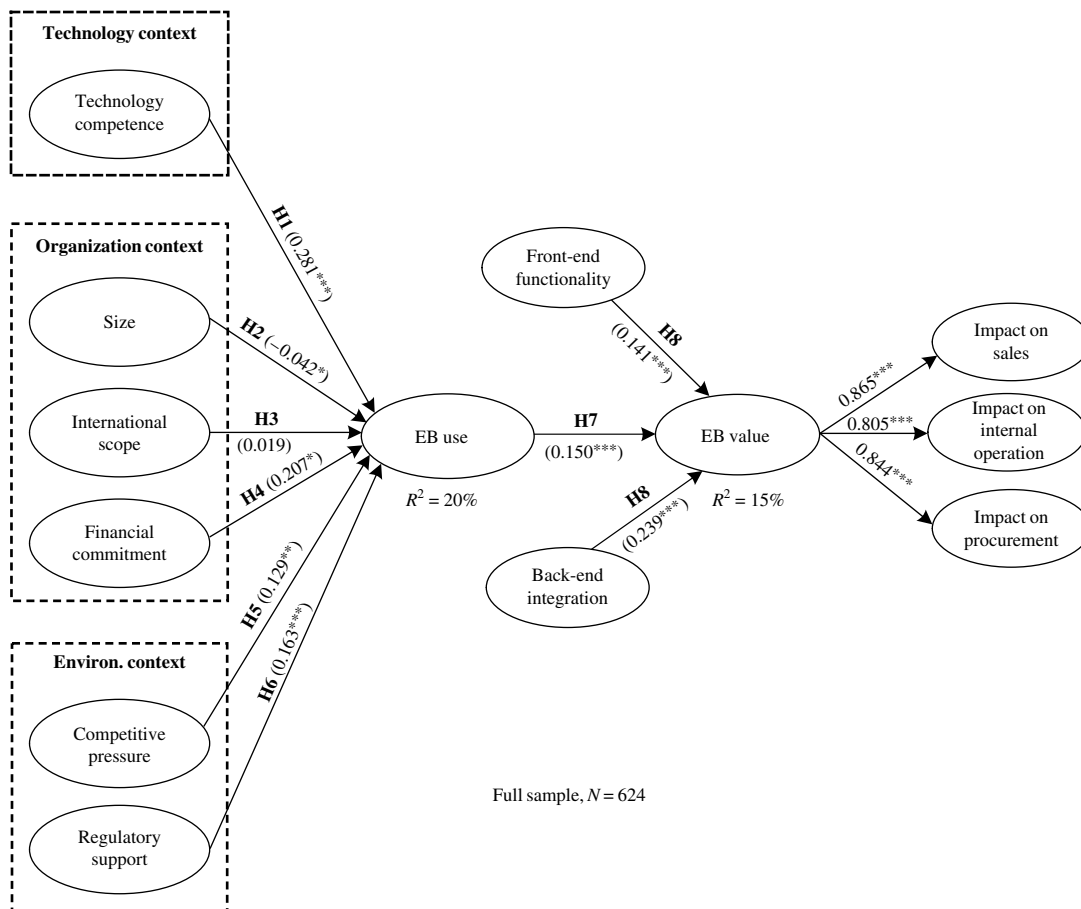
Integrating the TOE framework and the resource-based theory, we developed a conceptual model to assess the use and value of e-business by organizations. We present the model first in Figure 2, followed by explanations of the key elements of the model and postulated relationships.

Figure 2 focuses on two postadoption stages: use and value. The Internet is being adopted quickly by firms in both developed and developing countries, but there are differences in Internet adoption between

these countries (IDC 2002). The extent of technology diffusion depends on a variety of economic, social, and political factors, including basic information infrastructure; regulatory environment; and access to technical, managerial, and financial resources (Caselli and Coleman 2001, Dasgupta et al. 1999). Therefore, we expect that there will be systematic differences between countries and also among firms in the actual use of e-business and related value creation. We will use our model to examine these differences.

The focus on postadoption is also motivated by the process-oriented view about the use and value creation of IT innovations (Barua et al. 1995, Soh and Markus 1995). According to the process-oriented view, merely examining the initial adoption or the dollars invested in IT cannot reveal the reach and

Figure 2 An Integrated Model of E-Business (EB) Use and Value (and Full Sample Results)



\*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . Full sample results are listed in parentheses. To avoid a crowded graph, indicators for each construct are not shown in the graph.

richness of postadoption activities, because a multi-stage process exists before the business value of IT can be realized (Fichman and Kemerer 1997). Thus, we incorporate these two important stages in one unified model. We could have just used adoption and postadoption; however, consistent with the RBV and the process model of Soh and Markus (1995), we wanted to signal that the key activity in postadoption is value creation through use rather than simply adoption and penetration.

*E-business use* is defined as the extent to which e-business is being used to conduct value chain activities. This is measured by the *breadth* of use for different value chain activities and the *depth* of use (percentage) for each activity that has been migrated to the Internet platform, as motivated by the volume and diversity of EDI use proposed in the literature (Hart and Saunders 1998, Fichman 2000). *E-business value* refers to the impact of e-business use on firm performance, which is measured by three major activities along the value chain (Zhu et al. 2004): downstream sales (i.e., increasing sales and improving customer services), upstream procurement (i.e., reducing inventory and procurement costs and improving coordination with suppliers), and internal operations (i.e., increasing employee productivity and making internal processes more efficient).

The right-hand side of the conceptual model shows how the use of e-businesses impacts firm performance. Drawing on the value hierarchy in Figure 1, we posit that e-business leverages the unique characteristics of the Internet to improve business performance. These characteristics (open standard, public network, and global connectivity) are examined from a functional perspective. That is, we investigate e-business functionalities that make use of these unique characteristics and consequently enable e-business value creation. We classify these e-business functionalities into two types (Zhu and Kraemer 2002): *front-end functionalities* that provide product information to consumers on the Internet, facilitate transaction processing, and enable customization and personalization; and *back-end integration* that links Web applications with back-office databases and facilitates information sharing along the value chain. Together with usage, these two IT-enhanced capabilities will contribute to e-business value (Zhu 2004b).

The left-hand side of the conceptual model shows the antecedents of e-business use. As discussed earlier, the extent of e-business use by an organization would be influenced by its technological, organizational, and environmental contexts within the TOE framework (Zhu et al. 2004). Among the wide range of factors that we found from an extensive literature review on previous studies of IT adoption and use, this study focused on technology competence, firm size, financial resources, and competitive pressure, which were the most commonly studied antecedents in previous literature. Further, we added two factors—international scope and regulatory support—that we consider to be particularly relevant to Internet-based e-business. The rationale for each variable is as follows.

First, e-business is enabled by the existing technology base in use by an organization, including the general IS capability as well as Internet specific technologies (Zhu 2004b). Prior literature suggests that the study of IS diffusion requires considerations of the technology competence of the organization, or IT sophistication and technology resources as referred to in some previous studies (Cooper and Zmud 1990). Generally referring to a firm's technical and human IS capability, technology competence has been found to be related to IS and EDI diffusion (Thong 1999) and shown as a main feature of the technological context (Zhu et al. 2003). For example, on the basis of a thorough literature review, Kwon and Zmud (1987) asserted the importance of technology resources (e.g., infrastructure and technical skills) for successful IS diffusion. This theoretical assertion was strengthened by a number of empirical studies (Mata et al. 1995). Hence, we include technology competence in our model.<sup>5</sup>

Second, e-business is also influenced by organizational factors because these variables may constrain or facilitate the implementation and usage of e-business (Teo et al. 2003). Based on prior innovation studies (Damanpour 1996), size, scope, and financial commitment are identified as three critical organi-

<sup>5</sup> As will become clearer in the empirical section, most of these factors are integrative constructs in the sense that they are measured by multiple items. For example, technology competence is an integrative construct that is reflected by IT human resources (percent of employees as IT professionals), distributed computing (PCs per employee), and IT infrastructure items such as EDI, electronic funds transfer (EFT), intranets, and extranets.

zational factors that would influence the extent of e-business use in an organization.

(1) Firm size is one of the most commonly cited factors in the innovation literature (see Damanpour 1992 for a meta-analysis). As size represents several important aspects of the organization, including resource availability, decision agility, and prior technology experience, it should be included in the model.

(2) International scope is an antecedent new to this study, which refers to a firm's geographical spread or its extent of multicountry operations in the global market. Firms with activities dispersed geographically may benefit more from e-business use as a means of coordinating their value chains (Porter and Millar 1985). The public, open nature of the Internet makes doing so easier than earlier technologies such as EDI. The global reach of the Internet makes it potentially more beneficial as well. As a consequence, firms with greater international scope are likely to use e-business to a greater extent than those with less international scope. Given the international dimension of our research design and our geographical, multicountry emphasis on globalization of e-business, it is important to include international scope in the model.

(3) Financial resources have been a popular antecedent to IS diffusion (e.g., Iacovou et al. 1995, Ramamurthy et al. 1999). To capture financial resources specifically *committed* to e-business rather than the overall financial resources of the organization, we use the construct *financial commitment* and define it as the commitment of financial resources to e-business as a proportion of total firm resources. This is felt to be a more appropriate antecedent of e-business use because it reflects committed rather than merely available resources. It also reflects the strategic importance that the senior management puts on e-business. One would expect that greater resource commitments would lead to more e-business applications that are both more useable and used.

Third, as the environment presents both constraints and opportunities for technological innovation, e-business is influenced by environmental factors related to competition (Porter 2001) and regulation (Zhu et al. 2003). Competitive pressure has long been recognized in the innovation diffusion literature as

an important driver for technology diffusion (e.g., Grover 1993, Thong 1999). Recent EDI research has identified competitive pressure (sometimes called external pressure) as a significant antecedent of EDI adoption (Iacovou et al. 1995, Ramamurthy et al. 1999). These studies have shown that innovation diffusion is accelerated by the competitive pressure in the environment. In contrast to competitive pressure, regulatory support is a unique feature of e-business that has not been included in prior studies on technology diffusion. The open-standard nature of the Internet brings unique issues regarding business law, security, credit card use, and online transactions with parties that have no prior relationship, which in turn poses unique demands on regulatory support (again different from EDI). In addition, governments' embrace of e-business brings direct (government incentives) and indirect (required for government procurement) stimulus for its use. Thus, regulatory support is another critical environmental factor that tends to affect e-business use (Zhu et al. 2003).

As explained above, we have selected these six antecedents based on prior research and particular linkages to the nature of Internet-based e-business. We incorporated these six factors within the technological, organizational, and environmental contexts of the TOE framework. Further justification for each of these factors is provided below, together with hypothesis development.

### 3.2. Hypotheses

Based on the TOE framework, we developed the following hypotheses, corresponding to the six factors in Figure 2 within the technological, organizational, and environmental contexts of the TOE framework.

**Technology Context.** The literature suggests that IS capabilities consist of infrastructure, human resources, and knowledge (Mata et al. 1995, Bharadwaj 2000). Consistent with prior studies, *technology competence* in this study consists of technology infrastructure and IT human resources, where technology infrastructure refers to technologies that enable Internet-related businesses (e.g., EDI, EFT, intranet and extranet), and IT human resources refer to IT professionals possessing the knowledge and skills to implement Internet-related applications. By this definition, technology



competence is conceptualized as an integrative construct that is reflected not only by physical assets, but also by human resources that are complementary to physical assets (Mata et al. 1995, Slaughter and Ang 1995). It refers to a firm's technical capability as a result of having distributed computing power (number of PCs) within the organization and having implemented specific technologies such as EDI and EFT (Zhu 2004b). Technology infrastructure establishes a platform on which e-business can be built; IT human resources provide knowledge and skills to develop e-business applications. Therefore, firms with a higher degree of technology competence tend to enjoy greater readiness to use e-business in their value chain processes. As a result, they would be more likely to achieve a greater extent of e-business usage. This leads to the following hypothesis.

*HYPOTHESIS 1. Firms with greater technology competence are more likely to achieve a greater extent of e-business use.*

**Organization Context.** Firm size is commonly cited in innovation diffusion literature (Damanpour 1992), yet different opinions exist as to the role that firm size plays in the process of innovation diffusion, due to the tension between resource availability and organizational inertia (Damanpour 1996). On one hand, large firms generally possess slack resources that can facilitate implementation and usage (Tornatzky and Fleischer 1990). On the other hand, firm size is often associated with inertia; that is, large firms tend to be less agile and flexible than small firms. The possible structural inertia associated with large firms may slow down organizational usage and may therefore retard e-business value creation (Thong 1999). By contrast, smaller firm size is expected to facilitate innovation usage, as small firms "require less communication, less coordination, and less influence to gather support" (Nord and Tucker 1987, p. 18). The actual use of e-business may entail radical change in firms' business processes and organization structure, which might be retarded by the structural inertia of large firms (Damanpour 1992). In our study, firm size is defined by the number of employees in the organization. Because our model has controlled for technological and financial resources that large firms may possess, the notion of structural inertia leads us

to expect that large firm size may deter e-business usage and value creation. This leads to the following hypothesis.

*HYPOTHESIS 2. Controlling for resource availability effects, larger firms tend to achieve a lesser extent of e-business use.*

The IS literature has proposed that the greater the business scope, the greater the demand for IT (Dewan et al. 1998, Hitt 1999). In this study, scope is defined as the geographical extent of a firm's operations in the global market; hence it is called *international scope*. This definition is narrower than the literature, yet it is consistent with the international perspective of our research design and our multicountry emphasis on globalization of e-business, as opposed to the product orientation typically used in the literature (Tece 1980). This is also appropriate for the retail industry. The effect of international scope on e-business use can be explained from a resource-based perspective (Barney 1991, Mata et al. 1995). When companies expand into heterogeneous market segments, they need to develop resources and capabilities including a flexible IT infrastructure and IT management skills that enable them to deal with that heterogeneity as well as or better than their competitors (Ernst 2003). For instance, firms conducting business in multiple markets have to manage demand uncertainty in all segments simultaneously, which requires a high degree of integration, flexibility, and responsiveness in their information systems, as well as the broader information infrastructure linking the firm with its customers, trading partners, and distributors. As documented in the literature and consistent with our value hierarchy in Figure 1, e-business may help to create these capabilities within the firm and with its trading partners as a result of common standards, lower cost, and greater ease of implementation of Internet-based applications. In sum, retail companies that expand globally would have a greater incentive to use e-business to leverage their existing IT capabilities for a competitive advantage. This leads to the following hypothesis.

*HYPOTHESIS 3. Firms with greater international scope are more likely to achieve a greater extent of e-business use.*

Financial resources constitute another important factor recognized in the innovation literature (e.g.,

Iacovou et al. 1995, Ramamurthy et al. 1999). In this study, we tailor this factor to financial resources specially committed to e-business. Implementing e-business requires investment in hardware, software, system integration, and employee training. Sufficient financial resources dedicated to e-business helps companies to obtain these necessary resources and develop them into superior e-business functionalities. Thus, firms with greater financial commitment are more likely to achieve successful e-business implementation and thus tend to achieve a greater extent of usage. Hence, we have the following hypothesis.

**HYPOTHESIS 4.** *Firms with greater financial commitment are more likely to achieve a greater extent of e-business use.*

**Environment Context.** *Competitive pressure* refers to the degree of pressure that the company feels from competitors within the industry. Porter and Millar (1985) analyzed the strategic rationale underlying competitive pressure as an innovation-diffusion driver. They suggested that, by using a new innovation, firms might be able to alter the rules of competition, affect the industry structure, and leverage new ways to outperform rivals, thus changing the competitive landscape. This analysis can be extended to e-business. As documented in the existing literature, the use of e-business may induce changes of industry structure through disintermediation and reintermediation (Bakos 1998), offer new means of competing and altering competition rules through lock-in (Shapiro and Varian 1999), electronic integration (Venkatraman and Zaheer 1990), and brick-and-click synergy (Steinfeld et al. 2002). Thus, competitive pressure plays a significant role in pushing firms toward using e-business (Dos Santos and Peffer 1998).

**HYPOTHESIS 5.** *Firms facing higher competitive pressure are more likely to achieve a greater extent of e-business use.*

*Regulatory support* is another critical environmental factor that tends to affect innovation diffusion. This concept is similar to government policy theorized to affect IT diffusion in Umanath and Campbell (1994) and empirically tested in Dasgupta et al. (1999). The latter found that companies operating in an environment where government policies are restrictive

have low IT adoption. This is also consistent with Williamson (1983, p. 126), who summarized two ways in which government regulation could affect innovation diffusion: "One is to take specific action to increase or decrease payoffs—by taking tax and other measures. . . . The second way of influencing innovations is by altering the climate in which they are received." This second way is consistent with the empirical findings and is particularly applicable to e-business, as the lack of legal protection of online transactions as well as security and privacy tend to be common concerns both for companies (especially retailers) and for consumers (Straub et al. 2002, Xu et al. 2004). Accordingly, governments could encourage e-business usage by establishing supportive business laws to protect e-business transactions, regulating the Internet to make it a trustworthy business platform (e.g., dealing with fraud and credit card misuse), and providing incentives for using e-business in government procurements and contracts.

**HYPOTHESIS 6.** *Firms facing higher regulatory support are more likely to achieve a greater extent of e-business use.*

**Linkage from E-Business Use to E-Business Value.** We draw on the RBV to explain the connection between usage and value. RBV suggests that the greater the extent of IT use, the greater the likelihood that organizations will create IT capabilities that are rare, inimitable, valuable, and sustainable, thereby contributing to value creation (along with organizational compliments). Through deeper usage in organizations, IT creates asset specificity, which provides a competitive advantage. Although the Internet is a generic platform for e-business, firms create specific resources by integrating their systems and databases internally in the back end and with their trading partners and customers (Zhu and Kraemer 2002). The greater the flexibility and adaptability of the platform created, the greater the asset specificity and the greater the value. Thus, higher degrees of e-business usage will be associated with improved business performance. Only when firms are actually using e-business to conduct value chain activities can e-business have an impact on firm performance. Without broad and deep use of e-business along the value chain, it would be impossible for e-business to generate any impact on firm performance in terms of

sales, procurement, or internal operations. A classic model for general IS success developed by DeLone and McLean (1992) suggested that there tends to be a strong link between system use and system impact. In a recent study, Devaraj and Kohli (2003) show that actual usage may be the “missing” link to IT payoff. Based on this literature, we hypothesize the link from e-business use to value as follows.

*HYPOTHESIS 7. Firms with greater e-business use are more likely to generate higher e-business value.*

**E-Business Value.** The ultimate goal of using e-business is to improve the business performance of the organization. As shown in the value hierarchy of Figure 1, e-business helps companies develop appropriate functionalities to leverage the Internet’s characteristics. As discussed in §3.1, such e-business functionalities are categorized into two groups: *front-end functionality* and *back-end integration*. Front-end functionalities help firms deliver real-time product information to consumers, offer customization capability, and facilitate self-service via online account management, thereby improving transactional efficiencies and expanding the existing channel (Zhu and Kraemer 2002). Back-end integration helps firms achieve technology integration and enables information sharing within the firm and along the value chain. Thus, one would expect that superior front-end functionality and back-end integration help firms improve business performance. This leads to the following hypothesis.

*HYPOTHESIS 8. Greater e-business capabilities, including both front-end functionality and back-end integration, are positively associated with higher e-business value.*

Although both have the potential to create e-business value, front-end functionality and back-end integration may vary in importance, as suggested by the resource-based theory. Front-end functionality is public and open on the Internet, and thus could be easily observed and imitated by competitors. As a result, front-end functionality could become commodity-like as more competitors adopt e-business (Porter 2001, Carr 2003). In comparison, the process of back-end integration is far more difficult to imitate, because its success requires quality complementary resources. In addition, the integration process is often

tailored to a firm’s strategic context and is woven into the organization’s fabric, which is not transparent to competitors. Therefore, we propose the following hypothesis.

*HYPOTHESIS 9. Back-end integration will have a stronger impact on e-business value than front-end functionality.*

**International Effects: Differences Between Developed and Developing Countries.** Given that the Internet is an open platform with global connectivity, we believe it is important to incorporate an international dimension in this study. Previous research has shown that developed and developing countries differ in terms of the level of IT use and the factors shaping that use (Dewan and Kraemer 2000). At the general level, technology diffusion studies have found that diffusion occurs unevenly across countries with different environments. Moreover, the extent of diffusion depends on a variety of economic, social, and political factors, including income, education, technology policies, cultural norms, and access to formal and informal communication networks (Rogers 1983, Tornatzky and Fleisher 1990, Caselli and Coleman 2001). Looking specifically at the use of IT, wealth has been identified as the single most important factor accounting for differences between developed and developing countries (Dewan and Kraemer 2000, Pohjola 2001), but other factors have also been found to be important. These include inadequacy and access costs of the basic information infrastructure (Kraemer and Dedrick 1994, Shih et al. 2005), education levels (Caselli and Coleman 2001), scarcity of managerial, technical, and financial resources at the firm level (Dasgupta et al. 1999), and culture and politics, including the rule of law, political openness, and property rights protection (Jarvenpaa and Leidner 1998, Caselli and Coleman 2001, Oxley and Yeung 2001, Shih et al. 2005). Within the environmental context of the TOE framework, we want to understand the differences of e-business use and value across countries, as motivated by the international character of our study. Based on this, we put forth our final hypothesis.

*HYPOTHESIS 10. The strength of the antecedents of e-business use and value will differ for developed and developing countries.*

## 4. Research Methodology

### 4.1. Data

To test the conceptual model in Figure 2 and the associated hypotheses proposed above, we need data, but no secondary databases contain specific data on the required variables. Hence, we designed a questionnaire and conducted a multicountry survey. The questionnaire was designed on the basis of a comprehensive literature review and interviews with e-business managers and was refined via several runs of pretests, revisions, and pilot tests. Each of the items on the questionnaire was reviewed by an expert panel for its content, scope, and purpose (content validity). After the questionnaire was finalized, it was translated into different languages (Chinese, French, German, Japanese, and Portuguese) with the aid of International Data Corporation (IDC) and the translations were checked by multiple teams (survey design teams, market research professionals, and academic research partners in each country). Then the survey was executed jointly with IDC and a professional survey firm that specializes in large-scale survey research and has accumulated considerable experience within IT user communities in many countries.

To have a representation of both developed and developing economies, the survey was conducted in the United States and nine other countries (Brazil, China, Denmark, France, Germany, Japan, Mexico, Singapore, and Taiwan)<sup>6</sup> during the period of February–April 2002. The sample was stratified by firm size and country, with sites selected randomly within each size cell. The sample frame was obtained from a list source representative of the entire local market in each country.<sup>7</sup> Thus, we believe that our sample reflects the status of e-business across developed and developing economies.

In total, 5,400 establishments were surveyed, and 701 responses were received, resulting in a 13% re-

<sup>6</sup> More precisely, our sample contains nine countries because China and Taiwan belong to one country. We initially believed that there might be some differences in their IT infrastructure and economic environments, yet the differences turned out to be statistically insignificant.

<sup>7</sup> Dun & Bradstreet was used for Denmark, France, Germany, and the United States. Kompas was used for Brazil, Mexico, Taiwan, and Singapore. The Census of Enterprises was used for China. The Teikoku Data Bank was used for Japan.

**Table 1** Sample Characteristics (*N* = 624)

	Obs.	(%)
Country		
Brazil	64	10.3
China	64	10.3
Denmark	47	7.5
France	61	9.8
Germany	60	9.6
Japan	53	8.5
Mexico	69	11.1
Singapore	57	9.1
Taiwan (China)	63	10.1
United States	86	13.8
Total	624	100
No. of Employees		
<50	134	21.5
50~100	107	17.1
100~250	151	24.2
250~400	111	17.8
>400	121	19.4
Respondent Title		
President, Managing Director, CEO	21	3.4
CIO/CTO/VP of IS	90	14.4
IS Manager, Director, Planner	244	39.1
Other manager in IS department	126	20.2
Business Operations Manager, COO	36	5.8
Administration/Finance Manager, CFO	47	7.5
Others	60	9.6

sponse rate, which was comparable to other studies of similar scale. We checked the sample for consistency and dropped invalid responses, resulting in a final dataset of 624 valid cases. Table 1 shows the characteristics of the establishment sample. All of them have adopted e-business, as this was a selection criterion for inclusion in the sample. The distribution of firm size, measured by number of employees, reflects a balance of large and small businesses. Eligible respondents were the individuals in each firm best qualified to speak about the firm’s overall e-business activities. They were normally CIOs, CEOs, IS managers, business managers, or CFOs, as shown in Table 1. The positions of the respondents suggest the good quality of the data source. We examined the dataset for potential biases and found no significant biases among countries in terms of firm size, number of responses, or respondents’ titles. Further, we examined the common method bias by using Harman’s one-factor test (Podsakoff et al. 2003). These tests found no significant biases in our dataset that were due to the survey methodology.

**Table 2** Testing Possible Biases: IS Managers vs. Non-IS Managers

	IS managers		Non-IS managers		One-way ANOVA		K-S test	
	Mean	S.D.	Mean	S.D.	t-stat.	p-value	Z score	p-value
Technology competence	2.79	0.71	2.66	0.79	1.45	0.15	0.95	0.32
International scope	0.12	0.15	0.12	0.15	0.34	0.73	0.99	0.28
Financial commitment to e-business	1.11	2.49	3.18	7.92	2.76	0.01	1.09	0.19
Competitive pressure	2.92	1.31	3.06	1.22	1.08	0.28	1.00	0.28
Regulatory support	1.13	0.47	1.12	0.42	0.20	0.84	0.62	0.84
E-business use	0.73	1.02	0.77	1.09	0.36	0.72	0.66	0.78
Front-end functionality	0.19	0.16	0.18	0.14	0.57	0.56	0.45	0.98
Back-end integration	1.97	0.87	1.92	0.85	0.55	0.58	0.60	0.87
E-business value	2.20	0.80	2.11	0.77	1.13	0.26	0.88	0.43

Furthermore, we examined whether any systematic biases could exist due to respondent positions. Because respondents in our survey include both IS and non-IS managers, one might suspect that IS managers may overrate e-business usage and value. To test this possible bias, we split the sample into two groups: IS managers (CIO, CTO, and various IS managers) versus non-IS managers (CEO, president, COO, CFO, and other business managers). We used one-way ANOVA to compare the means of factor scores of all constructs between the two groups. We further used the Kolmogorov-Smirnov (K-S) test to examine whether the sample distribution of the IS-manager group is equal to that of the non-IS-manager group (Boes et al. 1974). As shown in Table 2, the *p*-value for each factor is insignificant ( $p \geq 0.10$ ), with only one exception—financial commitment to e-business.<sup>8</sup> Hence, we conclude that the role of the respondents did not cause any survey biases.

All the firms in the sample belong to the retail/wholesale industry. This industry is appropriate for testing our proposed model of e-business use and value because it has undergone significant transformation in the last two decades with the introduction of increasingly sophisticated information technologies such as point-of-scale scanners, computer-based systems for inventory management, and EDI links with

suppliers and distribution centers (Johnson 2002). More recently, this industry has experienced competition from dot-coms, which pressed the large traditional retailers to aggressively deploy Internet-based e-business initiatives and rapidly build strong foundations for e-business by integrating corporate, operational, service, and supply chain systems with Internet-enabled capabilities. Small traditional retailers also responded by building websites with front-end functionalities. By implementing e-business initiatives, traditional retailers are transforming themselves into “click-and-mortar” Internet-enhanced organizations (Steinfeld et al. 2002). These factors make the retail industry an appropriate testing field for our research. From an empirical perspective, concentrating on a single industry also allows us to control for extraneous industry factors that could otherwise confound the analysis, although we have no theoretical reason to believe that our conceptual model would not apply to other industries.

#### 4.2. Constructs

The development of the measurement model included successive stages of theoretical modeling, statistical testing, and refinement (Straub 1989). Measurement items were developed on the basis of a comprehensive review of the literature as well as expert opinion. We then tested multi-indicator constructs using confirmatory factor analysis (CFA).<sup>9</sup> Based on

<sup>8</sup> It appears that non-IS managers perceive the financial commitment to e-business to be larger than IS managers do. It is possible that business managers consider the intangible costs of the business units, whereas the IS managers consider only the tangible IS spending (e.g., hardware, software, Web development).

<sup>9</sup> For the purpose of testing the robustness of our measurement model, we also ran exploratory factor analysis on all indicators. Principal component analysis with equamax rotation yielded a consistent grouping with CFA.

the assessment of CFA, the measurement model was further refined and then fitted again. Constructs and associated indicators in the measurement model are listed in the appendix.

Several constructs deserve further explanation. First, technology competence is instrumented not only by physical technologies, but also by IT human resources that possess the knowledge and skills to implement e-business. Such a design is consistent with the theoretical rationale discussed in §3.2. Second, items for front-end functionality and back-end integration are designed on the basis of the e-business metrics developed by Zhu and Kraemer (2002). Through successive stages of testing and refinement, Zhu and Kraemer developed a set of e-business metrics—information, transaction, customization, and supplier integration. Our study used the major items in the first three dimensions to instrument front-end functionality, and the fourth dimension corresponded to our back-end integration. Third, e-business value is conceptualized as a second-order construct, manifested in three related dimensions—impact on sales, impact on procurement, and impact on internal operations—along the value chain.<sup>10</sup> They should not be considered as isolated from each other; rather they should be viewed in a collective and mutually reinforcing manner. Hence, the e-business value construct represents an integrative measure of the level of Internet-enhanced business performance along these three dimensions. Previous research notes that such a second-order approach represents a theoretically strong basis for capturing complex measures (Sethi and King 1994, Steward and Segars 2002).

### 4.3. Instrument Validation

To empirically assess the constructs theorized above, we conducted CFA using structural equation modeling as implemented in partial least squares (PLS). We assessed construct reliability, convergent validity, discriminant validity, and validity of the second-order construct. The measurement properties are reported in Table 3.

<sup>10</sup> Recognizing that many factors other than e-business may affect firm performance, we asked firms to evaluate, using a five-point Likert scale, the *net* impacts of e-business on these three dimensions.

**Table 3** Measurement Model: Factor Loadings, Reliability, and Convergent Validity

Constructs (reliability)	Indicators	Loadings	Convergent validity ( <i>t</i> -stat)
Technology competence (0.81)	TC1	0.79***	46.76
	TC2	0.79***	37.10
	TC3	0.71***	24.90
International scope (0.81)	FS1	0.64***	36.65
	FS2	0.86***	160.80
	FS3	0.78***	52.66
Financial commitment to e-business (0.83)	FR1	0.86***	29.07
	FR2	0.82***	15.84
Competitive pressure (0.86)	CP1	0.87***	74.04
	CP2	0.87***	73.89
Regulatory support (0.80)	RE1	0.68***	21.30
	RE2	0.69***	24.87
	RE3	0.71***	22.91
	RE4	0.74***	30.76
Back-end integration (0.86)	BI1	0.87***	80.53
	BI2	0.86***	79.54
E-business use (0.78)	EU1	0.64***	18.44
	EU2	0.50***	6.67
	EU3	0.46***	4.85
	EU4	0.83***	35.95
	EU5	0.75***	13.55
Front-end functionality (0.80)	FF1	0.63***	15.92
	FF2	0.65***	25.76
	FF3	0.67***	26.00
	FF4	0.72***	24.31
	FF5	0.68***	20.46
Impact on sales (0.88)	IS1	0.86***	76.46
	IS2	0.84***	51.62
	IS3	0.81***	41.92
Impact on internal operations (0.90)	IIO1	0.89***	81.85
	IIO2	0.91***	123.42
Impact on procurement (0.87)	IP1	0.85***	50.11
	IP2	0.85***	74.50
	IP3	0.79***	37.90

\*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . Insignificant factors are dropped (FS4 and FS5).

(1) *Construct Reliability*: Construct reliability measures the degree to which items are free from random error and therefore yield consistent results. In our measurement model (Table 3), all constructs have a composite reliability over the cutoff of 0.70, as suggested by Straub (1989).

(2) *Convergent Validity and Discriminant Validity*: Convergent validity assesses the consistency across multiple operationalizations. As shown in Table 3, all estimated standard loadings are significant ( $p < 0.01$ ), suggesting good convergent validity. To assess the

**Table 4 Measurement Model: Second-Order Construct**

Second-order construct	First-order constructs	Loadings	<i>t</i> -stat	Composite reliability
E-business value	Impact on sales	0.865***	77.68	0.88
	Impact on internal operation	0.805***	44.08	
	Impact on procurement	0.844***	55.52	

\*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

discriminant validity—the extent to which different constructs diverge from one another—we used Fornell and Larcker’s (1981) criteria: average variance extracted for each construct should be greater than the squared correlation between constructs. Such results suggest that the items share more common variance with their respective constructs than with other constructs. All our constructs meet this criterion.

(3) *Validity of the Second-Order Construct*: Table 4 shows the estimation of the second-order construct, e-business *value*. The paths from the second-order construct to the three first-order factors are significant and of high magnitude, greater than the suggested cutoff of 0.7 (Chin 1998). Marsh and Hocevar (1985) suggest that the efficacy of the second-order model be assessed by the target coefficient (*T* ratio) with an upper bound of 1. Our model has a very high *T* ratio of 0.99, implying that the relationship among first-order constructs is sufficiently captured by the second-order construct (Steward and Segars 2002). Therefore, on both theoretical and empirical grounds, the conceptualization of e-business *value* as a higher-order, multidimensional construct seems justified. In summary, our measurement model satisfies various reliability and validity criteria. Thus, constructs developed by this measurement model could be used to test the conceptual model and the associated hypotheses proposed earlier. Empirical tests are discussed in the following section.

## 5. Empirical Analysis

We tested the conceptual model in Figure 2 by structural equation modeling using both the full sample and the sample split between developed and developing countries. Although theory and prior research led us to expect differences, we did not know a priori that there would be differences between the full and split samples; therefore, we needed to do the analysis

for both. It also enabled us to relate our findings to the broader IT literature.

### 5.1. Analysis of the Full Sample

We tested the conceptual model by using the method of PLS.<sup>11</sup> We chose PLS because our research is still at an early stage and the proposed model has not been tested in the literature. Also, PLS is appropriate for handling both reflective and formative constructs and constructs with mixed scales (Chin 1998). The results (standardized paths) are shown in parentheses in Figure 2. To assess model fit, we report  $R^2$  in Figures 2 and 4, which indicate how well the antecedents explain an endogeneous construct. Our model was also evaluated in terms of statistical power, which refers to the ability to reject a poor model specification. Power analysis should be included in model evaluation and hypotheses testing, as advocated by researchers in social science (Kaplan 1995) and IS (Baroudi and Orlikowski 1989). Following the procedure suggested by MacCallum et al. (1996), we found that our model has a statistical power greater than 0.9, far above the conventional threshold of 0.8, as suggested by Baroudi and Orlikowski (1989).

The strong statistical power enhanced our confidence in the result of hypotheses testing, which is based on the examination of the standardized paths shown in Figure 2. For e-business use, five of the six TOE factors—technology competence, size, financial commitment, competitive pressure, and regulatory support—have significant paths leading to the dependent construct. Size has a negative path, while the other four factors have positive paths. The path associated with international scope is positive but statistically insignificant ( $p > 0.10$ ). Therefore, all hypotheses (except Hypothesis 3) dealing with e-business use are supported. In addition, the model shows a significantly positive linkage from usage to value (0.150\*\*\*), hence supporting Hypothesis 7.

E-business value is also shown to have significantly positive associations with front-end functionality and back-end integration. Hence, Hypothesis 8 is supported. To test Hypothesis 9, we compared the

<sup>11</sup> For the purpose of cross-checking our results, we also fitted the structural model using AMOS and obtained consistent path estimates in terms of both magnitude and significance, indicating the robustness of our model.

standardized path (the magnitude and significance) from front-end functionality to e-business value with the standardized path from back-end integration to e-business value. Back-end integration is found to have a much higher magnitude than front-end functionality (0.239\*\*\* versus 0.141\*\*\*). Thus, Hypothesis 9 is supported.

## 5.2. The International Effects: Developed vs. Developing Countries

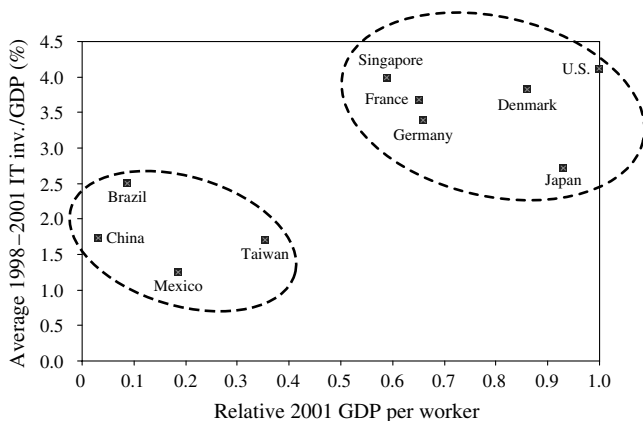
As discussed earlier, the theoretical and empirical evidence motivated us to investigate how different economic environments shape e-business use and value. We evaluated two dimensions describing national environments: aggregated IT investment as a percentage of GDP, and GDP per worker. These two dimensions were used because wealth and accumulative investment in IT played an important role in cross-country differences of IT diffusion and value (Dewan and Kraemer 2000). As shown in Figure 3, the 10 countries in our sample can be categorized into two distinct groups according to these two dimensions. Brazil, China, Mexico, and Taiwan form a developing-country subsample ( $N = 260$ ) with lower IT infrastructure and less per capita income, while Denmark, France, Germany, Japan, Singapore, and the United States form a developed-country subsample ( $N = 364$ ).

We then ran structural equation modeling on the developed- and developing-country subsamples,

respectively. Figure 4 shows estimated paths for both subsamples, with the developing-country subsample reported in parentheses. In the developed-country subsample, all six TOE factors are positive and statistically significant, as indicated by their standardized paths. Thus, all hypotheses (1–6) about e-business use are supported. In addition, the model indicates a strong linkage from e-business usage to e-business value (Hypothesis 7). Of the two types of e-business functionalities, back-end integration has a stronger association ( $p < 0.01$ ) with e-business value than front-end functionality (Hypothesis 9). In the developing-country subsample, only four of the six TOE factors are found to be significant (technology competence, size, financial commitment, and regulatory support), while international scope and competitive pressure are insignificant ( $p > 0.10$ ). Again, the model shows a significantly positive linkage between e-business usage and e-business value. Back-end integration remains very strong ( $p < 0.01$ ), with higher magnitude and greater significance than front-end functionality. Hence, Hypothesis 9 is again supported. These results support our theoretical argument in §3.2, where we asserted that, as more firms adopt e-business, front-end functionalities would become more and more common and e-businesses could hardly be differentiated by them. Firms in developed countries have been using e-business longer; thus back-end integration is more important.

Finally, the differences between developed and developing countries are further examined through group analysis with  $t$ -test, that is, by statistically comparing each path coefficient in the developed-country subsample with the corresponding path coefficient in the developing-country subsample (Chin 1998). It turns out that competitive pressure and regulatory support show statistical differences between the two subsamples ( $p < 0.01$ ). This result provides support for the cross-national effects as proposed in Hypothesis 10. It also supports our theoretical argument in §3.2 that there would be differences in the factors shaping e-business usage because of wealth, industry structure, and other differences in the national environments in which the firms operate. This shows that the economic environment shapes IT use.

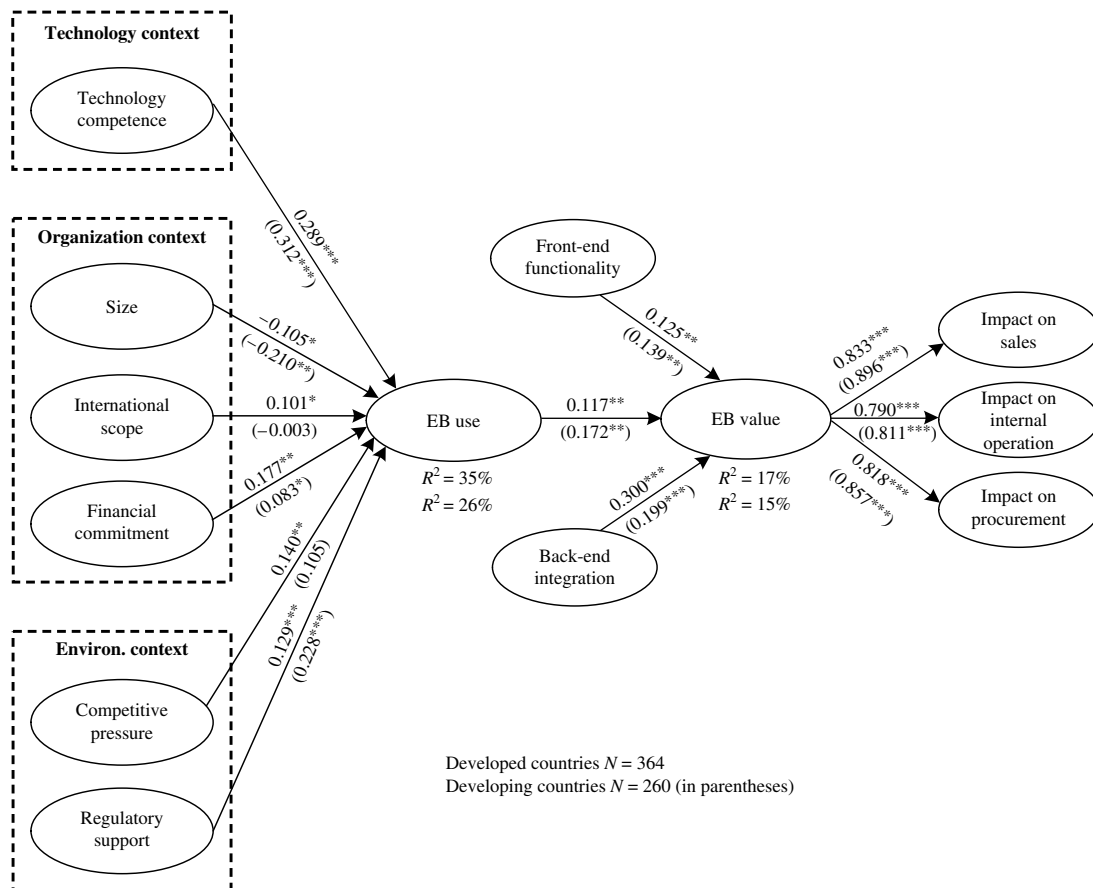
**Figure 3** Scatter Plot Between IT Investment as a Percentage of GDP Against Relative (to U.S.) GDP per Capita (Both Variables Measured in Constant 2001 U.S. Dollars)



Note. Data source: IDC (2001).



Figure 4 E-Business (EB) Use and Value—Results of Developed vs. Developing Countries



\*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . Full sample results are listed in parentheses. To avoid a crowded graph, indicators for each construct are not shown in the graph.

## 6. Discussion

With the purpose of studying e-business use and value, we have developed and empirically assessed our theoretical model across different economic environments. All hypotheses have been tested in the full sample and the two subsamples. The empirical analysis demonstrated several major findings. Interpretations based on these findings and implications for managers and researchers are discussed below.

### 6.1. Major Findings and Interpretations

**FINDING 1.** *Within the TOE framework, technology competence, financial commitment, competitive pressure, and regulatory support are found to have significant influence on the extent of e-business use. Among these, technology competence appears to be the strongest factor.*

As indicated by their significant and positive paths in Figure 2, firms with higher levels of technology competence tend to achieve greater extent of e-business use, as do firms facing competitive pressure and regulatory support. Among all the TOE factors, technology competence is the most significant factor, as indicated by its path loadings and significance levels ( $p < 0.01$ ), followed by regulatory support. Within the organizational context, our study reveals a negative effect of firm size on e-business use. While it has been commonly believed that large firms have more slack resources for committing required investments (Rogers 1983), our results show that large firms are also burdened by structural inertia, possibly due to fragmented legacy systems and entrenched organizational structures. Our model has controlled for technological and financial resources, and thus the net

effect of firm size in our model might be dominated by structure inertia. These results suggest that the proposed research model in Figure 2 is a useful theoretical framework for explaining factors that affect the use of e-business by companies.

**FINDING 2.** *The linkage from e-business use to e-business value is found to be significant, suggesting that use would be a “missing link” if not included.*

As theorized earlier, firms with higher e-business use tend to achieve greater value from e-business. Our results from both the full sample and the split sample consistently show a significant and positive linkage from e-business use to e-business value. This means that higher degrees of e-business use are associated with improved business performance. This also confirms the earlier postulation that actual use may be the “missing link” to IT payoff (Devaraj and Kohli 2003). This significant linkage also supports our research design, in which use and value are evaluated together in one model.

**FINDING 3.** *Both front-end functionality and back-end integration contribute to value creation of e-business.*

Using a large dataset, our analysis has identified two ways in which e-business creates value—front-end functionality and back-end integration. This finding is supported by the significant and positive linkages from front-end functionality and back-end integration to e-business value, as shown in the path loadings of Figures 2 and 4. As discussed in §3, front-end functionalities help firms provide timely information to customers, facilitate personalization and account management, expand existing channels, and improve transactional efficiencies; back-end integration enables technology integration within the organization and facilitates information sharing with suppliers and business partners (Zhu and Kraemer 2002). As a result, these two types of e-business capabilities help firms improve performance by affecting intermediate achievements such as customer intimacy in the front end and operational excellence in the back end; both are critical for firms to achieve performance improvement (Treacy and Wiersema 1993).

**FINDING 4.** *Back-end integration is found to have a much stronger impact on firm performance than front-end functionality, highlighting its importance to e-business*

*value, which seems consistent with the resource-based theory.*

While e-business value can be created from the front end and the back end, our study has further evaluated their relative importance, theoretically motivated by the RBV. As we hypothesized in §3, back-end integration would have a greater contribution to firm performance than front-end functionality, because back-end integration is firm specific, difficult to imitate, and less mobile across firms. More importantly, back-end integration helps e-businesses develop the capability to link fragmented resources together, hence increasing integration and complementarities among disparate systems (Zhu 2004b), which is strengthened by the Internet-enabled connectivity and open-standard network integration. In the full sample (see Figure 2), both paths associated with back-end integration and front-end functionality are significantly positive, but the one with back-end integration is much stronger. A similar pattern is found for the two subsamples (see Figure 4), but the difference is more pronounced in the developed-country subsample. The underlying rationale would be the following: Firms in developed countries have been using e-business longer (Zhu et al. 2003), thus front-end functionalities have become more and more common (Porter 2001); e-businesses are more differentiated by back-end integration because it is often tailored to a firm’s strategic context and is woven into the organization’s fabric, which is not transparent to competitors. The resource-based theory suggests this as an important source of e-business value.

**FINDING 5.** *The importance of two factors—competitive pressure and regulatory support—differs across developed versus developing countries. This finding confirms that economic environments shape e-business use.*

This result might be explained as follows. First, *competitive pressure* is statistically significant for developed countries but not for developing countries. Such a difference could be explained by the distinct market environments of developed and developing countries. Prior research has shown that information asymmetry exists in less-developed markets, and market imperfections and inefficiencies may weaken the pressure from competitors (Dewan

and Kraemer 2000). In developed countries, however, markets have evolved into mature stages over time, characterized by more transparent information flow and more stable legal frameworks and government policies. Therefore, firms in developed countries can obtain more information about competitors' e-business development (Zhu 2004a), which may force them to adopt e-business to avoid competitive decline. Second, although the path loadings of *regulatory support* appear to be significant in both subsamples, more sophisticated analysis (group analysis) reveals that it is relatively more important in developing countries. This finding is related to the above discussion, that markets in most developing countries are characterized by information asymmetry and immature institutional structure (Zhu et al. 2004). As a result, government regulation (e.g., legal protection of online transactions), or the lack thereof, tends to be a greater force in developing countries. In light of these varying behaviors across the two subsamples, we have learned the significant role that economic environments play in shaping the extent of e-business use. This finding further confirms the usefulness of the proposed conceptual model for studying e-business, as economic environment is an important factor within the TOE framework.

## 6.2. Limitations and Future Research

We believe that the key limitations of this study are as follows. First, the impact measures were subjective in the sense that they were based on Likert-scale responses provided by managers. While we have been careful in assessing potential biases inherently associated with such data, it would have been desirable to have more objective measures of impact. Also, our measure of IT human resources is weak in the sense that it includes only the number of IT employees rather than employee knowledge and skills per se. Although there probably is a relationship between the number of employees and both the variety and skill levels of technical specialists, the current measure is only a proxy for IT competence. Further, our sample may represent advanced Internet firm users in each country rather than a representative sample of the overall population. Further, because our dataset is cross sectional in nature, we cannot analyze longitudinal processes, such as the evolution of e-business

usage and value in a dynamic context. We cannot speak empirically to the issue of whether value is sustained because this requires a longitudinal study. Hence, our empirical results show only that relationships exist among the stages and factors. A more complete test of the process model would require more comprehensive, longitudinal data or indepth case studies over time.

These limitations suggest avenues for further research. We plan to refine our measures of key variables (e.g., e-business value measures supplemented by objective performance data) in future studies. To investigate the dynamic nature of e-business usage and value, we plan to enhance the database over time to pave the way for a longitudinal study. Finally, we also plan to expand our study into other industries (manufacturing and services). While this study provides a base on which future research can build, there is clearly much more work to be done.

We hope this study offers implications for other researchers as well. First, we have demonstrated the solid theoretical basis of the TOE framework in conjunction with a resource-based view. We have shown the usefulness of this framework for identifying factors that affect e-business usage and value. In particular, usage is shown as an important link to e-business value, which seems to be understudied in the IS literature. This framework could be used by other researchers for studying technology use. Second, we have developed several constructs, including e-business use, e-business value, front-end functionality, and back-end integration. These instruments have passed various reliability and validity tests, and they could be used in future studies. Third, grounded in theory and empirical data, we have categorized e-business functionalities and analyzed their relative significance for e-business value. The result could serve as a theoretical base for studying further sources of value creation from technology innovations.

## 6.3. Managerial Implications

These results have several important implications for management. First, they offer a useful framework for managers to assess the *technological* conditions under which e-business is launched to better pursue business value. It is important to build up technology competence and keep in mind that technology competence includes tangible technologies, intangible

managerial skills, and human resources. Further, IT managers have struggled for ways to create value from Internet technologies. Our study sheds light on ways to realize value from e-business—greater breadth and depth of use, customer-facing Web functionalities on the front end, and tight integration on the back end.

In particular, our empirical results highlight the importance of *back-end integration* among various back-office databases and enterprise systems, and information sharing with business partners. Our analysis has identified this as a major source of e-business value. It will become even more important as e-business develops into deeper stages, as suggested by the result that the significance of back-end integration is more pronounced in developed countries that seem to be at deeper stages of e-business development. These findings could serve as useful guidelines for firms to develop their e-business capabilities. This is especially important in the retail industry, where firms have been building various legacy systems and using multiple IT platforms over the years.

Furthermore, managers need to assess the appropriateness of e-business to certain *organizational* characteristics (e.g., size, scope), as suggested by our empirical findings. This implies that potential value of e-business investment could be affected by structural differences. Effective e-business programs rely on necessary organizational reconfiguration and business processes reengineering. As Internet technologies diffuse and become necessities, these organizational capabilities and structural differences will be even more critical. In particular, managers in retail firms with a wider scope should pursue e-business usage more proactively, given the greater potential to achieve benefits from e-business. This implication should be of special interest for retailers seeking global expansion into different regions and market segments. Such expansion means that retailers would face greater coordination tasks and could leverage e-business initiatives to facilitate coordination and achieve resource integration.

Finally, our study also offers implications for *policy makers*. Regulatory support has emerged as an important factor for e-business use and value. This is even more important for developing countries. During our study, companies frequently cited significant obstacles

to doing e-business, including inadequate legal protection for online transactions, unclear business laws, and security and privacy concerns. While this was important for all countries, it was a much more significant factor for developing countries. It also pointed to the need for establishing a broad legal and institutional framework that supports e-business. Governments, therefore, could accelerate the diffusion of e-business by establishing supportive business laws to make the Internet a trustworthy business platform (e.g., dealing with transaction fraud, promoting credit card use). This is particularly important at early stages of e-business development in an economy. Technological innovations are considered the primary driver of improvements in industrial productivity (Greenspan 2002). Yet if promising innovations cannot be widely deployed, then the benefits resulting from their invention will be curtailed (Fichman and Kemerer 1997).

## 7. Conclusions

Grounded in the innovation diffusion literature and the resource-based theory, this study has theoretically developed and empirically evaluated an integrative research model incorporating technological, organizational, and environmental factors, for assessing e-business use and value at the firm level. While these issues were typically studied separately in the literature, our results suggest that usage and value are closely linked, indicating that this unified perspective helps us gain a more holistic picture of the postadoption diffusion and consequence of e-business. To realize e-business value, firms need to facilitate the usage of e-business in various value chain activities. Our model moves beyond dichotomous “adoption versus nonadoption” and accounts for the “missing link”—actual usage—as a critical stage of value creation. This is a significant contribution to the academic literature.

For e-business use, our study has examined six factors, within the TOE framework, as drivers of e-business use. Some of these factors play different roles across different economic environments. This finding shows that, while e-business is a global phenomenon, its use is moderated by local environments.

For e-business value, our study has demonstrated that the extent of e-business use and e-business capabilities, both front-end functionalities and back-end integration, contribute to value creation of e-business, but back-end integration has a much stronger impact.

This is consistent with the resource-based theory, in the sense that back-end integration possesses the value-creating characteristics of resources (e.g., firm specific, difficult to imitate). There are also cross-country differences: Back-end integration is more important in developed countries than in developing countries, yet front-end functionality is the opposite. Because firms in developed countries are typically at a more advanced stage of the digital transformation, this result shows that back-end integration becomes more important at deeper stages of e-business development. Linking this to the ongoing debate over sources of IT value, our result provides empirical evidence that points to these capabilities (especially back-end integration), enhanced by the open-standard connectivity of the Internet, as one such source. This seems to be a promising area for future research.

Our study also adds an international perspective to IT diffusion and e-business value literature. Unlike most of the studies in the literature, our study was not limited to a single country. The broad dataset from 10 countries allowed us to examine how economic environments influence innovation diffusion. Our results indicate that careful attention must be paid to the economic and regulatory factors that may affect technology diffusion across different countries. Because our sample included developed, developing, and newly industrialized countries, this helps to strengthen the generalizability of our results.

In summary, this study has developed an integrative theoretical framework for assessing e-business use and value, beyond initial adoption. This study

is the first to demonstrate the theoretical value of integrating TOE and RBV. The findings contribute to the unsettled debate on IT value—in this case, in the e-business environment. This framework could be applied by researchers to study other complex information systems in different settings. We see this research as a first step toward understanding the complex relationships among technology, environments, and organizational performance. We hope that these initial results will motivate others to engage in future research to refine the theory and measurement.

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### Appendix. Measures

Constructs		Indicators
<i>Technological context</i>		
Technology competence	TC1	Number of PCs per employee (#)
	TC2	IT professionals, as percent of total employees (#)
	TC3	Number of items the establishment has in the following list (#): Use of e-mail, website accessible by public, use of intranet, use of extranet, use of EDI, use of EFT, use of call center
<i>Organizational context</i>		
Size	SZ1	Number of employees at establishment
	FS1	Multiestablishments (Y/N)
International scope	FS2	Establishments outside of country (Y/N)
	FS3	Headquarters located outside of country (Y/N)
	FS4	Percent of sales from outside country (#)
	FS5	Percent of procurement spending from outside country (#)
	FR1	IS operating budget, as percent of total revenue (#)
Financial commitment	FR2	Web-based spending, as percent of total revenue (#)

(cont'd.)

Constructs		Indicators
<i>Environmental context</i>		
Competitive pressure	CP1	Degree affected by competitors in the local market (1~5)
	CP2	Degree affected by competitors in the national market (1~5)
Regulatory support	RE1	Government provided incentive (1~5)
	RE2	Required by government purchase (1~5)
	RE3	Business laws support electronic business (1~5)
	RE4	Legal protection for consumer purchase on the Internet (1~5)
<i>E-Business functionalities</i>		
Front-end functionality	FF1	Website supports product catalog (Y/N)
	FF2	Website supports product reviews (Y/N)
	FF3	Website supports consumer customization (Y/N)
	FF4	Website supports account management (Y/N)
	FF5	Website supports registry of online community (Y/N)
Back-end integration	BI1	Web applications electronically integrated with back-office systems and databases (1~5)
	BI2	Company databases electronically integrated with suppliers and partners (1~5)
<i>E-Business usage</i>		
Extent of e-business use	EU1	Number of items in the following list (#): Providing information online, making sales online, providing service online, joining electronic intermediaries for online sales, making purchases online, joining electronic intermediaries for online purchase.
	EU2	Percent of consumer sales conducted online (#)
	EU3	Percent of business-to-business sales conducted online (#)
	EU4	Percent of goods for resale ordered online (#)
	EU5	Percent of supplies and equipment for doing business ordered online (#)
<i>E-Business value</i>		
Impact on sales	IS1	Sales increased (1~5)
	IS2	Sales area widened (1~5)
	IS3	Customer service improved (1~5)
Impact on internal operations	II01	Internal processes more efficient (1~5)
	II02	Staff productivity increased (1~5)
Impact on procurement	IP1	Procurement costs decreased (1~5)
	IP2	Inventory costs decreased (1~5)
	IP3	Coordination with suppliers improved (1~5)

Note. #, continuous variable; Y/N, dummy variable; 1~5, 5-point Likert scale.

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