

A Cross-Country Investigation of the Determinants of Scope of E-commerce Use: An Institutional Approach

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INTRODUCTION

The Internet and electronic commerce have become increasingly diffused globally, bringing countries together into a global networked economy. Despite the dot.com bust and the economic downturn of recent years, Internet commerce continues to grow and become a more integral part of firms' business strategies. According to the latest US Census Bureau statistics, US retail e-commerce sales rose 19.3% from the first quarter of 2001 to the first quarter of 2002, to \$9.8 billion (Horn 2003). The value of business-to-business e-commerce transactions is predicted to reach \$3.9 trillion in 2004 (Hickey 2002). E-commerce is growing at an even faster pace outside the US, as more firms and consumers gain access to the Internet; nearly one-third of new Internet users are in developing countries (UNCTAD 2002). Although e-commerce still makes up only a tiny percentage of total revenues, it is forecasted to reach as much as 18% of worldwide business-to-business (B2B) and business-to-consumer (B2C) transactions by 2006 (UNCTAD 2002). E-commerce has received a lot of attention in the popular press as well as case studies

A u t h o r s

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A b s t r a c t

The Internet and e-commerce have become increasingly diffused globally, bringing countries together into a global networked economy. Understanding global diffusion requires insight into the determinants of this process across countries. Building on past EDI and IT diffusion studies, this paper moves beyond adoption to look at the determinants of scope of use among e-commerce adopters. It develops and tests an integrated model of scope of e-commerce use, drawing on extensive survey data from a total of 2,139 establishments from three industries across ten countries. Derived from institutional theory and the technology-organization-environment (TOE) framework, the model integrates factors of national environment and policy with organizational and technological factors, finding the most significant predictors of scope of use to be technology resources, perceived strategic benefits, financial resources, legislation barriers, external pressure, and government promotion. There were also significant country effects, such that US firms had significantly higher scope of use than firms from other countries. This is the first empirical study of the scope of e-commerce use among adopters. It confirms the importance of strategic benefits, external pressure, and technology and financial resources in e-commerce use. In addition, it highlights important effects of the policy environment on scope of e-commerce use.

Keywords: e-commerce, Internet, diffusion, adoption, cross-country

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focusing on a single country or industry. However, so far there have not been any large-scale attempts to empirically examine the extent of global e-commerce diffusion in companies across a range of countries and industries.

E-commerce diffusion is an uneven process, among countries as well as among firms. Understanding 'global' diffusion requires insight into the determinants of this process across countries. In this regard, the diffusion literature has been limited in several key ways. First, prior firm-level diffusion studies have primarily addressed adoption of information systems (IS), electronic data interchange (EDI), or the Internet in various national or firm contexts, often focusing on small and medium enterprises (SMEs) or firms within a single country or industry. Moreover, most of these studies have been carried out in the US and other developed countries. There is a need for large-scale studies conducted across a range of countries — both developed and developing — in order to examine the extent of firm e-commerce adoption in very different economic and regulatory environments (Austin 1990; Dewan and Kraemer 2000). There is a corresponding need for comprehensive theoretical frameworks and models to explain the global diffusion process and help integrate the knowledge generated by past isolated cases.

Second, much previous research has measured simple adoption (versus non-adoption), or intention to adopt, among adopters and non-adopters. This dichotomous approach has been criticized for taking a limited view that fails to capture the scope and richness of the use of IT innovations (Ramamurthy *et al.* 1999). A significant exception to this is a stream of research that examines the extent of EDI implementation within firms (Crum *et al.* 1996; Premkumar *et al.* 1994; Premkumar and Ramamurthy 1995; Ramamurthy *et al.* 1999). This research goes beyond initial adoption to investigate determinants of various stages of diffusion, namely, adaptation, internal and external integration, and perceived success of implementation (Premkumar *et al.* 1994). E-commerce studies, however, have remained focused on the adoption/non-adoption dichotomy. There is a need to look beyond firm adoption of the Internet and investigate the extent to which firms are using e-commerce in their value chain activities.

This study differs from previous research by moving beyond adoption/non-adoption to empirically test determinants of the extent of adoption, which we call the scope of e-commerce use. We define 'scope of use' as the extent to which a firm uses e-commerce for various activities along the value chain, from marketing to sales and procurement, customer support, and coordination with business partners and customers. Our rationale for studying scope of use is that IS diffusion has been found to reach different stages in an organization, from initial adoption to various degrees of implementation (Premkumar and Ramamurthy 1995; Ramamurthy *et al.* 1999). Adopting a technology does not guarantee that it will be used extensively. Diffusion levels vary within and

among organizations depending on the need for or perceived benefits of that technology. For example, a firm may adopt EDI in order to satisfy its trading partners, but may not use it extensively if it is not found useful (Premkumar and Ramamurthy 1995). This research on the extent of EDI use also confirms that the same factors that have been found to influence EDI adoption appear to be important in the extent of EDI use (Ramamurthy *et al.* 1999). Extending these findings, we assume that scope of e-commerce use is likely to be driven by the same determinants as adoption of IT more generally. Indeed, we wish to specifically investigate whether the same determinants that have been found to influence firm-level adoption also lead to increased incorporation and use of e-commerce within firms.

We focus on the scope of e-commerce use for various business activities among firms that have adopted the Internet to buy, sell, or support products and services. The choice to study current adopters was made in order to capture greater variation in the scope of e-commerce use among firms. Since e-commerce diffusion remains low globally, as evidenced by the fact that e-commerce sales make up less than 2% of the GDP in any country (Gibbs *et al.* 2003; IDC 2002), we focus on the small 'advanced' group of firm Internet users in each country, in order to investigate how extensively they use it for business.

Building on past EDI and IT diffusion studies, this paper develops and tests an integrated model of e-commerce determinants across a broad range of countries (ranging from developing to developed) and industries, and including both small and large firms. We draw on institutional theory (DiMaggio and Powell 1983; Scott, 2001) and adopt the technology–organization–environment (TOE) framework (Tornatzky and Fleischer 1990) to explain determinants of e-commerce scope of use. Data for this study are based on extensive survey data from 2,139 establishments across three industries (manufacturing, distribution, and finance) in ten countries. The next section reviews relevant literature and develops our theoretical framework, followed by a methodology section, presentation of the results, and discussion of the results and their implications.

THEORETICAL BACKGROUND

Institutional theory

Most of the studies on firm-level EDI adoption rely on diffusion of innovations theory (Rogers 1995), which regards diffusion as driven primarily by characteristics of the technology or users' perceptions of the technology. The research tends to assume that the adoption of innovations is a rationalistic decision aimed at improving technical efficiency (Teo *et al.* 2003). However, adoption of interactive technologies such as the Internet

for business may be influenced as much or more by the institutional environment in which the firm is embedded. This environment consists of suppliers and other trading partners, competitors, customers, and regulatory agencies such as government, which may create incentives and barriers to adoption and use. Hence, this study draws on institutional theory to account for broader factors of environment and policy that play a role in scope of e-commerce use.

Institutional theory emphasizes the importance of institutional environments in shaping organizational structure and actions (Scott 2001; Scott and Christensen 1995). According to institutional theory, organizational decisions are not driven purely by rational goals of efficiency but also by social and cultural factors and concerns for legitimacy. Institutions are transported by cultures, structures and routines and operate at multiple levels. The theory posits that firms become more similar due to isomorphic pressures and pressures for legitimacy (DiMaggio and Powell 1983). This means that firms in the same field tend to look like each other over time, as competitive and customer pressures motivate them to copy industry leaders. For example, rather than making a purely internally driven decision to adopt e-commerce, firms are likely to be induced to adopt and use e-commerce by external isomorphic pressures from competitors, trading partners, customers and government.

Several recent studies have taken an institutional approach to e-commerce or EDI diffusion and assimilation (Chatterjee *et al.* 2002; Purvis *et al.* 2001; Teo *et al.* 2003). The most relevant study by Teo *et al.* (2003) examined mimetic, coercive and normative institutional pressures (DiMaggio and Powell 1983) and found strong empirical support for these three types of institutional variables as predictors of intention to adopt interorganizational linkages, specifically financial electronic data interchange (FEDI). Mimetic pressures operate by causing an organization to imitate the actions of other structurally equivalent firms in the same industry, particularly those it considers successful, in order to gain status and legitimacy and to avoid being perceived as less innovative or technologically advanced (Teo *et al.* 2003). Mimetic pressures were measured through variables of extent of adoption among competitors and perceived success of competitor adopters. Coercive pressures are those exerted by resource-dominant suppliers, customers, and parent corporations, and these were defined as perceived dominance of suppliers and customer adopters and conformity with parent corporations' practices. Finally, normative pressures result from frequent contact with other adopters (whether suppliers, customers or trade organizations) that induces firms to behave similarly by adopting the innovation as well. These were defined as extent of adoption among both suppliers and customers and participation in industry, business and trade associations. All of these variables were found to be

significant predictors of intention to adopt FEDI except for extent of adoption among suppliers (Teo *et al.* 2003).

Technology–organization–environment framework

Studies employing the technology–organization–environment (TOE) framework, developed by Tornatzky and Fleischer (1990), also recognize that the decision to adopt a technological innovation is based on factors in the organizational and external environment, as well as characteristics of the technology itself (Kuan and Chau 2001). TOE specifies three types of factors that influence adoption: the technological context (including both internal and external technologies of the firm), organizational context (defined in terms of size and scope, characteristics of a firm's managerial structure, and quality and degree of its human and slack resources), and environmental (or institutional) context, which refers to the firm's industry and dealings with business partners, competitors and government (Tornatzky and Fleischer 1990).

Empirical studies using the TOE framework have examined and consistently found support for determinants of adoption such as external pressure, organizational readiness (defined as both technology and financial resources), and perceived benefits. Iacovou *et al.* (1995) developed a model of EDI adoption by small firms based on these three factors from in-depth case studies in seven firms. This model of EDI adoption has been tested on a sample of 575 small firms in Hong Kong (Kuan and Chau 2001), and modified to test a perception-based model of EDI intent to adopt among purchasing managers in Canadian firms (Chwelos *et al.* 2001). Zhu *et al.* (2003) applied the TOE framework in the financial industry to explain determinants of e-business intent to adopt, finding support for the importance of technology readiness, financial resources, and firm size, as well as the regulatory environment.

Applying institutional theory in conjunction with the TOE framework is helpful in identifying and explaining important determinants of adoption. The external pressure factor tested in the TOE studies encompasses institutional variables such as extent of adoption by competitors, suppliers and customers, as well as their perceived success and dominance. We adopt a framework inspired by TOE, but in addition to these factors we examine additional institutional factors of policy — namely, government promotion and legislation — which have not been examined in prior TOE research.

RESEARCH MODEL AND HYPOTHESES

Our conceptual framework tests the effects of factors from each of the three TOE categories on scope of e-commerce use, as follows:

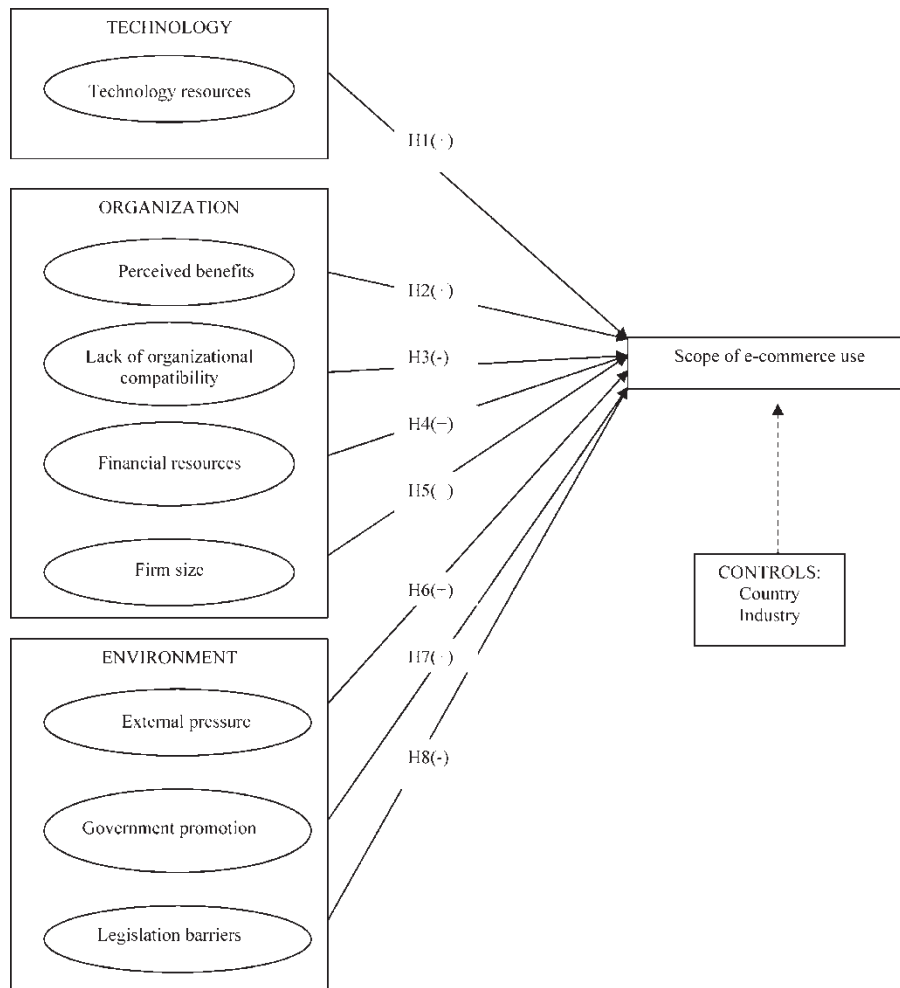


Figure 1. Predicted relationships in model of scope of e-commerce use

1. technology context (technology resources);
2. organizational context (perceived benefits, organizational compatibility, financial resources and firm size); and
3. environmental context (external pressure, government promotion, and legislation barriers) (Figure 1).

This section discusses the theoretical basis for each of these determinants and their proposed relationships to scope of e-commerce use.

Technology resources

Technological readiness, also called IT sophistication and technology resources, has been identified as an important determinant of e-commerce adoption (Chwelos *et al.* 2001; Iacovou *et al.* 1995). A firm's technical competence (including IT infrastructure, IT expertise and e-business know-how) has been found to be a strong enabler of e-business adoption, as it forms a basis upon which e-commerce initiatives are built (Kuan and Chau

2001; Zhu *et al.* 2003). Although all the firms in our sample have access to Internet technology, we propose that the technological infrastructure in which Internet use is embedded (consisting of other technologies such as email, intranets, extranets, public websites, EDI, EFT, or call centres) will increase the extent to which they use the Internet across their value chains. This leads to our first hypothesis.

H1. Technological resources are positively associated with scope of e-commerce use.

Perceived benefits

Research on EDI adoption and implementation has identified the importance of perceived benefits of the technology in adoption (Chwelos *et al.* 2001; Iacovou *et al.* 1995; Kuan and Chau 2001; Ramamurthy *et al.* 1999). Perceived benefits of EDI, also referred to as 'relative advantage' in classical innovation literature, have been identified as including lower costs, improved

coordination with trading partners and customers, and improved productivity (Ramamurthy *et al.* 1999). Although the construct of perceived benefits has been operationalized somewhat differently across different studies, it has consistently been found to be a significant predictor of EDI adoption (Chwelos *et al.* 2001; Kuan and Chau 2001; Iacovou *et al.* 1995), as well as extent of use (Ramamurthy *et al.* 1999).

We examine several perceived benefits related to firm strategy, namely, goals of expanding existing markets, entering new markets, cost reduction and improved coordination, which have been associated with e-commerce use. Although perceived benefits have been regarded as characteristics of the technology itself in TOE studies, we regard them as organizational characteristics, since such benefits are not inherent in the technology per se but relate to organizational strategy. This leads to our second hypothesis:

H2. Perceived benefits of e-commerce use are positively associated with scope of e-commerce use.

Organizational compatibility

We include organizational compatibility in our examination of organizational factors, which refers to the extent to which a technological innovation is compatible with the way the organization works, in terms of its values and beliefs, previously introduced ideas, and needs (Rogers 1995). A meta-analysis of IT adoption research found that compatibility was positively related to rate of adoption across a number of studies (Tornatzky and Klein 1982). Lack of organizational compatibility may thus impose constraints on the level of e-commerce use. For example, high costs of implementing a website, and difficulties making organizational changes or using the Internet as part of a firm's business strategy are potential barriers to extensive e-commerce use, due to the fact that e-commerce technologies may not be compatible with the firm's organizational structure or strategy. We examine these factors in a combined index of organizational compatibility.

H3. Lack of organizational compatibility is negatively associated with scope of e-commerce use.

Financial resources

There is substantial empirical support for the importance of financial resources in e-commerce adoption, as resource intensity and IS support and resources have been found to be significant determinants of EDI and IS adoption and implementation (Rai and Bajwa 1997; Ramamurthy *et al.* 1999). Firms that are able to make a greater investment in hardware, software and technical

training are likely to conduct e-commerce more extensively. This leads to our next hypothesis:

H4. Financial resources are positively associated with scope of e-commerce use.

Firm size

Firm size has also been established in previous research as an important predictor of IT adoption (Rogers 1995). Larger organizations have been found to be more likely to adopt IT, as they possess greater resources and knowledge to invest in and implement technology effectively as well as economies of scale to leverage such investment (Dasgupta *et al.* 1999; Iacovou *et al.* 1995; Kimberly and Evanisko 2002; Kuan and Chau 2001; Thong 1999; Tornatzky and Fleischer 1990; Zaheer and Venkatraman 1994; Zhu *et al.* 2003). This leads to our next hypothesis:

H5. Firm size is positively associated with scope of e-commerce use.

External pressure

Competitive pressure has been identified through numerous studies as an important determinant of IT adoption, whether EDI adoption and use (Banerjee and Golhar 1993; Ramamurthy *et al.* 1999; Webster 1995), adoption of IT innovations (Gatignon and Robertson 1989; Grover 1993), degree of computerization (Dasgupta *et al.* 1999) or e-business adoption (Zhu *et al.* 2003). Pressure to go online and adopt e-commerce because one's competitors are online is one form of institutional pressure. As market competition increases, firms may feel the need to adopt e-commerce technologies more extensively to gain competitive advantage (Sadowski *et al.* 2002). They may also simply respond to mimetic pressure to keep up with competitors, regardless of expected benefits, based on the extent of adoption and perceived success of these competitors (Teo *et al.* 2003).

Another common form of external pressure to adopt e-commerce is that coming from customer demands, such as branded firms requiring their suppliers to adopt e-commerce. For example, multinational corporations (MNCs) create coercive pressures on their subsidiaries and suppliers by requiring them to use e-commerce technologies to link to global production networks (Gibbs *et al.* 2003). Several empirical studies have found such coercive or normative pressure from trading partners, customers or parent corporations to be a strong determinant of EDI adoption (Chwelos *et al.* 2001; Iacovou *et al.* 1995; Teo *et al.* 2003). We hypothesize that firms facing greater external pressure — from

competitors and customers — will use e-commerce more extensively.

H6. External pressure is positively associated with scope of e-commerce use.

Policy

Government policy is also likely to play a significant role in firms' e-commerce use. Government incentives and subsidies have been identified as important drivers of e-commerce adoption in that they encourage firms to invest, particularly in newly industrializing countries such as Singapore and Taiwan (Chen 2003; Wong 2003) and developing countries such as India, Mexico, Brazil and other Latin American countries (Dasgupta *et al.* 1999; Montealegre 1999; OECD 1999; Palacios 2003; Tigre 2003). Government support and incentives have been found to be less effective in developed countries such as France, Germany and the Netherlands, although they may still play an important role (Brousseau 2003; Koenig *et al.* 2002; OECD 1999; Sadowski *et al.* 2002). We expect government promotion to have a positive impact on the extent of e-commerce adoption.

On the other hand, inadequate legal protection or business laws may hinder the spread of e-commerce. One of the biggest barriers to e-commerce use is privacy or security concerns about fraud or credit card misuse due to lack of protection of Internet transactions (Gibbs *et al.* 2003). Oxley and Yeung (2001) find that the spread of e-commerce depends most of all on an institutional environment with 'rule of law' that facilitates transactional integrity in online markets. Countries without such 'rule of law' are likely to be characterized by a legal infrastructure without business laws for e-commerce and inadequate legal protection more broadly. We expect insufficient legislation or regulatory environment to hinder the scope of firm e-commerce adoption as well.

We examine the role of two dimensions of government policy: government promotion (financial incentives and procurement requirements) and legislation barriers (taxation of Internet sales, business laws for e-commerce and legal protection for Internet purchases). Both promotion and legislation have been found to be key policy dimensions affecting e-commerce use (Gibbs *et al.* 2003). We predict the following relationships.

H7. Government promotion is positively associated with scope of e-commerce use.

H8. Legislation barriers are negatively associated with scope of e-commerce use.

In summary, all of these variables have been identified in previous research as important factors influencing firm e-commerce adoption and extent of use. We integrate

them into a model of e-commerce scope of use and test them to determine their relative importance.

METHODOLOGY

This paper is part of a study of the globalization of e-commerce in ten countries. The research employs a mix of quantitative and qualitative methods, and levels of analysis (country, industry and firm).

Survey design and sample

Data were gathered through a telephone survey of 2,139 establishments (defined as a physical location or site that uses the Internet to buy, sell, or support products and services). These establishments were located in 10 countries — Brazil, China, Denmark, France, Germany, Japan, Mexico, Singapore, Taiwan¹ and the United States. Data collection took place from February to April 2002. A stratified random sample was used, drawing from company lists representative of each local market and stratified by industry and firm size within each country. Countries were selected to include developed, newly industrializing and developing nations in the three major regions of the world. Establishments were selected from three major industry sectors that are known to be more advanced users of e-commerce — manufacturing, distribution (wholesale and retail) and finance (banking, insurance and financial services). The sample breaks down into approximately 300 establishments in the US and 200 in each of the other countries, and is evenly split by industry as well as firm size, between small (defined as 25 to 249 employees) and large (defined as 250 or more employees) firms in each country. Respondents were primarily CIOs, CEOs, or IS managers responsible for making the firm's IT-related decisions. The overall response rate was 13%. Response rates varied by country, ranging from 8% to 39% (Table 1).

Concepts and measures

Indices were created for each of the independent and dependent variables and tested for validity and reliability. Table 2 displays summary statistics (means, standard deviations and alphas) for the research variables. Table 3 contains inter-item correlations for these variables.

Independent variables. We constructed measures of the scope of technology resources and financial resources available to the firm, as well as firm size. A *Technology resources* index was constructed by aggregating seven items on technologies used by the firm (on a yes/no scale): email, public website, Intranet, Extranet, EDI, EFT and call centre. The scale ranges from 0 to 7. This variable measures the scope or richness of the firm's

Table 1. Sample profile (N = 2,139)

<i>Industry and firm size</i>	<i>Manufacturing</i>	<i>Distribution</i>	<i>Finance</i>	<i>Total</i>
Small Firms (25–249)	364	357	365	1086
Large Firms (250+)	379	344	330	1053
Total	743	701	695	2139
<i>Respondent Job Title</i>			<i>N</i>	<i>%</i>
CEO, President, Owner, Managing Director			76	3.6
CIO, CTO, VP of IS			363	17.0
IS Manager, Director, Planner			759	35.5
Other IS Manager			449	21.0
COO, Business Operations Manager			103	4.8
CFO, Administration/Finance Manager			172	8.0
Other (IS Analyst, other Manager or VP)			217	10.2
<i>Number of Employees</i>			<i>N</i>	<i>%</i>
25–99			624	29.2
100–199			321	15.0
200–499			733	34.3
500+			461	21.6
<i>Country</i>	<i>Response rate (%)</i>	<i>N</i>	<i>%</i>	
Brazil	15	200	9.4	
China	39	204	9.5	
Denmark	18	200	9.4	
France	9	201	9.4	
Germany	8	202	9.4	
Japan	10	227	10.6	
Mexico	12	201	9.4	
Singapore	27	202	9.4	
Taiwan	38	202	9.4	
United States	8	300	14.0	
Total	13	2139	100.0	

technology infrastructure to support e-commerce initiatives. *Financial resources* were measured by the firm's annual IT spending as a percentage of total revenue, as a measure of e-commerce related spending (Mahmood and Mann 1993; Zhu *et al.* 2003). Standardized z-scores were used for both of these variables to ensure that they were comparable with the other independent variables. *Firm size* was operationalized in terms of the total number of employees in the organization, log-transformed to reduce data variance (Raymond 1990; Zhu *et al.* 2003).

In addition, indices were created to measure two organizational factors, perceived benefits and organizational compatibility, and three institutional or environmental factors, external pressure, government promotion and legislation. All items were evaluated on 5-point Likert

scales, ranging from 1 = not a factor at all to 5 = a very significant factor. *Perceived benefits* is measured by four survey items on the degree to which these strategic benefits motivated firms to conduct e-commerce: to expand market for existing products/services; to enter new businesses or markets; to reduce costs; and to improve coordination with customers and suppliers. *Organizational compatibility* was measured through four items on the degree to which the organizations faced certain barriers to conducting e-commerce: making needed organizational changes; ability to use the Internet as part of their business strategy; finding staff with e-commerce expertise; and costs of implementing an e-commerce site.

External pressure was measured through two items: the degree to which firms were motivated to conduct

Table 2. Summary statistics of research variables

Variables	N	Mean	Standard deviation	Standardized alpha	Number of items in scale
<i>Independent variables</i>					
External pressure ¹	2063	3.10	1.15	0.61	2
Perceived benefits ¹	2055	3.25	1.02	0.76	4
Government promotion ¹	2008	1.94	1.10	0.70	2
Legislation barriers ¹	1834	2.47	1.08	0.78	3
Organizational compatibility ¹	1957	2.62	0.89	0.68	4
Technology resources ²	2105	4.43	1.53	–	7
Financial resources ³	1158	8.04	12.19	–	1
Firm size ⁴	2006	2.92	0.90	–	1
<i>Dependent variable</i>					
Scope of EC Use ⁵	2075	3.26	1.92	–	7

¹ Item scores range from 1 'not a factor at all' to 5 'a very significant factor'

² Score is an aggregate of all technologies used by the establishment (email, public website, Intranet, Extranet, EDI, EFT, call centre) and ranges from 0 'low' to 7 'high'

³ Score is the percentage of total revenue devoted to the firm's IT budget and ranges from 0 to 100

⁴ Score is number of total employees (log-transformed)

⁵ Score is an aggregate of all uses of the Internet for business (advertising/marketing, online sales, after-sales customer service and support, online purchases, exchange of operational data with suppliers, exchange of operational data with business customers, and formal integration of the same business processes with suppliers or other business partners) and ranges from 0 'low scope of use' to 7 'high scope of use'

Table 3. Intercorrelations among study variables (N = 2,139)

	1	2	3	4	5	6	7	8	9
1. External Pressure	–								
2. Perceived Benefits	0.48	–							
3. Government Promotion	0.26	0.34	–						
4. Org. Compatibility	0.18	0.17	0.20	–					
5. Legislation Barriers	0.16	0.21	0.30	0.40	–				
6. Technology Resources	0.20	0.19	–0.03	–0.06	–0.06	–			
7. Financial Resources	0.07	0.12	0.10	–0.01	0.09	0.06	–		
8. Size (# Employees)	0.12	0.12	0.03	–0.04	–0.01	0.38	0.02	–	
9. Scope of EC Use	0.25	0.33	0.08	–0.00	–0.07	0.43	0.15	0.14	–

Note: $r \geq 0.05$, $p < 0.05$; $r \geq 0.07$, $p < 0.01$; $r \geq 0.10$, $p < 0.001$

e-commerce because customers demanded it and major competitors were online. The two policy dimensions were derived from prior research examining national environment and policy factors (Gibbs *et al.* 2003; Kraemer *et al.* 2002). *Government promotion* was measured by two items: the degree to which government incentives and procurement requirements acted as drivers for firms to conduct e-commerce. *Legislation barriers* were measured through three items on the degree to which each one acted as a barrier to a firm's e-commerce use: lack of business laws supporting e-commerce; lack of legal protection for Internet purchases; and taxation of Internet sales.

Control variables. We also tested for effects of *industry* and *country* in our model. The scope of e-commerce use is likely to vary across industries and countries. For example, EDI use has been particularly strong in the manufacturing industry, used to integrate production activities with the supply chain. Manufacturing firms are thus likely to make greater use of B2B e-commerce to coordinate activities with trading partners. Service-based industries such as retail and finance, on the other hand, are more likely to do B2C e-commerce with their customers. The industry control variable was measured by dummy variables for distribution and finance firms, using manufacturing as the baseline.

A country control variable was also included. Most prior firm-level studies of EDI and IT adoption have been conducted in developed countries, and most often in a single national context. However, recent cross-country studies have found GDP per capita to be the strongest determinant of e-commerce and IT diffusion (Beilock and Dimitrova 2003; Caselli and Coleman 2001; Shih *et al.* 2002) and have found significant differences in diffusion between countries at different stages of economic development. For this reason, we included country dummies as control variables, based on the country in which the establishment was located. The country dummies used were Brazil, China, Denmark, France, Germany, Japan, Mexico, Singapore and Taiwan. The US was used as the baseline.

Dependent variable. The dependent variable in this analysis is scope of e-commerce use. We define scope as the extent of e-commerce use for a number of different activities in the value chain, from advertising and marketing to sales, procurement, service and support, data exchange with customers and suppliers, and integration of business processes. The *Scope of e-commerce use* was measured by an index that was created by aggregating seven items regarding Internet use for various business activities. The items are use of the Internet for: 1) advertising and marketing; 2) online sales; 3) after-sales customer service and support; 4) online purchases; 5) exchange of operational data with suppliers; 6) exchange of operational data with business customers; and 7) formal integration of the same business processes with suppliers or other business partners. The scope of use is the total number of these Internet uses, ranging from 0 to 7.

Validity and reliability of constructs

The constructs were subjected to several validity and reliability tests. Content validity, which refers to how well items measure a given concept, was established through careful selection of items based on a comprehensive review of prior literature as well as consultation with experts. Survey items were culled from prior multi-country e-commerce studies (Empirica 2000; IDC 2001) as well as the e-commerce and EDI literature reviewed earlier. Some questions were modified or dropped from earlier studies, after examining their frequency distributions. The instrument was pre-tested and survey items were modified based on pre-testing. The questionnaire was translated into the local language of each country and each version was checked by a country expert on our team, all of whom were academics and native speakers. It was also checked by experts from the data collection firm. Data collection was carried out by a large-scale research firm with significant experience conducting large-scale international studies of IT, including e-commerce.

Construct validity was assessed through tests of both convergent and discriminant validity. Convergent and discriminant validity were assessed through principal component analysis. Convergent validity, which measures the consistency across multiple operationalizations, was tested through factor analysis of the items measuring each construct. Factor analysis with varimax rotation was performed on all items measuring the various constructs to determine whether the items loaded on the appropriate constructs to assess discriminant validity, the extent to which constructs differ from one another.

A set of nine drivers and 12 barriers to e-commerce use was factor analysed using principal component analysis with varimax rotation, with Eigenvalues set at 1.0. Items with low factors loadings and substantial cross-loading on multiple factors were dropped from the analysis. A total of eight drivers and seven barriers remained. A factor analysis was then performed specifying a 5-factor solution, to determine whether items loaded on the five theoretical dimensions predicted for the institutional and organizational variables. Principal component analysis using varimax rotation confirmed the five factors, and items loaded as predicted on each dimension. Item loadings were high (0.6 or higher), and cross-loading was low (less than 0.3 for any other factor). All Eigenvalues were greater than 1. Factor loadings are reported in Table 4. The five factors were identified as *Perceived benefits*, (lack of) *Organizational compatibility*, *Legislation barriers*, *Government promotion*, and *External pressure*. These factors confirmed our theoretical constructs. Indices were constructed for each factor using standardized z-scores to normalize the variables. Construct reliability, which refers to the degree to which items are free from random error and hang together as a scale, was then assessed by testing the resulting scales for reliability using Cronbach's alpha. All constructs had acceptable reliabilities of over 0.6 (Table 2).

RESULTS

Hypotheses were tested using ordinary least squares regression. A model was tested using SPSS/PC+ and regression results are reported in Table 5. H1, H2, H4, H6, H7 and H8 were all confirmed. No support was found for H3 and H5.

The most significant determinant of the scope of e-commerce use was technology resources ($b=0.356$, $p<0.001$), followed by perceived benefits ($b=0.210$, $p<0.001$), financial resources ($b=0.093$, $p<0.001$), legislation barriers ($b=-0.078$, $p<0.05$), external pressure ($b=0.065$, $p<0.05$), and government promotion ($b=0.052$, $p<0.10$). Thus firms that have greater technology infrastructure, perceive greater strategic benefits from e-commerce, devote a greater percentage of revenue to their IS operating budget, face fewer legislation barriers and more external pressure, and are more affected by

Table 4. Factor loadings of institutional and organizational variables¹

Variables	Factors				
	1	2	3	4	5
<i>Perceived benefits</i>					
To expand market for existing products/services	0.844				
To enter new businesses or markets	0.841				
To reduce costs	0.607				
To improve coordination with customers and suppliers	0.606				
<i>Lack of organizational compatibility</i>					
Making needed organizational changes		0.726			
Ability to use Internet as part of business strategy		0.708			
Finding staff with e-commerce expertise		0.682			
Costs of implementing an e-commerce site		0.667			
<i>Legislation barriers</i>					
Business laws do not support e-commerce			0.843		
Inadequate legal protection for Internet purchases			0.826		
Taxation of Internet sales			0.738		
<i>Government promotion</i>					
Required for government procurement				0.841	
Government provided incentives				0.833	
<i>External pressure</i>					
Customers demanded it					0.788
Major competitors were online					0.774

¹ Principal component analysis set for 5-factor solution. All Eigenvalues are above 1.0. Factor entries are varimax rotated loadings. Five factor solution explained 63% of variance. N = 1,609.

government promotion are likely to adopt e-commerce more broadly across their value chains. The other independent variables (organizational compatibility and firm size) were not significant. Of the control variables, industry had no significant effect, but there were significant country effects, as firms in all countries except for Denmark were found to have significantly less scope of e-commerce use than US firms. The model explains 29% of the variance.

DISCUSSION AND IMPLICATIONS

Discussion of findings

This research confirms the importance of key variables tested in prior IT adoption studies (Chwelos *et al.* 2001; Kuan and Chau 2001; Iacovou *et al.* 1995; Zhu *et al.* 2003) for scope of e-commerce use. Specifically, our findings confirm that technology resources, perceived strategic benefits, financial resources, and external pressure are key determinants not just of adoption but of the scope of e-commerce use in firms' business activities. The results also demonstrate the importance of policy

factors. These factors all act as technological, organizational or environmental determinants of scope of e-commerce use. Accordingly, the results provide further support of the usefulness of the TOE framework for examining scope of e-commerce use among firms. The importance of external pressure, government promotion and legislation provides support for institutional theory (Teo *et al.* 2003), in that mimetic, coercive and normative pressures from a firm's competitors and customers were also found to be key determinants of the scope of e-commerce use. Further, country differences in extent of use were evident even within this sample of 'advanced' Internet users, indicating that US firms use e-commerce more extensively than comparable firms in other countries.

Other variables did not have a significant effect, however. Lack of organizational compatibility did not have a significant impact on the scope of e-commerce use. One possible explanation for this is that organizational barriers may impact initial adoption, but not scope of use. That is, firms that have adopted e-commerce may have already overcome such barriers, and so they become less influential in distinguishing between different levels of use. Perhaps firms that have adopted e-commerce

Table 5. Standardized regression coefficients for e-commerce scope of use model

Variables	EC Scope of Use
Perceived benefits	0.210***
External pressure	0.065*
Government promotion	0.052 [†]
Organizational compatibility	-0.005
Legislation barriers	-0.078*
Technology resources	0.356***
Financial resources	0.093***
Firm size	-0.030
Industry – Distribution	0.001
Industry – Finance	-0.017
Country – Brazil	-0.082*
Country – China	-0.127***
Country – Denmark	-0.053
Country – France	-0.176***
Country – Germany	-0.076*
Country – Japan	-0.142***
Country – Mexico	-0.121***
Country – Singapore	-0.125***
Country – Taiwan	-0.136***
F	24.241
Sig.	0.000
df	19
Std. Error	1.62
Adj. R ²	0.29

Note: [†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

have already made requisite organizational changes. Since all of the firms in our sample were current adopters, there is likely to be less variance in the organizational environments in which their adoption practices are embedded.

Additionally, firm size did not have a significant effect on scope of e-commerce use. Again, it is possible that firm size has an effect on adoption but not on use after adoption. Moreover, research on the effects of firm size on adoption has been somewhat mixed. While a number of studies have found that large firms are more likely to adopt due to greater resources and knowledge to implement technology and economies of scale, other research has found large firms to be limited by structural inertia (Nohria and Gulati 1996) and small firms to be more agile and flexible in making organizational changes needed for adoption of information systems (Koenig *et al.* 2002; Zhu *et al.* 2003). SMEs are also likely to have less legacy IT to overcome in investing in new e-commerce technology than large firms. Thus the mixed blessing associated with firm size may result in opposite effects that cancel each other out. These results indicate that small firm adopters may possess certain advantages

that allow them to use e-commerce as extensively as large firm adopters.

The findings also confirm the importance of government policy, particularly legislation, in firms' e-commerce use. Lack of a supportive regulatory environment for e-commerce was found to have a significant negative effect on scope of use. The importance of an established legal infrastructure and laws for e-commerce has been suggested in previous research (Oxley and Yeung 2001). Our findings confirm that policy factors such as a lack of legal protection, business laws supporting e-commerce, and Internet taxation barriers are likely to inhibit the scope of e-commerce use. Government promotion through incentives and procurement requirements was also marginally significant, although it had less of an effect. The importance of a regulatory environment protecting e-commerce transactions for firms' scope of use is further support for institutional theory, as policy provides further institutional pressure that drives e-commerce use (or inhibits it, if it is lacking).

Limitations and future research

This study is limited in several ways. First, the results are based on a cross-sectional design conducted at one point in time, so claims of causality cannot be drawn from these data. Second, due to our choice of research design, our results are reflective of 'advanced' Internet users from small and large firms across these industries and countries, but do not necessarily generalize to all firms or even Internet users in these countries. Third, our model does not include other potentially important factors, such as the reliability and cost of the national telecommunications infrastructure. Additionally, the TOE framework does not capture interorganizational factors such as trust and trading partner readiness, which have been examined in other research on IOS adoption. Finally, our findings relate specifically to scope of use, but say nothing about effects on depth of use. Nevertheless, this study makes important contributions with regard to developing an integrated model that measures scope of e-commerce use based on a large-scale dataset that includes a range of countries, industries and firms. Further research should investigate determinants of depth of use as well, and should also explore country differences in greater detail.

Policy and managerial implications

The findings underscore the importance of policy factors in addition to organizational characteristics. The fact that traditional policy drivers such as financial incentives and requirements for procurement are of only marginal significance compared to the others may give the impression that government does not play an important role in e-commerce use. We believe the opposite to be true.

Rather, the findings suggest that there are major barriers to e-commerce diffusion that can be ameliorated or eliminated by the policy environment. These findings indicate that governments should play a major role in providing a positive legal environment for e-commerce, in addition to specific incentives or requirements. Requirements around procurement are likely to vary across countries as only a small proportion of firms in developed countries do business with government, whereas government e-procurement and promotion appear much more influential in Singapore and developing countries such as Mexico, Brazil and China (Palacios 2003; Tigre 2003; Wong 2003). These findings indicate the importance of including policy factors, which have not been previously addressed in TOE research.

An implication for technology vendors and IS managers is that they should become involved in creating a positive policy environment for e-commerce to flourish. E-commerce thus should not just be dealt with as a business issue but as a policy issue as well, in order to ensure that a supportive environment exists. Such involvement can be achieved through industry and professional associations, taking positions on national and international issues such as taxation of the Internet, telecommunications liberalization, privacy protection and financial protections. It can also be done by working closely with government policy committees and standards' bodies to improve the regulatory environment for e-commerce. Becoming more involved in policy-making will also enable firms to enjoy the benefits of network effects in e-commerce use.

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Note

1. We are aware that Taiwan is not internationally recognized as an independent country. However, due to its economic and legal autonomy, we treat Taiwan as a separate country for the purposes of this research. There is precedent for this in other IT research (cf ITU 2001).

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