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Sources of Cross-national Heterogeneity in E-retail Spending: Evidence from Country-Level Data*

Nir KSHETRI
Ralf BEBENROTH
Nicholas C. WILLIAMSON

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Research Institute for Economics and Business Administration
Kobe University
2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

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Nir Kshetri, The University of North Carolina at Greensboro, USA
Ralf Bebenroth, Kobe University, Japan
Nicholas C. Williamson, The University of North Carolina at Greensboro, USA

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Abstract
The global e-retail industry is growing rapidly. Economies worldwide, however, differ greatly in the development of the e-retail industry. Using data from forty-seven economies, this paper empirically examines how technological, economic, and institutional factors explain international heterogeneity in e-retail spending. The results indicated that broadband penetration was the strongest predictor of e-retail spending. We found that externalities mechanisms generated by the development of the conventional retail industry drives the growth of the e-retailing industry. Our findings also indicated that the degree of concentration of traditional retail sites is negatively related to the development of the e-retailing industry.

Keywords: *E-retailing externality mechanisms, time series cross sectional models, economic freedom, broadband penetration*

Introduction

The global e-retail industry is growing rapidly. For instance, online retailing accounted for 8.6% of global retail spending in 2006, which is estimated to reach 12.9% by 2012 (MarketWatch: Global Round-up 2007). According to comScore Inc., online retail spending in the U.S. amounted $130 billion in 2009 (Kell 2010). Likewise, online retail sales in 2009 reached about $60 billion in the U.K. and $200 billion in the European Union countries (Clark 2010). It was reported that online retail spending in the UK in 2006 grew about 13 times faster than the overall retail sector (MarketWatch: Global Round-up 2007).

Economies worldwide, however, differ greatly in the development of the e-retail industry. For instance, according to Euromonitor International, in 2007, per capita internet retailing varied from $0.25 in India to $ 442 in the United Kingdom (Table 1). Cross country variability in income does not seem to explain a large proportion of the variability in e-retail spending. For instance, Japan's per capita income is almost double that of South Korea. However, Euromonitor data indicate that Japan's per capita e-retail spending in 2007 was less than half that of South

Korea (Table 1). Likewise, the Perasonian coefficient of correlation between per capita spending in conventional retailing and e-retailing is 0.559. This means that conventional retail spending explains only 31.2% of variance in e-retail spending in the cross national setting. Obviously factors other than conventional retail spending explain a large proportion of the cross-country variance in e-retailing.

Prior researchers have suggested that e-commerce growth is driven by consumer welfare and business competitiveness associated with the electronic channel's lower transaction costs. Brynjolfsson, Hu and Smith's (2003) analysis, for instance, indicated that in 2000, in the book retailing industry, the Internet-led increase in product variety enhanced consumer welfare by $731 million to $1.03 billion, which was 7-10 times higher than the consumer welfare gain from increased competition and lower prices.

Various factors may affect the transaction costs associated with e-retailing and the relative transaction costs of e-retailing vis-a-vis conventional retailing. The benefits offered by the relative convenience of e-retailing may cancel, or even reverse the effects of perceived risks associated with shopping on the Internet (Bhatnagar et al. 2000). These factors associated with perceived convenience and transaction costs vary considerably across nations. Little theory or research exists to explain economic and institutional factors that may explain cross-national variation in the growth of the industry. We contribute to filling this research gap with an empirical analysis of cross-national heterogeneity in the development of the e-retailing industry. We have proposed and tested several hypotheses to explain the wide variation observed in the development of the e-retail industry across the world.

Tables 1 about here

In the remainder of the paper, we first provide a literature review and develop some hypotheses on cross-national variation in the diffusion of e-retailing. Next, we discuss our methods. It is followed by a section on the results. Then, we provide discussion and implications of our study. The final section provides concluding comments.

Literature Review

In a small but growing body of theory and empirical research, scholars have addressed the topic of cross-national variation in e-commerce activities from different perspectives. Table 2 summarizes representative empirical studies, showing that researchers have studied the effects of various environmental and contextual factors at different levels of analysis (e.g., firm, individual and national) while adopting multiple methodologies and approaches.

Tables 2 about here

While these studies significantly improved our understanding of international heterogeneity in e-commerce activities, several gaps can be identified in the literature. Prior researchers have emphasized the importance of studying width and depth of adoption of an innovation rather than merely focusing on the adoption decision (Gatignon and Robertson 1985). Following Gatignon and Robertson (1985), the width of e-commerce adoption can be defined as the number of different uses of e-commerce technology by an individual or a firm. Similarly, the depth of e-commerce adoption can be defined as the amount of usage of the e-commerce technology (e.g., e-commerce revenue or spending). The depth of adoption may warrant elaboration. Dholakia, Dholakia and Kshetri (2004) have introduced the concepts of overall depth, which is related to the total usage of the technology and functional depth, which is related to the usage of the technology for performing a particular function (e.g., the use of the Internet in retailing). To put things in context, e-retail spending can be considered as a measure of a functional depth of e-commerce adoption. Although there has been a growing interest in the

information system and e-commerce literature on cross-national e-commerce adoption and diffusion research, there is a relative scarcity of research on width and depth of e-commerce adoption.

Second, most cross-national e-commerce studies focus on a small number of countries and thus lack representativeness and generalizability. For instance, very few studies have included more than twenty countries in their research (Table 2). Moreover most studies on this topic have included only industrialized countries.

Third, most cross-national e-commerce studies are cross sectional in nature. Prior researchers have noted the important role of analyzing longitudinal processes associated with e-commerce adoption (Zhu and Kraemer 2005). Only a longitudinal study can illuminate the changing influence of various environmental and contextual factors on individuals' and firms' e-commerce behaviors and whether such behaviors are sustained over time (Zhu and Kraemer 2005).

Prior researchers have suggested that careful attention must be paid to economic and institutional factors that facilitate or hinder technology diffusion across countries (Oxley and Yeung 2001; Zhu and Kraemer 2005). This paper attempts to address these issues by empirically examining the sources of cross-national heterogeneity in e-retail spending. Our framework builds on innovation diffusion theory. Of special interest to this paper are relative advantage and observability (Rogers 1995). Relative advantage measures the perceived benefits of a technology over previous technologies. Observability measures the degree to which the features and benefits of e-retailing are visible, noticeable and understandable to self/others and the results can be described to non-users (Rogers 1995).

E-retailing has various relative advantages and a higher degree of observability. In this regard, the first observation is that there is a higher variety of products in an online store compared to a physical store. Brynjolfsson et al. (2003) reported that Amazon.com had over 23 times book titles available compared to a Barnes & Noble superstore and 57 times more than the number of books available in a typical large independent bookstore. The second commonplace observation is that the emergence of e-retailing has allowed consumers to locate and purchase products to an extent which would not be possible in the absence of such a channel due to high transaction costs and/or low product awareness. For instance, businesses are exploring the possibilities of three-dimensional (3D) e-retailing, where consumers can "walk" the aisles of supermarkets, interact with experts and find items that are unavailable in the local store (Cleverley 2009). E-retailing thus has a potential to enhance consumer welfare. E-retailers can ensure the availability of a greater variety of products**.** Features such as product recommendation systems and cataloging are unique to e-retailing, which help to lower transaction costs and increase product awareness (Brynjolfsson et al. 2003). Finally, it is observed that the benefits offered by the relative convenience of e-retailing may cancel, or even reverse the effects of perceived risks associated with shopping on the Internet (Bhatnagar et al. 2000).

The above discussion indicates that in theory, the electronic channel offers various benefits and has a potential to stimulate the growth of the retail industry. In practice, however, problems related to economic, geographic and institutional barriers may stand in the way of implementation and practical results in some economies. There is little, if any, empirical cross-national evidence, which shows how effectively these theories and speculations can translate into practice.

The extent to which consumers can realize the above benefits is a function of the nature of ecosystem and various externalities generated by the conventional retail industry. Prior researchers have noted the important roles of country level factors such as income and population size, the availability of credit, venture capital, and telecom and logistical infrastructure, tax and other incentives, tariff/non-tariff barriers, government emphasis on the development of human capital and regulations in their influence on firms' investment in R&D in the development of the e-commerce industry (Kshetri 2001; Kshetri and Dholakia 2002).

Success in the development of an e-retail industry hinges on having various new intermediaries that provide services such as aggregating, matching suppliers and customers, providing trust, and providing inter-organizational market information (Bailey and Bakos 1997). These intermediaries help match manufacturers with relevant consumers (Bailey and Bakos 1997). Institutions in a country can attack many of the barriers associated with the development of e-retailing industry by legal and non-legal influences such as new laws, investment incentives, foreign technology transfer, and other supply-push and demand-pull forces (King et al 1994; Montealegre 1999). 'Successful' countries are found to be those that are able to attack the barriers related to skills, information, market and infrastructures by such means (Kshetri and Dholakia 2002). For instance, Singapore has been able to develop itself as an IT hub of Asia by providing attractive infrastructure, skilled workers and a stable labor environment which attracted a large number of IT firms to locate there (Kraemer et al. 1992; Wong 1998). Similarly, strong university-industry linkages and a large pool of highly trained scientists and engineers, mostly supported by the defense sector, drive the technology diffusion in Israel (Porter and Stern 2001).

While prior research has identified many factors that may contribute to the growth of an IT and e-commerce industries in an economy, there has been little cross-country research on the factors on specific aspects of e-commerce such as e-retailing. Important gaps exist in our current knowledge of the drivers of the global e-retailing industry and cross-country variation in the development of this industry. In particular, empirical evidence on this area has lagged behind theoretical development.

Drivers of e-retailing: some hypotheses

Broadband penetration

In prior theoretical and empirical research, scholars have viewed the availability of well-developed ICT infrastructures as an important variable explaining cross-national variation in e-commerce activities (Gibbs et al. 2003; Ho et al. 2007; Oxley and Yeung 2001). It is also observed that the digital divide has shifted from basic to advanced communications and more generally from quantity to quality (World Telecommunication Development Report 2002). A study of Pew Research, for instance, indicated that dial-up and high-speed Internet connections differ in terms of their impact on e-retailing standpoint. A 2004 Pew study on online banking indicated that during 2002-2004, the adoption of online banking increased from 24% to 35% for dial-up users, compared to 35% to 63% for broadband users (cf. Sciglimpaglia and Ely 2006). Consumers with broadband access are also likely to make more purchases online. One study suggested that in 2000, broadband users spent 20% more online than their dial-up counterparts (O'Rourke 2000).

It is argued that broadband capability in the home is an important driver of e-retailing (Johnsen 2007; MarketWatch: Global Round-up 2007). Why might this be the case? An extensive body of literature indicates the importance of retail buyers' perceived convenience to the success of e-retailing (Hemp 2006; Sherwood 2007; Spiller and Lohse 1998; Szymanski and

Hise 2000). Broadband offers convenience, ease of use and other benefits. To attract consumers, e-retailers need to provide “ambience-enhancers” such as video streaming and music (Allred et al. 2006: 330), which are bandwidth intensive applications. A number of single-country surveys have confirmed the impact of broadband on the growth of the e-retail industry. A survey of 3,000 U.K. consumers surveyed by Verdict Research indicated that two thirds of them had broadband access, who reported that broadband influenced them to shop online more frequently (MarketWatch: Global Round-up 2007).

As noted earlier, 3D e-retailing allows consumers to interact with experts and find items that are unavailable in the local store (Cleverley 2009). The 3D Web space thus provides experience that would be difficult to replicate in conventional retailing (Hemp 2006). Lands' End’s Swim Finder feature introduced in Spring 2005 provides a case in point. The 3D feature allows women to choose swimsuits that "enhance or de-emphasize" certain body parts (LNWWJ 2005). These e-retailers, for example, offer feature such as message boards and the ability to review products and allow groups of people to interact with one another, some of them in a three-dimensional Web space (Hemp 2006; Sherwood 2007). In order to attract customer attention, e-retailers use features such as 3d/2d animation, voice, video, graphics, music and other multimedia (Ranganathan and Ganapathy 2002). In sum, broadband enables consumers to benefit from the potential of e-retailing. The discussion in this section is summarized as:

H_1: Ceteris paribus, the per capita e-retail spending in an economy is positively related to broadband penetration.

Concentration of traditional retail stores

The e-commerce literature has emphasized the role of consumer perceptions of online convenience in driving online retailing (Brynjolfsson et al. 2003; Spiller and Lohse 1998; Szymanski and Hise 2000). Prior researchers have also noted that the lower transaction costs

offered by the Internet have led to increased orders for many book titles which were not previously available in conventional stores (Brynjolfsson et al. 2003).

Regarding consumers' switch from conventional retailing to e-retailing, the reason perhaps most often cited is that e-retailing offers consumer convenience (Litan and Rivlin 2001). Using innovation diffusion theory, convenient access to products can be framed as a higher degree of relative advantage of Internet retailing over conventional retailing (Rogers 1995).

According to Brynjolfsson and Smith (2000), the closest bookstore in the U.S. was about 5.4 miles for the average person. Their study indicated that to place an order for a special book from the store, a consumer needed to drive 21 minutes and spend an additional 8 minutes to park, search for the book and to find a sales person in the store and to place the order. Therefore, the consumer needed to spend 29 minutes for driving, parking and paying for the special order (cf. Brynjolfsson et al. 2003).

The line of argument developed above leads us to the suggestion that the relative convenience of e-retailing over conventional retailing also depends on the availability of physical stores. Prior researchers have suggested that well-developed and efficient traditional retailing networks (e.g., in France and Taiwan) reduce the need for e-retailing (Gibbs et al. 2003; Ho et al. 2007).

In many cases, consumers use the Internet only during the searching phase and visit physical stores to make a purchase. A survey indicated that 46% of online browsers went to make a purchase in the store (MarketWatch: Global Round-up 2007). This is especially true for consumers living in remote areas, who lack specialty retailers and are thus likely to benefit from the Internet retailing (Brynjolfsson et al. 2003).

A final issue that deserves mention relates to the importance placed on touch and feel. Consumers' preference for touch and feel has been an important factor hindering the growth of e-commerce (Kshetri 2001). The unavailability or inaccessibility of conventional retail stores leads to a higher cost to experience the touch and feel of the products as a part of their making purchase in a conventional retail store. In sum, we argue that:

H_2: Ceteris paribus, the per capita e-retail spending in an economy is negatively related to the concentration of the retail stores.

Externalities generated by traditional retailing

Prior researchers have also suggested a possible complementation effect between traditional retailing and e-retailing (Anderson et al. 2003). One way to understand the complementation effect would be to look at the generation of externality by the conventional retailing industry for the growth of the e-retailing industry. According to Demsetz, "[e]very cost and benefit associated with social interdependencies is a potential externality" (1967, 348). Put differently, economic actors with interdependent relations jointly produce an externality and whether it is positive or negative is a function of how and who produces it (Frischmann and Lemley 2007).

An issue that deserves mention thus relates to various externality mechanisms generated by the development of the retail industry. Retail firms' behaviors have self reinforcing effects. They may generate externalities by making e-retail-related specialized inputs and services available, forming a specialized "labor market", and facilitating the exchanges and spillovers of information and technology (Marshall 1920). These externalities, which originate from other firms in the same industry, are called MAR externalities (Marshall 1890; Arrow 1962; Romer 1986). MAR externalities represent the positive role of specialization on growth through knowledge spillovers (Bun et al. 2007). There is also a possibility of "inter industry knowledge spillovers", which are referred as Jacobs (1969) externalities.

A source of relative advantage concerns the availability of a higher variety of products online compared to a physical store. The emergence of e-retailing has allowed consumers to locate and purchase products which would not be possible in the absence of such a channel due to high transaction costs and/or low product awareness. E-retailing thus has a potential to enhance consumer welfare. The Internet can stimulate the growth of the retail industry. E-retailers can ensure the availability of a greater variety of products**.** Features such as product recommendation systems and cataloging are unique to e-retailing, which help to lower transaction costs and increase product awareness (Brynjolfsson et al. 2003). The extent to which consumers can realize these benefits is a function of the nature of ecosystem and *v*arious externalities generated by the conventional industry. The above leads to the following:

H_3: Ceteris paribus, the per capita e-retail spending in an economy is positively related to the development of the retail industry.

Regulatory restrictions on e-retailing: Economic freedom

Policymakers play a key role in establishing the general parameters in which e-retailing industry can develop. Governments' concern about the outflow of foreign currency has been an obstacle for e-commerce growth in some countries such as China and Malaysia. These barriers are compounded by monopoly in telecom and courier markets (Kshetri 2001). In China, for example, when FedEx, UPS, TNT and DHL first entered, they were all required to work with the same Chinese company, Sinotrans, as the exclusive agent (Yan 1998).

Government policies and regulations influence the generation and use of e-commerce technology by organizations and individuals. For instance, Asian countries such as Hong Kong, India, Malaysia, Singapore, Taiwan, and Thailand are providing tax and other incentives for MNCs and are promoting high-tech districts. Tariff/non-tariff policies also influence the availability and price structures of IT products needed for e-retailing. Prior research indicates

that higher tariffs and customs on IT products are hindering the growth of e-commerce in Latin America (Kshetri and Dholakia 2002).

Institutional economists have provided abundant evidence to suggest that the institutional and policy environment of a country is tightly linked to economic growth (Gwartney 2009). We extend this logic to the context of the retailing industry to suggest that countries with high economic freedom enjoy rapid growth in the development of new industry such as e-retailing, ceteris paribus. Gwartney (2009: 947) notes: "As transportation and communication costs have fallen substantially through time, production in regions far from sources of key inputs and markets where output will be sold is now more feasible than ever before. As a result, entrepreneurs and investors have more discretion with regard to the location of production facilities. However, trade restrictions that make it more costly to import resources and export products will significantly reduce the attractiveness of a country as a potential location for production. Thus, theory indicates that countries with lower trade restrictions will have higher private investment rates than those that are relatively closed".

Economies worldwide also vary widely in terms of the ease and speed with which a business can be started. According to the World Bank's Doing Business Survey, to start a new business, 16 procedures are to be completed in Venezuela, which take 141days (The World Bank Group 2009). In New Zealand, on the other hand, starting a new business requires only one procedure, which can be completed in a day. The survey also found that costs to start a new business as a proportion of per capita income vary from 0.4% in Canada to 66% in India (The World Bank Group 2009). For instance, consider North Korea, which had the lowest economic freedom index[1] in 2009 (2 out of 100 compared to Hong Kong's 90). In June 2009, North Korea reportedly shut down its largest unofficial market on the outskirts of Pyongyang. Analysts argued

that this was a measure to increase the government control on market activities. Thus, we hypothesize that:

H_4: Ceteris paribus, the per capita e-retail spending in an economy is positively related to economic freedom.

Method

This section describes the data and the statistical analysis we employed in the empirical investigation. First, we discuss the sources of the data and how the variables were measured, and second, we discuss the statistical analysis that was used to examine the effect of the economic and institutional variables on the ad spending.

Data and Measures

Data on gross national product (GNP*)* at purchasing power parity, retail sites, traditional retail spending, online retail spending, population, population density and broadband Internet subscribers were obtained from *Euromonitor*. There are five major constraints related to the use of international secondary data: accuracy, age, reliability, lumping and comparability (Kotabe and Helsen 2001). *Euromonitor* largely addresses these constraints (Kotabe 2002). Data are compiled from various "reputable sources" and measures are taken to make them internationally comparable (Kotabe 2002: 173). Regarding comparability, it is also important to note that this constraint is mainly a consequence of a lack of common and shared understanding of a concept (e.g., social capital) across countries (Harper 2002). This problem is compounded by different languages used in the surveys for measuring the concepts. Since the data used in this paper represent actions rather than attitude, feeling or intention and have straightforward operationalizations, international comparability doesn't seem to be a problem. Kotabe (2002) observes: "Usually, the measurement quality of data collected from reputable data sources such *WMDS* [Euromonitor's World marketing data and statistics] do not get challenged in the blind

review process" (p. 174). Note that *Euromonitor* data have been used in past studies (e.g., Coulter et al. 2003; Ganesh 1998; Kshetri et al. 2007).

Data on economic freedom were obtained from the Heritage Foundation. As is the case with *Euromonitor* data, researchers have used the Heritage Foundation's data (Gwartney 2009).

Dependent and Independent Variables

Our dependent variable is per capita spending in Internet retailing (PCIR) in US Dollar. Table 1 presents PCIR data for the economies used in our analysis. A full list of the explanatory and control variables used in this study, together with their description, is given in Table 3. Table 4 reports descriptive statistics for all variables for 2007. Table 5 presents the correlation matrix of the independent and dependent variables for 2007.

Control variables

Prior researchers have suggested that empirical model estimating cross-national variation in e-commerce activities need to control for per capita GDP (Oxley and Yeung 2001). According to these researchers, e-commerce activities as well as explanatory variables related to economic and institutional factors are likely to have significant correlations with the level of economic development. In addition to per capita GDP, we have also controlled the effects of population size and population density.

Income

As e-retailing and e-shopping are in an early phase of diffusion both within and across countries' economies, e-shoppers are considered to be "innovators" (Rogers 1983). One of the variables most likely to characterize innovators is high per capita income (Gatignon and Robertson 1985; Rogers 1983). Per capita income is one of the important factors influencing "demand and cost conditions" of a country's involvement (Beise 2001) in technological innovations such as e-retailing. Dekimpe et al. (2000) argue that high per capita income allows potential adopters to

afford greater economic sacrifice to adopt an innovation. For instance, consumers' ownership of credit cards facilitates e-retailing. In an international context, it can be argued that an economy's standard of living and the level of economic development influence the adoption timing as well as diffusion speed of technological innovations such as e-retailing (Antonelli 1993; Gatignon and Robertson 1985; Dekimpe et al. 2000; Gruber and Verboven 2001; Kshetri 2001). Empirical evidence also supports this argument. A study conducted by Forrester Research, for instance, found that multi-channel shoppers are characterized by higher incomes, more discretionary dollars and less price sensitivity (Retail Merchandiser 2007). We thus controlled for the income effect in our analyses.

Population density

As the density of the population of a country grows, inconvenience experienced by the typical retail consumer buyer likely grows as well. In very dense populations, even the most mundane retail excursion of a typical consumer can become a time-consuming chore. Such consumers are likely to switch to e-retailing whenever it is feasible to do so. The increase in the density of a country's population also holds promise for cost-related benefits in the domain of physical distribution in e-retailing. For products that cannot be digitized, retailing requires transportation of physical goods (Anderson et al. 2003). From a retailer's standpoint, total distribution costs may, in some cases, be lower under an e-commerce model thanks to scale economies in freight industry (Anderson et al. 2003). We thus controlled for population density in our analyses.

Population size

Location choices of firms depend on spatial patterns of accessibility (Anderson et al. 2003: 415). Prior researchers have suggested that "gains in producer welfare" are an important factor affecting the diffusion of e-retailing (Brynjolfsson et al. 2003: 1592). Market and infrastructure factors controlling the availability of a marketing technology (e.g., e-retailing) to potential

adopters are less likely to be available in new markets and those with small size (Brown et al. 1976). Industry concentration and spatial concentrations of Internet activities within firms favor the use of a few locations (Anderson et al. 2003: 422) characterized by substantial operating size. We have robust examples to substantiate the claim that large e-retailers tend to keep their Internet businesses highly concentrated in big markets. For instance, as of 2001, Amazon.com had new sites geared to the U.K. and German markets albeit the servers were in Seattle (Dodge 2001). Likewise, Yahoo! Japan, launched in April 1996, was Yahoo's first overseas site. The company then expanded to the U.K., France, and Germany between September and October of the same year (Pickering 2000). Note that Japan is the world's second biggest economy, and Germany, France and the U.K. are the biggest European economies. The size of a market, which is an important factor technology suppliers take into account in assessing the profitability of a market, is positively related to per capita retail spending. In the analyses we have therefore controlled for population size.

Tables 3, 4, 5 about here

Statistical Analysis

Time series cross sectional (TSCS) models

Only by confronting retailing theories with data for a long period of time can such theories be put to a test that is more rigorous than is feasible with cross-sectional data. We thus employed time series cross sectional (TSCS) models linear in parameters using annual data for 2003-2007. TSCS models are designed to overcome the limitations of usual linear models. When pooling data one or more assumptions of the usual linear model may be violated. Fomby et al. (1984: 337) point out several such possibilities. First, the error terms in a pooled model may be "heteroskedastic, autocorrelated and may exhibit contemporaneous correlation" which makes a

generalized least square technique inappropriate. Second, the parameters of the data generating process may differ from observation to observation. The reactions of different cross sections may be different to changes in explanatory variables, and the reactions may also change over time. TSCS models allow for differences in behavior over cross sectional units as well as the differences in behavior over time for a given cross section. In sum, in addition to a gain in degrees of freedom (DF) (Bass and Wittink 1975), TSCS models overcome limitations of usual linear models and are consistent with the way the data are generated (Fomby et al. 1984).

We employed the following TSCS model:

$$PCIRit = \beta_{1it} + \sum_{k=2}^{K} \beta_{kit} x_{kit} + \varepsilon_{it} \qquad (1),$$

where, $PCIR_{it}$ is the per capita spending on e-retailing and β_{1it} is the dummy variable for the i^{th} country for the t^{th} time period and β_{kit} ($k \geq 2$) are the slopes. X_{kit} ($k \geq 2$) is the value of the predictor X_k for the i^{th} country in time t.

A key concern with TSCS models is the selection of the most efficient estimation procedure and associated testing of hypotheses about the parameters. Several factors need to be taken into consideration in selecting the appropriate model. The first is the choice between fixed and random effects models. For the fixed effect (or dummy variable) model, the intercept term β_{1it} in (1) can be written as

$$\beta_{1it} = \alpha_i + \tau_t \qquad (2),$$

where α_i are the country "dummies" and τ_t are the time "dummies". The dummy variable model, however, eliminates a major portion of the variation among explained as well as explanatory variables if the between-country and between-time period variation is large (Maddala 1971).

Additional problems include a loss in a substantial number of degrees of freedom and a lack of meaningful interpretation of the dummy variables (Maddala 1971).

These problems can be overcome by treating α_i and τ_t as random (Bass and Wittink 1975) in which case only two parameters, the mean and the variance of the α's (and similarly for τ's), are estimated instead of N+T parameters in dummy variable models (N= No. of cross-sections and T= No. of time periods). The procedure of treating α_i and τ_t as random can be rationalized by arguing that the dummy variables represent ignorance like ε_{it}. Maddala (1971) argues that this "specific ignorance" can be treated in the same manner as ε_{it}.

Then the residual can be written as: $u_{it} = \alpha_i + \tau_t + \varepsilon_{it}$ (3). Then,

$$PCIRit = \sum_{k=2}^{K} \beta_{kit} x_{kit} + \alpha_i + \tau_t + \varepsilon_{it} \qquad (4).$$

In TSCS models, two considerations, *logical and statistical*, may determine the choice of specification—fixed vs. random (Hausman 1978). The *logical* consideration is whether β_{1it} can be considered random and drawn from an independently and identically distributed (IID) distribution (Hausman 1978, p. 1263). The statistical consideration is whether β_{1it}'s satisfy "di Finnetti's exchangeability criterion" (p. 1263), a necessary and sufficient condition for random sampling. If these conditions are satisfied, then random model can be more appropriate than fixed model. To empirically test the statistical consideration, we estimated the fixed effect model[2] for the cross-sections for which "complete" data for the period under consideration were available. Then we calculated the correlation between the country specific fixed effects and time specific fixed effects with other country specific factors or regressors (Table 6). As table 6

indicates, none of the Pearsonian coefficients is significant, which makes it clear that random effect TSCS models are more appropriate for the given data set than fixed effect TSCS models.

Tables 6 about here

After knowing the appropriateness of the random effect TSCS models over fixed effect ones, the next step would be to select the most appropriate random effect model. In the pooled data on Internet diffusion, it is reasonable to expect heteroskedasticity [i.e. $E(u_{it}^2) = \sigma_{ii}$], contemporaneous correlation or spatial heterogeneity [i.e. $E(u_{it}u_{jt}) = \sigma_{ij}$] (Anselin 1987), and autoregression [i.e. $u_{it} = \rho_i u_{i,t-1} + e_{it}$]. Among the three most commonly used estimation procedures for random effect TSCS models–Fuller-Battese, Da Silva and Parks– the Fuller-Battese (Fuller and Battese 1974) takes only heteroskedasticity into account while Da Silva (1975) considers heteroskedasticity and autoregression. Parks (1967) method, on the other hand, takes heteroskedasticity, autoregression as well as contemporaneous correlation into account and hence appears to be the most appropriate method to study the multi-country diffusion process. We used Parks' (1967) autoregressive model to estimate the parameters of (4).

Results

The results from the TSCS regression analyses are presented in Table 7. The model in column I includes all the variables—explanatory and control. The model in column II includes all the explanatory variables. We also estimated models that included only one explanatory variable at a time (columns III- VI).

Tables 7 about here

It is also important to note that conventional measures of R^2 are inappropriate for TSCS models (SAS Institute 1999: 1136). We thus did not report R^2 values for the models.

The estimation results provided in Table 7 support hypotheses 1, 2 and 3. This means that each of the three variables---broadband penetration, concentration of conventional retail stores and development of the conventional retail industry-- has a significant effect on the development of the e-retail industry. These results are still valid when controlled for the effects of other variables.

Considering column 1 first, we note from Table 7 that when PBIS is included in a TSCS model, the highest t value was observed with this variable. Broadband penetration remained the strongest predictor of e-retail spending. Researchers have suggested that the development and availability of infrastructure needed for efficient marketing an international marketer's country selection decision (Manrai and Manrai 2001). Instead of physical infrastructures such as road, telecommunications infrastructures play an important role in the development of the e-retail industry. Therefore, in the present study, we extended prior observations related to marketing in the context of the online world. The widespread use of low-cost broadband services is thus a leading reason for the rapid growth of the global e-retailing industry (MarketWatch: Global Round-up 2007).

We also ran the TSCS models with dial-up Internet subscribers as a percentage of total Internet users (PDIS) as an independent variable. When it was included with other explanatory variables, the coefficient for PDIS was -109.6 ($p < 0.10$). However, when only the PDIS variable was included as the explanatory variable, the level of significance increases ($t = 5.72$, $p < 0.01$).

Regarding the effects of economic freedom (ECFR), a comparison of results in Col. VI with those in Col. I and Col. II (Table 7) indicates that, when taken alone and with other explanatory variables, this variable influences online retail spending. However, when control

variables are also included in the model, its effect on online retail spending is insignificant. Thus, there are mixed results regarding the effects of economic freedom on the development of the e-retailing industry.

Discussion and Implications

A complaint that was often heard in the literature was that most of the e-commerce studies are limited to a single country (Zhu and Kraemer 2005) and most have focused primarily on the U.S. (Dedrick et al. 2003). While some recent studies (Table 2) have attempted to address this issue, none has done so in a way that served the theoretical and empirical objectives of this study. Moreover, existing cross-national e-commerce studies have focused on a small group of countries. In this regard, this study is the largest and most inclusive study on cross-national e-commerce industry.

A sample consisting of developed, developing, and newly industrialized countries in e-commerce research would help strengthen the generalizability of findings (Zhu and Kraemer 2005). The sample in our study has a higher degree of representativeness than most cross-national e-commerce studies, which is likely to lead to a high degree of generalizability.

The framework presented in this paper also has implications for management practice and public policy. As noted earlier, broadband penetration is the strongest predictor of e-retail spending. In this regard, global e-retailers must give major attention to economies with the highest levels of broadband penetration in their country selection decision. At the same time, countries with heavy concentration of physical stores are less attractive for e-retailers. However, well-developed retail industry in a country is likely to generate various externalities needed for the e-retail industry and is thus an attractive market for an e-retailer.

Policy makers need to understand the drivers of e-retailing identified in this paper if they would like to develop a fully developed digital economy. Special attention needs to be placed on

the development of the broadband infrastructure. Economic freedom is also a significant determinant of the development of the e-retail industry, which implies the importance of business friendly policies.

Several limitations of this research must be recognized in a balanced discussion of its findings. First, this study does not include many economies that are at the bottommost of the global economic pyramid as data were not available for these economies. One reason behind the data unavailability is that the e-retailing industry is still at a nascent stage of development in these economies. An additional limitation of this research is that we did not include variables related to culture.

Both the contributions and limitations of this research merit attention and afford directions for future research. Further inquiry is needed to investigate whether the findings of this paper can be extended to economies that could not be included. There are mainly low-income countries that are characterized by different economic and institutional conditions. When e-commerce data on these economies become available, the above hypotheses need to be tested.

Future research based on the present framework can be extended to other e-commerce areas. For instance, economic and institutional factors driving cross-national variation in Internet advertising might be worthwhile target of study.

Future research might also examine how cultural factors are related to international variation in e-retailing. Unlike the explanatory variables used in this paper, longitudinal data related to relevant cultural variables may not exist. However, even a cross-sectional study using some measures of culture as independent variables would help to understand international variation in e-commerce.

Concluding comments

Development of the e-retailing industry is tightly linked to the existence of a strong ecosystem of the retail industry, which is a function of the availability of retailing technologies and services, consumers' retailing behavior and entry of foreign firms in the value chain of retail sector. The results in this paper demonstrated how institutional factors, telecommunications infrastructures (e.g., broadband development) and availability of traditional retail stores, superimpose in a unique interaction to influence the development of the e-retailing industry in an economy. We found evidence suggesting that broadband penetration was the strongest predictor of e-retail spending. On the whole, this evidence, both anecdotal and from our data, appears to suggest that the relative convenience of e-retailing over conventional retailing is an important factor in determining consumers' switch to this channel.

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Table 1: Per capita retail spending in economies used in the analysis

Economy	Per capita retail spending (US$, 2007)	Economy	Per capita retail spending (US$, 2007)
Argentina	11.39	Malaysia	37.52
Australia	60.63	Mexico	3.78
Austria	293.29	Morocco	0.21
Belgium	99.80	Netherlands	146.33
Brazil	14.98	Norway	154.91
Bulgaria	2.28	The Philippines	2.76
Canada	59.45	Poland	28.39
Chile	11.81	Portugal	16.04
China	0.79	Romania	0.72
Colombia	7.83	Russia	14.95
Czech Republic	67.96	Saudi Arabia	1.32
Denmark	39.80	Singapore	83.36
Finland	293.13	Slovakia	338.90
France	196.36	South Africa	2.15
Germany	208.77	South Korea	323.60
Greece	37.01	Spain	46.40
Hong Kong	4.43	Sweden	88.23
Hungary	15.33	Switzerland	157.18
India	0.25	Taiwan	27.18
Ireland	114.69	Turkey	11.37
Israel	23.28	Ukraine	20.99
Italy	36.22	United Kingdom	442.43
Japan	153.23	USA	286.44
		Venezuela	10.33

Source: Authors' calculation based on data from Euromonitor International

Table 2: A review of cross-country e-commerce studies

Study	Dependent variable(s)	Major explanatory variables examined	Method	No. of countries	Level of analysis
Oxley and Yeung (2001)	Internet users per capita (1998) Internet hosts per capita (1998)	Rule of law, availability of payment channels	OLS	25-30	Country
Zhu et al. (2003)	E-business adoption	Technology competence, firm scope/size, consumer readiness, competitive pressure, trading partner readiness.	Logit models	8 (European countries)	Firm/individual
Gibbs et al. (2003)	B2B and B2C e-commerce adoption	Consumer preferences and values, national culture, distribution systems, global competition, e-commerce legislation	Case studies	10	Firm
Mahmood et al. (2004)	On-line shopping behavior	Trust and economic conditions, educational level and technology savviness	Structural equation models	26	Individual
Xu et al. (2004)	Adoption of e-business-related technologies (mainly inter-organizational)	Government regulation, technology competence, enterprise integration, competition intensity	Structural equation models	2 (the U. S. and China)	Firm
Zhu and Kraemer (2005)	E-business use and value	Technology competence, firm size, financial commitment, competitive pressure, and regulatory support	Structural equation models	10	Firm
Ho et al. (2007)	Per capita online shopping expenditures (2000-2004)	number of Internet users, capital investment in telecommunications, credit card penetration, venture capital availability, level of education	OLS and GLS	15 (European countries)	Country

Table 3: Explanatory and control variables used in this study

Variable	Explanation	Remarks
GNPPC-PPP	Gross national product (GNP) per capita at purchasing power parity	
RSPK	Retail sites per 1000 persons	It measures the concentration of the conventional retail industry.
PCRETAIL	per capita retail spending (US$)	It measures the development of the conventional retail industry.
POP	Population in thousand	
ECFR	Economic Freedom (Score)	The Wall Street Journal and The Heritage Foundation have tracked the economic freedom of the world's 183 countries. The Index covers 10 freedoms, which according to Heritage Foundation, are based on Adam Smith's theories about liberty, prosperity and economic freedom and measure economic success (The Heritage Foundation 2009).
PBIS	Broadband Internet subscribers as a percentage of total Internet users	Euromonitor defines a broadband Internet subscriber as "someone who pays for high-speed access to the public Internet (a TCP/IP connection)". High-speed access is 256 kbit/s or greater, as the sum of the capacity in both directions.
PDIS	Dial-up Internet subscribers as a percentage of total Internet users	
DEN	Population Density	

Table 4: Descriptive statistics for 2007 data (N= 47)

	Mean	Minimum	Maximum	SD
PCIR (US$)	85.069	0.214	442.429	110.986
POP ('000)	94,623	4,339	1,317,885	24,135
RSPK	7.39	2.28	15.66	3.34
PCRETAIL (US$)	4355	192.1	10,598	3251
ECFR	66.828	47.862	89.915	10.057
PBIS	0.287	0.03	0.76	0.142
DEN	424.918	2.70	6996	1369
GNPPC-PPP (US$)	24,632	2,618	52,913	13,850
PDIS	0.0489	0	0.3119	0.0553

Table 5: Correlation matrix for 2007 data

	POP	RSPK	PCRETAIL	ECFR	PBIS	DEN	GNPPC-PPP	PDIS
PCIR	-0.129	-0.191	**0.559*** **	**0.450*** **	**0.308** **	-0.060	**0.488*** **	0.071
POP		-0.043	**-0.278** **	**-0.313** **	-0.200	-0.060	**-0.326** **	-0.134
RSPK			-0.142	-0.151	-0.002	0.027	-0.144	-0.204
PCRETAIL				**0.649*** **	**0.622*** **	-0.040	**0.874*** **	0.1299
ECFR					**0.534*** **	**0.468*** **	**0.791*** **	**0.414*** **
PBIS						0.175	**0.659*** **	0.062
DEN							**0.334** **	**0.619*** **
GNPPC-PPP								**0.445*** **

Table 6: Estimation of Pearsonian correlation coefficients of the regressors with the country specific fixed effect and time specific fixed effect

Variable	Pearsonian correlation coefficient with country specific fixed effect (p-value)	Pearsonian correlation coefficient with time specific fixed effect (p-value)
PCIR	-0.022(0.882)	-0.356(0.557)
POP	-0.054(0.717)	-0.297(0.628)
RSPK	-0.150(0.315)	-0.456(0.441)
PCRETAIL	-0.083(0.580)	-0.200(0.746)
ECFR	-0.095(0.527)	-0.648(0.237)
PPCBIS	-0.141(0.346)	-0.310(0.611)
PCBIS	-0.134(0.368)	-0.331(0.586)
DEN	0.094(0.530)	-0.375(0.534)
GNPPC-PPP	-0.028(0.850)	-0.321(0.599)
PDIS	0.128(0.392)	0.286(0.641)

Table 7: TSCS regression results (2003-2007) (Park's Method)

	DV= PCIR	**DV**= PCIR	**DV**= PCIR	**DV**= PCIR	**DV**= PCIR	**DV**= PCIR
	Col. I	Col. II	Col. III	Col. IV	Col. V	Col. VI
Intercept	16.433 (0.46)	**-24.99 (1.84)***	**14.27 (2.68) *** **	**75.14 (24.57) *** **	**-27.56 (3.97) *** **	**-118.12 (11.75) *** **
PBIS	**120.875 (5.26)*** **	**108.27 (5.78) *** **	**187.68 (11.70)** ***			
RSPK	**-4.517 (2.22)** **	**-2.65 (3.36)** ***		**-4.22 (17.52)** ***		
PCRETAIL	**0.0058 (2.10)** **	**0.0089 (3.99)** ***			**0.015 (5.95)** ***	
ECFR	0.232 (0.72)	**0.445 (2.25)** **				**2.29 (10.68)** ***
POP	-0.0001 (1.24)					
DEN	-0.018 (0.26)					
GNPPC-PPP	0.0002 (0.26)					
N	47	47	47	47	47	47
T	5	5	5	5	5	5
DFE	227	230	233	233	233	233

Note: The numbers in the parentheses represent t-values.

*Significant at 0.1 level, ** Significant at 0.05 level, ***Significant at 0.01 level

Notes:

[1] In 2009, economic freedom was not scored for four of the economies covered in the study because of a lack of sufficient reliable data.

[2] Even if random effects specification is found more appropriate on logical ground, one may still estimate fixed effects models. The fixed effect estimators are based on a particular sample which treats them as fixed in the sample (Hausman 1978).