NATIONAL INFORMATION ECOLOGY: A NEW INSTITUTIONAL ECONOMICS PERSPECTIVE ON GLOBAL E-COMMERCE ADOPTION

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ABSTRACT

Building off of the new institutional economics and e-commerce adoption literatures, we conduct a cross-country analysis assessing the impact and effect of national information ecology on global e-commerce adoption in the years of 2003 and 2007, respectively. We utilize a secondary dataset from the Global E-readiness Rankings of the Economist Intelligence Unit, which evaluated information environments and e-commerce adoption in major economies around the world. The results of the analysis indicate that at the infant stage of e-commerce, supportive government policies, effective legal environment and compatible socio-cultural infrastructure were powerful facilitators of e-commerce adoption. As e-commerce becomes more prevalent, supportive government policies and socio-cultural infrastructure foster e-commerce activities, while the effect of the legal environments becomes negligible. The study presents evidence that national information ecologies, shaped by various institutional environment factors, exert influence on a country's e-commerce adoption at different stages of e-commerce development. It is one of the first cross-country studies on the relationship between national institutional environments and e-commerce adoption and the research findings have managerial and policy implications for global e-commerce development.

Keywords: national information ecology, institutional environment, e-commerce adoption, legal environment, government policy, socio-cultural infrastructure

1. Introduction

E-commerce has become a pervasive business phenomenon in the world. By making business more competitive and productive, e-commerce is important for both developed and developing countries in strengthening their economies and in supporting national economic development. The reality is, however, that after more than a decade of development, e-commerce adoption and diffusion is still uneven among different countries and a digital divide of e-commerce adoption is widening in the world. The challenge is for researchers, practitioners and policy-makers to better understand the phenomenon and to ensure the opportunity and potential offered by e-commerce is taken and realized in all economies.

While e-commerce adoption in general has gained much attention in academia, a particular question remains unanswered: whether adoption of e-commerce in a country is affected by this country's national information environment, which is in turn shaped primarily by this country's government policies, legislations and regulations, and social and cultural values. As long as their real effects on e-commerce adoption are unclear, scientific evidence cannot support government policy-making. It is an objective of this study, therefore, to look into uneven global e-commerce adoption, and in particular, to understand how enabling national "e-strategies" could be created to facilitate e-commerce adoption. The study aims to answer two specific research questions as follows:

1) What are the primary components of national information environments required for e-commerce adoption? And
2) To what extent do those national environmental factors influence e-commerce adoption around the world?

Accordingly, this study assesses the impact and effect of three components of national information ecology—policy environment, legal environment and socio-culture environment. We first build the research model based on institutional theory of new institutional economics (NIE) and its theoretical application in information system; that is, information ecology theory. We then proceed to test three research hypotheses using secondary data sources (i.e., country aggregated data collected by an international institution) and a multi-time point approach (i.e., the first point in 2003 and the second point in 2007). The results of later multiple regression analyses demonstrate the degrees of association between the three national information ecology factors and e-commerce adoption at two stages. The findings provide researchers and policy-makers systematic insights into the role of national information ecology in e-commerce adoption, at a country level and over time.

The subsequent sections are organized as follows. Section 2 discusses the research background (including the uneven adoption and external environment of e-commerce). Section 3 explains institutional theory of NIE and information ecology theory. Section 4 reviews relevant environmental studies in e-commerce adoption, in alignment with the research model and hypotheses constructed in this study. Section 5 demonstrates the methodology on how this research was designed and pursued. Section 6 presents statistical analysis results based on the secondary dataset adopted from the global e-readiness rankings of the Economist Intelligence Unit (EIU). Research findings and implications are discussed in the last section.

2. Research Background

2.1. Uneven Adoption of E-commerce

Even with considerable opportunities offered by e-commerce, adoption of e-commerce varies largely among different countries and regions. According to the United Nations Conference on Trade and Development (UNCTAD)'s global e-commerce report in 2002 [UNCTAD 2002], e-commerce was almost negligible in Africa, except in South Africa; and in Latin America, e-commerce was only concentrated in four Internet markets—Brazil, Mexico, Argentina and Chile. Overall, e-commerce in developing countries did not reach five percent of global e-commerce. Five years later, UNCTAD found that e-commerce remained limited in developing countries and there were still wide gaps between countries [UNCTAD 2007]. Even among developed countries, the level of e-commerce adoption varied. For example, in 2004, the shares of enterprises purchasing online in EU (European Union) countries ranged from less than 10% in Italy to more than 50% in UK [UNCTAD 2006]. While it accounted for 10% of all sales in Ireland, the share of online sales was close to zero in several EU countries.

The problem of uneven adoption was also shown in the World Economic Forum (WEF)'s latest Global Information Technology Report (GITR): the U.S., South Korea, Canada and developed countries in Europe topped the ranking of the "Extent of Business Internet Use" category, while countries in Africa and South America were at the bottom of the list [WEF 2009]. Using data from the GITR, Figure 1 compares the average e-commerce scores in 2001 and 2006 of the top-40% and bottom-40% countries in the reports. It shows that the difference between the average scores of fast-adopter and slow-adopter countries increased 67% from 2001 to 2006. Unfortunately, such a "digital gap" was broadened rather than narrowed in the past half-decade.
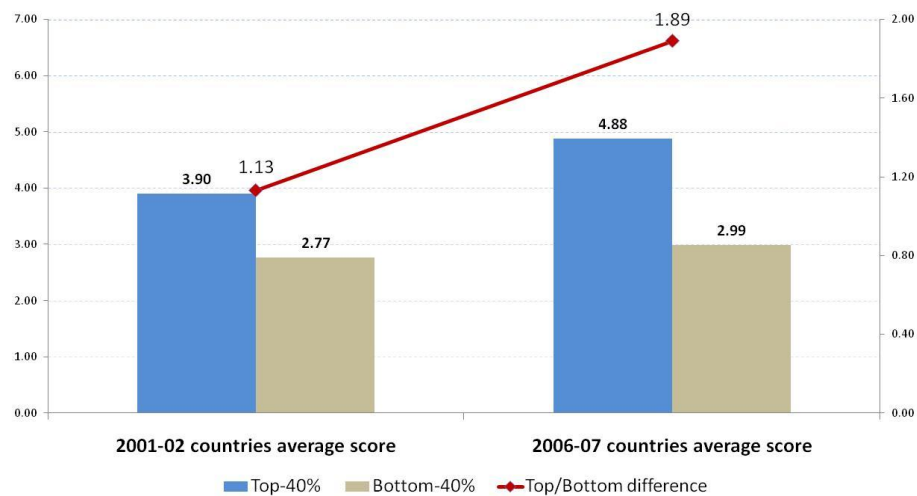

Figure 1: Average Scores of E-commerce Between Top and Bottom Countries
Data source: The Global Information Technology Reports 2001-2002 and 2006-2007, World Economic Forum (WEF).

There has been a concern that uneven adoption of e-commerce creates an unfair competitive advantage for multinational oligarchs against local SMEs (small and medium sized enterprises) and creates a "digital divide" between developed and developing countries. Countries that lag behind in e-commerce will risk being bypassed by those using the new technologies [UNCTAD 2001]. A worse scenario is that existing socio-economic divisions will be reinforced by the "digital divide," rather than being narrowed or changed by the benefits offered by e-commerce.

2.2. External Environment for E-commerce Adoption

The social and economic significance of e-commerce provided an incentive for policymakers and other stakeholders to take actions in the past decade. Many disparate guidelines, directives, laws, and treaties have emerged. Bold plans to boost e-commerce have been developed by governments around the world. The key areas that have seen regulations and policies for e-commerce included digital signatures, information privacy, intellectual property, and online taxation. For example, aiming at encouraging e-commerce worldwide, more than 140 member countries of the World Trade Organization (WTO) have committed to a moratorium on imposing customs duties on electronic transactions since 1998. Even in the U.S., where the government generally takes a hands-off approach to the Internet economy, Congress has engaged in many e-commerce policy issues, such as Internet taxation, encryption and digital signature, online patent and copyright protection, network security and privacy safeguards [Tehan 2003]. These institutional activities, in turn, created and shaped the national information environments for e-commerce adoption, although the extent of these effects is likely to vary across countries.

Despite the numerous governmental endeavors, constructing policies to enable and promote e-commerce faces significant challenges. It should proceed carefully with consideration for the cultural and institutional capacities of a country. The creation of a supportive environment for e-commerce adoption has thus formed much of the policy-making debate since the end of the 1990s. One of the responses was a Framework for Global Electronic Commerce proposed by US government in 1997. Among the principles suggested to help the growth of e-commerce were 1) governments should avoid undue restrictions on e-commerce; and 2) the aim of governmental involvement should be to support and enforce a predictable, minimalist, consistent and simple legal environment for e-commerce [Clinton et al. 1997]. The Framework recognized that governments could have a profound effect on e-commerce through either facilitation or obstruction. Knowing when and how the government should act is crucial.

From a global perspective, while adoption of IT and economic development are positively correlated, countries with similar levels of GDP have very different levels of adoption of IT, and vice versa [UNCTAD 2004]. Thus, the variation among countries in e-commerce cannot be explained simply by relative income and physical infrastructure levels [Shih et al. 2005]. The UNCTAD's global e-commerce report therefore suggested that policy choices could make a significant difference in e-commerce adoption [UNCTAD 2004]. The report, however, did not investigate further the relationship between IT policy and e-commerce adoption, due to the lack of e-commerce data in non-US countries. Moreover, it is commonly believed that it is difficult to identify and measure the policy outcomes in an increasingly complex information economy.

As shown above, both the significance and challenge of e-commerce are so obvious that there is an imminent need to evaluate scientifically the effects of national environment factors on e-commerce adoption for reference in appropriate policy making and business decisions.

3. Theoretical Foundation

Adoption and diffusion of e-commerce has been a growing topic of academic research. One of the research approaches is to employ institutional theory, focusing on the external environment for e-commerce. "Insights from the New Institutional Economics suggest that we should look beyond those proximate indicators [i.e. physical infrastructure] to examine how the institutional environment in a country contributes to (or undermines) confidence in e-commerce and supports private investment in the new medium [of business transaction]." [Oxley et al. 2001] This study follows this theoretical suggestion to conduct a series of empirical studies on the institutional environment for global e-commerce adoption. The theoretical underpinnings in this section provide the context, rationale and relevance of using institutional theory in the study.

Prior to this study, almost all IS research using institutional theory focused on the normative, coercive and mimetic pressures that influence organizations' decision on IT adoption. However, the sociological perspective on organizational behavior, which was proposed by new institutionalism [DiMaggio et al. 1991b], should not be confused with the new institutional economics (NIE) perspective adopted in this study. The NIE perspective of institutional theory emphasizes the social and legal norms and rules that shape the external environment of economic activities.

Under the NIE methodological principles, the meaning of the term "institution" is twofold. First, institutions are the "rules, procedures, and arrangements" of the game [Shepsle 1986], or "prescriptions about which actions are required, prohibited, or permitted." [Ostrom 1986] Therefore, the concept of "institution" could also be coined as

"institutional frameworks". Second, institutions could be labeled as social organizations including legislatures, government agencies, and even societies [Ahrens 2002]. These two definitions relate to each other. The social entities in the second definition create and shape the normative rules in the first definition. Those norms, rules and arrangements, in turn, influence the decision and behavior of individuals and organizations in the society. In addition to its formal legal historical roots, institutional frameworks in contemporary NIE have also included cultural values. At this point, both NIE and sociological perspectives of institutional theory recognize that social and economic choices are shaped, mediated, and channeled by institutional frameworks, since those choices are generally not free from institutions, customs, social norms, or legal procedures [DiMaggio et al. 1991a].

Insights from NIE further reveal that individuals and organizations live and operate in an environment consisting of institutions. Every member of the society is influenced by this socio-economic ecology, the structure of which is determined by social, economic and political factors. On the one hand, such institutional environment can reduce uncertainty by providing dependable and efficient frameworks for economic exchange [North 1986]. On the other hand, in order to survive, organizations must conform to the rules and belief systems prevailing in the environment [DiMaggio et al. 1991b].

As for IS research, external environments have been included as a component of MIS research models for three decades. Ives, Hamilton and Davis suggested that we should study political, legal, economic and social environments within which social entities were embedded [Ives et al. 1980]. Scholars also recognized that the use of information technology could be profitably analyzed drawing on socio-economic and political (i.e., external contextual) levels of analysis [Pettigrew 1985]. King et al. later defined institutions in the IS domain as "any standing social entity that exerts influence and regulation over other social entities" [King et al. 1994]. They further argued that the relationship between environmental factors and e-commerce innovation could be explained using institutional theory. Later in a cross-country study, the governmental, legal and cultural factors were analyzed as the institutional environments for e-commerce [Oxley et al. 2001]. In that study, the institutional environment was defined as the "set of fundamental political, social and legal ground rules that establish the basis for production, exchange and distribution" [Oxley et al. 2001].

The concept of "information ecology," which connects ecological ideas with the evolving information economy, is a theoretical extension of the institutional approach. Information ecologists treat the external environment of information systems as ecologies and suggest an ecological approach to describe and analyze information systems from the perspective of how these systems are influenced by their environment—economic, social and other environmental activities. These ecological factors can be powerful. They drive individual and organizational behavior and help to build a new organizational vision on IT [Davenport 1997a]. They also motivate actions on IT [Davenport 1997b]. Accordingly, an extended concept of "national information ecology" is coined in this study and discussed in the following section.

4. Research Model, Literature Review and Hypotheses

The research model of this study is shown in Figure 2. The model conceptualizes and focuses on the expected directional relationships between e-commerce adoption and three major components of "national information ecology"—government policy, legal environment, and socio-cultural infrastructure in different countries. The posited relationships control for the effect of GDP per capita in each country. The research model does not mean to capture exhaustively all possible factors in e-commerce adoption, but to illustrate how some of the national environmental factors affect e-commerce adoption worldwide.

This research model helps specify the three research hypotheses in the study. As described in the next sub-section, each construct in the research model has been tested by previous empirical studies; yet no research has investigated these three ecological factors collectively in a single research model.

4.1. Government Policy

In early empirical studies, Iacovou et al. found that the use of governmental subsidies and promotional efforts could lead to faster adoption of EDI in Canada [Iacovou et al. 1995]. Dasgupta et al. found that government policy was an important determinant of IT adoption in India [Dasgupta et al. 1999]. After a longitudinal study over 16 years, Wang concluded that building national IT infrastructure was a primary policy choice supporting IT adoption in Taiwan [Wang 1999].

When asked to identify government measures that would encourage wider adoption and use of e-commerce, SMEs in the APEC (Asia Pacific Economic Cooperation) region highly ranked the following government actions: improving telecom infrastructure, imposing fair tax policy for online transactions, developing national e-commerce strategy, enhancing government e-commerce use, providing e-commerce training, and promoting e-commerce use [PWC 1999]. In a qualitative interview with seven SMEs in southern Italy, interviewees indicated that governmental campaigns, financial incentives and tax breaks were important external factors affecting their adoption

of e-commerce [Scupola 2003]. Similarly, after interviewing 22 leading companies in five developing countries in the Caribbean region, Fraser et al. suggested that governments hoping to promote e-commerce should emphasize training, education, reducing telecom cost and improving its service [Fraser et al. 2005].
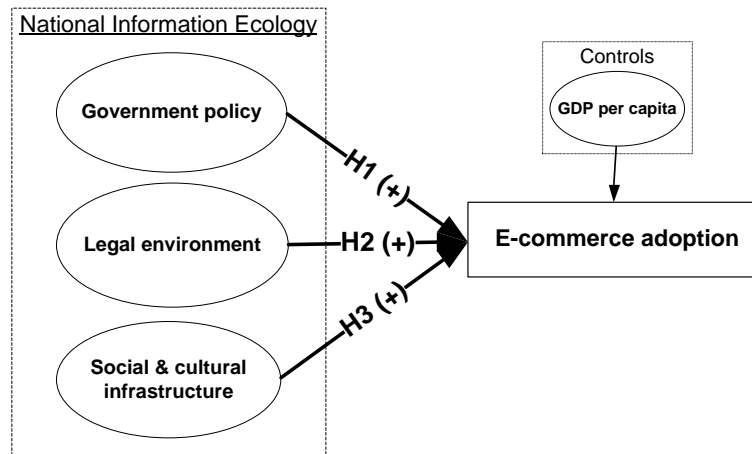

Figure 2: Research Model

The adoption of e-commerce in Singapore was a good example of governmental support driving technology innovation. Singapore was among the best performers of e-commerce around the world thanks to the government's early focus on e-commerce adoption [Mia et al. 2007]. The government in Singapore had a clear vision for e-commerce and IT development. It not only engaged deeply in national IT development (such as the creation of an e-commerce master plan and a series of initiatives to take it forward), but also launched a major educational program exposing the society to e-commerce [PWC 1999; Thatcher et al. 2006]. Those government programs were impressive in increasing the level of understanding of e-commerce in Singapore [PWC 1999]. Moreover, the government in Singapore encouraged e-commerce uptake by qualified local companies through subsidizing their costs of e-commerce consultancy, Internet connections, and hardware and software purchases [EIU 2003]. The government also provided tax incentives for foreign companies to use Singapore as their base for e-commerce activities in Asia [PWC 1999].

Among other economies, government policy affected positively the likelihood of EDI adoption in Hong Kong [Chau et al. 2001; Kuan et al. 2001]. Governmental promotions and supportive policies were related significantly to e-commerce decisions in China [Cui et al. 2006] and the extent of e-commerce adoption in Pakistan [Seyal et al. 2004]. In the cases of Chile, the U.S. and South Korea, firms felt pressure from the government to adopt e-commerce [Grandon et al. 2004a; Grandon et al. 2004b; Joo et al. 2004]. On the other hand, lack of governmental support was a significant barrier to e-commerce adoption in Oman [Khalfan et al. 2004].

Governmental support could also be realized through its own adoption of e-commerce and thus a role model for the private sector. Although there were fewer governmental incentives in the U.S. than in other countries, government procurement using e-commerce was a relatively important driver for US firms to adopt e-commerce [Fomin et al. 2005]. Fifty interviewed companies in less technologically advanced countries in southeastern Europe perceived e-government application as a form of e-commerce promotion from the government [Papazafeiropoulou 2004].

Oxley et al. indicated that governments played a critical role in creating the institutional environments that fostered private investment in e-commerce [Oxley et al. 2001]. Governmental actions should leverage and facilitate but not stifle e-commerce adoption. Gibbs et al. argued that governmental promotions and incentives were a major enabler of e-commerce and that national policies for IT infrastructure, such as trade and telecommunication liberalization, were also likely to have a big impact on e-commerce by making IT more affordable to the society [Gibbs et al. 2003]. Shore suggested that governmental IT support could be provided through national policies for training and maintaining an adequate IT workforce [Shore 2001]. Government's role in supporting e-commerce diffusion has been referred to as a leader, promoter, facilitator, regulator, educator and financier [PWC 1999]. Mann further posited that the slowness or failure of e-commerce adoption in some developing countries were the consequence of policy inaction or wrong action by their governments [Mann 2002]. The European Commission, in its e-business report, suggested that governmental policies aiming at promoting e-commerce should include, among

others, 1) creating incentives and a favorable environment; 2) supporting educational and training programs; and 3) becoming a role model for the public sector [EC 2006].

Drawing on the theoretical arguments, together with the previous empirical findings, this study hypothesizes that government policy, such as national IT policy and initiatives, tax deductions and other financial incentives, educational and training programs, and governmental role modeling in e-commerce adoption, has a positive impact on e-commerce adoption, as follows:

H1. The more supportive is the governmental policy for e-commerce in a country, the more extensive is the e-commerce adoption in that country.

4.2. Legal Environment

A number of cross-country studies using secondary data found that the legal environment in a country significantly affected e-commerce activities and revenues in that country [Ndubizu et al. 2002; Oxley et al. 2001; Zhao et al. 2007]. A group of survey studies also showed that the regulatory environment was significantly important in determining both the breadth and depth of e-business adoption, especially in developing countries and newly industrialized economies [Gibbs et al. 2004; Xu et al. 2004; Zhu et al. 2005; Zhu et al. 2004]. A study of SMEs' e-commerce adoption in the APEC region further specified that an adequate legal framework supporting e-commerce was important for reducing uncertainties and building trust and confidence in the electronic marketplace; this was particularly important for lower GDP economies [PWC 1999]. Overall, the legal environment should be secure, stable and predictable for e-commerce adoption.

Unfortunately, the development of the legal framework for e-commerce is generally behind developments in technology, and thus conducting business through the electronic networks raises numerous legal issues [PWC 1999]. Absences of regulations and legislations were a major barrier and/or serious limitation to e-commerce diffusion in the APEC region, Oman, Turkey, and UK [Kaynak et al. 2005; Khalfan et al. 2004; PWC 1999; Simpson et al. 2004]. One study shows that e-commerce adoption was slow in the countries without adequate legal frameworks regulating rights and obligations in the intangible cyberspace [Shih et al. 2005]. For example, compared with the U.S., fewer firms in China adopted e-commerce due to the less friendly legal environment [Shih et al. 2005]. By contrast, the US legal environment was more supportive of e-commerce than in other countries. It led to a higher percentage of US firms using e-commerce [Shih et al. 2005]. A related study confirmed that the U.S. did have a better legal environment supporting e-commerce use than other countries and that US companies expressed fewer legal concerns when doing e-commerce [Hsu et al. 2006]. Furthermore, APEC's study on e-commerce adoption found that firms in lower GDP countries appear to be more concerned about legal issues than similar firms in higher GDP countries [PWC 1999]. This concern might be due, in part, to a relative lack of adequate legal infrastructure for e-commerce in those lower GDP countries. The issue was further reflected in Wang's study in which he found that regulatory reform was critical for IT adoption in developing and newly industrialized economies [Wang 1999].

The legal issues are at the root of traditional institutional theory. Institutions were, first and foremost, the legal ground rules and procedures. Institutional influences were therefore political in nature so that members in society must conform to laws and regulations to earn legitimacy [DiMaggio et al. 1991b; North 1986]. The legal institution should provide predictable, credible, coherent and adaptable rules for economic transactions. Among those criteria, adaptability is particularly necessary because it helps ensure that changes in social preferences, technology and other external factors can be accommodated by institutional structures [Ahrens 2002]. Accordingly, the legal environment should reduce uncertainty by providing adequate, clear and efficient frameworks for economic exchange [North 1986]. Drawing on both theoretical and empirical assertions, this study hypothesizes that an adequate, adaptable and supportive legal environment should have a positive impact on e-commerce adoption, as follows:

H2. The more effective is the legal environment for e-commerce in a country, the more extensive is the e-commerce adoption in that country.

4.3. Socio-cultural Infrastructure

In IT adoption research, there is a growing interest in the role of social and cultural values. Researchers argue that national culture plays an important role in determining not only whether social entities in a particular country would adopt a certain technology, but also the degree to which technology innovation was accepted and the ways in which it was used [Harris et al. 1999; Thatcher et al. 2006].

Studies in different countries reflect this viewpoint. In the Arab world, for example, cultural beliefs and values were significantly related to IT adoption—the more compatible the culture, the more IT adoption [Straub et al. 2001]. Hill et al. found that communicating via technological means was not desirable in Arabian countries since it ran counter to the affective nature of communication [Hill et al. 1998]. Goodman et al. also found that cultural factors were one of the main explanations for the lack of IT diffusion in the Middle East because the Western assumptions that free movement of information had positive connotations violated the social and cultural environments of many Middle Eastern countries [Goodman et al. 1992].

In another example, Guanxi, which refers to the personal network in Chinese societies, was deemed one of the most important assets for doing business. It was the reciprocal interdependencies that resulted from the interpersonal relationships that were important in business relationships [Thatcher et al. 2006]. However, e-commerce automated business processes that were traditionally done either face-to-face or between individuals who had established business relationships. Therefore, it was generally believed that e-commerce was not compatible with Chinese culture, in which there was a lack of trust in impersonal business interaction and a preference for personalized commercial transactions. Focus group participants in the APEC's e-commerce study cited similar culture-related factors contributing to low levels of e-commerce use in Taiwan: a cultural preference for more traditional business practices involving face-to-face contact between buyer and seller, the lack of comfort with online activities particularly involving cash transactions, and the language barriers [PWC 1999].

E-commerce also requires a willingness of consumers and companies to freely share information with others. Culture might thus become a factor which either encourages or inhibits the sharing of information online [Shore 2001]. For example, Burn found that there were a number of cultural inhibitors to the development of a public EDI service in Hong Kong. One of the inhibitors was the unwillingness of organizations to share information and extend their business chains through other organizational networks [Burn 1995].

Despite the limited literature shown above, much e-commerce adoption research does not typically include the socio-cultural variable, in part because of the difficulties in measuring cultural dimensions. A handful of research on the impact of corporate culture on IT adoption might provide a useful viewpoint, but ethnic or national cultures undoubtedly have a special character [Straub et al. 1997]. With an increasing emphasis on IT diffusion in the context of globalization, there is a pressing need to discuss potential national cultural impacts as well as empirically check for their significance [Maitland et al. 2001].

At a theoretical level, institutionalists question whether social entities' choices and preferences could be properly understood outside of the cultural framework in which they are embedded [DiMaggio et al. 1991a]. One aspect of institutional theory posited that such preferences arising from cultural biases, in turn, shape positions and preferences in social processes [Douglas 1986]. New institutionalism has already included social norms and cultural beliefs as a primary component of the institutional environment. Based on the theoretical assertions and limited research that has been conducted to date, there is a reason to believe that connections do exist between socio-culture and e-commerce adoption. Therefore, a socio-culture dimension is incorporated into the research model and it is hypothesized to have a positive impact on e-commerce adoption, as follows:

H3. The more compatible is the socio-cultural infrastructure with e-commerce in a country, the more extensive is the e-commerce adoption in that country.

5. Research Methodology
5.1. Use of Secondary Data

The data collected by other research institutions, government agencies or international bodies are called "secondary data" or "archival data". Secondary data analysis is especially appropriate for studies that cover large numbers of countries over time [Hakim 2000]. Some scholars argue that the intelligent use of secondary data sets plays a significant role in the development of research continuity and the accumulation of knowledge in IS research [Kraemer 1991]. Furthermore, since secondary data is collected by a different organization, the analyst has only minimal impact on the data collection process and thus there is minimal researcher bias in the analysis [Gurbaxani et al. 1991]. Given these advantages provided by secondary analysis, there are several calls for employing secondary data in IS research [Gurbaxani et al. 1991; Lucas 1991]. However, secondary data analysis is still rare so far in IT adoption literature.

This study uses secondary data collected and compiled by the UK-based Economist Intelligence Unit (EIU), a well-respected global research and advisory institute. The EIU has published an annual e-readiness ranking since 2000. A country's e-readiness is essentially a set of measures of its e-business environment (including legal, policy and culture environments) which is conducive to its e-commerce adoption. The earliest available data for this study was collected in 2003 and the latest data was collected in 2007.

5.2. Multi-time Points Approach

Unlike most cross-sectional analyses that take place at a single point in time, this study involved a series of data collections and measurements at multiple points in time. Phase-I of the data collection occurred in 2003. It represented the early stage of e-commerce adoption—the private sector began to adopt innovative business models and governments around the world began to take e-commerce into account in formatting economic policies. Phase-II of the data collection occurred in 2007. This data represents a snapshot of the more recent developments of e-commerce and the national information ecologies around the world. This study repeated the secondary analysis in Phase-II to test the same (or similar) hypotheses as in Phase-I. It is particularly important and interesting to see

whether the impact of the national information ecology on e-commerce adoption differs when e-commerce was seen as something innovative from when e-commerce is seen as something routine. This temporal approach to observe the transformation of the influence of national information ecology over time provides a better basis for causal inference than a single cross-sectional study does [Jupp 2006]. It also enhances the comprehension and explanation of the institutional circumstances that affect global e-commerce diffusion.

5.3. Sample

The samples in both phases represented an exhaustive set of countries for which reliable national aggregated data were available at the time of data collection.

5.3.1. *Phase-I (2003)*

The unit of analysis in this study was the country. There were 60 countries (N1=60) in the EIU E-readiness Rankings of 2003. This sample covered the world's 60 largest economies, which accounted for 95% of global GDP [EIU 2001].

5.3.2. *Phase-II (2007)*

EIU extended its 2007 e-readiness rankings to 69 countries (N2=69), including the original 60 countries in Phase-I. For EIU, it simply means data from more countries were available to compile the ranking; for this study, it means the sample size in Phase-II increased by 15%. Since the findings of this study are based on the statistical inferences drawn from the later regression analysis, the larger sample size implies a more representative and meaningful result in Phase-II. In the meantime, the statistical results in Phase-II are still applicable to the 60 countries in Phase-I.

5.4. Measurement Items

5.4.1. *Phase-I (2003)*

The e-readiness rankings in the EIU's report were composite scores from aggregating scores in several distinct categories, and these categories in turn were aggregated scores of nearly 100 quantitative and qualitative observable criteria. The majority of original data were sourced from the EIU's regularly calculated Country Forecasts. Those national forecast indicators were scored on a scale from 1 to 10, reflecting qualitative assessments by the EIU's extensive network of country analysts and reviewed by the EIU's top economist team [EIU 2001; EIU 2003]. For this study, three composite indices were selected and shown in Table 1.

Table 1: Measurement Items Used in Phase-I

Composite Indices	Measurement Items
Legal and policy environment	1. Overall political environment; 2. Policy towards private property; 3. Government vision regarding digital-age advances; 4. Government financial support of Internet infrastructure projects; 5. Effectiveness of traditional legal framework; 6. Laws covering the Internet; 7. Level of censorship; 8. Ease of registering a new business.
Social and cultural infrastructure	1. Level of education and literacy; 2. Level of Internet literacy; 3. Degree of entrepreneurship; 4. Technical skills of workforce.
Consumer and business adoption	1. National spending on IT as proportion of GDP; 2. Level of e-business development; 3. Degree of online commerce; 4. Quality of logistics and delivery systems; 5. Availability of corporate finance for IT.

EIU's 2003 e-readiness rankings scored the "legal and policy environment" of a country by assessing this country's overall legal framework and specific laws governing Internet use. In addition, governments that supported the creation of an Internet-conducive legal environment—through policy and enforcement—get high scores. The "social and cultural infrastructure" of a country was assessed by looking at literacy and education levels that were necessary for e-commerce adoption. It also considered a population's "e-literacy"—its experience using the Internet and its receptivity to it. The national proclivity to innovation and entrepreneurship was assessed as well. As for the "consumer and business adoption", the e-readiness rankings assessed how prevalent e-commerce practices in each

country, such as the share of commerce conducted online, the extent of Internet usage for business processes, the online logistics and payment systems, and the investment in IT.

5.4.2. *Phase-II (2007)*

The EIU repeated its measurement at annual intervals and the index frameworks used for the analyses were constant from one year to the next. However, the variables in the rankings have been continuously updated and refined from year to year. This was due to the dynamism of the IT developments and the need to review the appropriate set of measurements in order to improve the data quality. The revisions made in the Phase-II measurements better match the research model we test in this paper than the Phase-I measurements.

Compared with the items used at Phase-I, several new ranking criteria were introduced to the EIU's e-readiness model in 2007. As a reflection of its greater emphasis on the role of governments in fostering e-business, the EIU isolated the effect of government policy from the original category of "legal and policy environment" and created its own category called "government policy and vision". Consequently, the legal environment index had been refined to reflect a more focused look at the specific regulatory frameworks that influenced e-adoption [EIU 2007]. The whole process of refinement was undertaken by the EIU analyst panel led by the director of global technology research. All assessments were, in turn, reviewed by the EIU's senior economist team. All Phase-II measurement items used in this study are shown in Table 2.

Table 2: Measurement Items Used in Phase-II

Composite Indices	Measurement Items
Government policy and vision	1. Government spending on IT as a proportion of GDP; 2*. National digital development strategy; 3*. E-government strategy; 4*. Government online procurement.
Legal environment	1. Effectiveness of traditional legal framework; 2. Laws covering the Internet; 3. Level of censorship; 4. Ease of registering a new business.
Social and cultural infrastructure	1. Level of education; 2. Level of Internet literacy; 3. Degree of entrepreneurship; 4. Technical skills of workforce; 5*. Degree of innovation.
Consumer and business adoption	1. Consumer spending on ICT per capita; 2. Level of e-business development; 3. Level of online commerce; 4*. Availability of online public services for citizens and businesses.

*: New measurement item when compared with 2003 e-readiness rankings.

5.5. Variable List

5.5.1. *Phase-I (2003)*

The first IV (independent variable) in the Phase-I data analysis was defined as *legal and policy environment* (LE+GP), using the composite index of "legal and policy environment" in EIU's 2003 e-readiness rankings. The second IV was defined as *social & culture infrastructure* (SCI), using the "social and cultural infrastructure" index in the rankings. The DV (dependent variable) was defined as *e-commerce adoption* (EA), using the "consumer and business adoption" index.

E-commerce adoption as well as legal and policy environments are commonly believed to correlate with the level of economic development in a country [Oxley et al. 2001]. It is thus important to control for this aspect of country difference. The *GDP per capita* (GDPPP) of each country was used as the control variable (CV). The GDP data were obtained from IMF (International Monetary Fund).

5.5.2. *Phase-II (2007)*

There were three IVs at Phase-II: LE (*legal environment*), GP (*government policy*), and SCI (*social & cultural infrastructure*). The DV and CV remained the same at Phase II: EA (*e-commerce adoption*) and GDPPP (*GDP per capita*).

5.6. Validity and Reliability

In this study, we effectively assumed that the secondary (published) data from the EIU had undergone rigorous statistic tests and were thus reliable and accurate [Ethridge 2004][1].

6. Data Analyses and Results

6.1. Phase-I (2003)

6.1.1. *Descriptive statistics and testing of assumptions*

The descriptive statistics of the IVs and DV in the EIU 2003 data analysis are shown in Table 3. There were no extreme values outside the range of plus or minus 3 standard deviations from the mean in both IVs and DV. However, due to several outliers, all three variables were not normally distributed. After 12 cases were dropped, all variables' distribution statistics fell in the normality range of -2 to +2. Both the ANOVA test of linearity and the linear curve fitting scatterplot show the linear association between each IV and the DV.

Table 3: Descriptive statistics of the EIU 2003 data (N1=60)

Variable	Item	Mean	Minimum	Maximum	Std. Deviation
LE+GP	Legal & policy environment	6.34	2.10	8.90	2.07
SCI	Social & cultural infrastructure	6.47	2.50	9.30	1.96
EA	E-commerce adoption	5.51	1.00	9.10	2.47

A partial correlation between the legal & policy factor and the social & culture factor, controlling for GDP per capita, was run to check the multicollinearity between the two IVs. The correlation was 0.641, which was below the cutoff value of 0.8. It thus did not signal a possible multicollinearity problem. Lastly, the runs test showed that the assumption of randomness of the sample of the EIU 2003 dataset could be established.

6.1.2. *Pearson's correlations and partial correlations*

The Tukey's nonadditivity significance = 1.000, which showed that there were no interaction effects between the two IVs. The Pearson's correlation results are presented in Table 4. Both legal & policy environment and social & cultural infrastructure had strong positive linear relationships with e-commerce adoption. Both correlations were statistically significant at $p<0.01$ level (a p value of less than 0.025 was required). The result showed that whenever the country had more supportive legal & policy environment or more compatible social & culture infrastructure, e-commerce was more prevalent in that country. The legal & policy factor explained about 87% of the variance in e-commerce adoption in different countries, while the cultural factor explained 83%.

Table 4: Pearson's correlations between each IV and DV in the EIU 2003 data (N1=48)

	E-commerce adoption
Supportive legal & policy environment	0.931**
Social & cultural compatibility	0.910**

**$p<0.01$

A similar partial correlation result showed that both IVs had significant correlations with e-commerce adoption, even after the variance explained by GDP per capita and another IV had been removed. Legal & policy environment uniquely accounted for about 39% of the variance in e-commerce adoption, while social & cultural infrastructure uniquely accounted for 9% variance of e-commerce adoption.

6.1.3. *Multiple regression model*

Based on the research model and its relevant hypotheses, the multiple regression equation using the EIU 2003 data was specified as following:

$$\text{E-commerce adoption} = b1 * \text{legal \& policy environment} + b2 * \text{social \& cultural infrastructure}$$
$$+ b3 * \text{GDP per capita} + c + e \qquad (1)$$

First, all residual statistics were used to check for multivariate outliers. One influential outlier of Brazil was dropped. After that, the leverage values of all cases passed the criterion of 0.5. The Mahalanobis distances of all cases were less than 23 (= 0.5 * 46). The Cook's distances of all cases were below the cutoff line of 1. All cases had |DfBeta values| < 1. Finally, no standardized residuals lay outside the range of -3.3 to 3.3.

Second, a simple residual plot of standardized residuals against standardized predicted values of e-commerce adoption was used to check the random pattern and no problem was found of nonlinearity and heteroscedasticity.

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[1] Detailed information about how the indicators were developed, measured and collected can be found in the EIU publications of the E-readiness Rankings 2003 and 2007.

Third, the coefficient correlation between the legal & policy factor and the social & cultural factor was -0.641, the absolute value of which was lower than the criterion of 0.7. The correlation between each IV and the control variable was also below 0.6. No VIF values exceeded the criterion of 10 and no condition indices in the formal collinearity diagnostics approached 10. Therefore, we determined that multicollinearity was not a serious issue here.

Fourth, both the histogram and P-P plot of the standardized residuals of e-commerce adoption were used to check whether the errors were normally distributed. Both showed adequate normality. The formal Shapiro-Wilk test also confirmed the normal distribution of the residual (W=0.988, Sig.=0.910).

Lastly, the Durbin-Watson statistic was 1.943, close enough to 2 to show the absence of autocorrelations and thus the independence of all cases.

As all assumptions had been met, the final multiple regression model was run and is shown in Tables 5-1 and 5-2. The results show that both legal & policy environment and social & cultural infrastructure are significant predictors of e-commerce adoption ($p<0.05$) in 47 countries of the EIU sample in 2003. The positive coefficients of both IVs confirm their roles as e-commerce facilitators. Whenever the legal & policy factor increased 1 standard deviation and other independents (including GDP per capita) were held constant, the average amount of e-commerce adoption would increase by a 0.556 standard deviation. Whenever the social & cultural factor increased 1 standard deviation, the e-commerce adoption would increase by a 0.288 standard deviation. The relative importance of the two IVs in predicting a country's e-commerce adoption in this given model was 1.9:1, corresponding to the ratio of unique contributions of legal & policy environment and social & cultural compatibility. The former factor was almost twice as important as the latter factor. It was also notable that the standard error for each regression coefficient was low, making the confidence interval narrow and indicating a good prediction.

Table 5-1: Multiple regression coefficients for the EIU 2003 data

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.020	.075		-.263	.794
	Zscore: Log (GDP per capita)	.856	.075	.862	11.409	.000
2	(Constant)	-.020	.043		-.479	.634
	Zscore: Log (GDP per capita)	.153	.091	.154	1.678	.101
	Zscore: Supportive legal & policy environment	.552	.097	.556	5.716	.000
	Zscore: Social & cultural compatibility	.286	.118	.288	2.427	.019

a. Dependent Variable: Zscore: E-commerce adoption

b. Selecting only cases for which CaseID ~= 7

Accordingly, the original regression equation (1) could be re-specified using the regression coefficients as following:

E-commerce adoption = 0.552 * legal & policy environment + 0.286 * social & cultural infrastructure

$$+ 0.153 * Log (GDP per capita) - 0.020 + e \qquad (2)$$

Note: All variables in this equation are standardized scores.

In the model summary (see Table 5-2), R^2 in the full regression model (with both IVs and control variable) showed that 92% of the variance in e-commerce adoption in the EIU 2003 sample was explained jointly by legal & policy environment, social & cultural infrastructure and GDP per capita, an almost 18% increase compared with the first model with only the control variable. The significant change of F value further confirmed the significance of adding the two IVs into the regression model in addition to the control variable and constant. In another ANOVA test, the significance of the F value itself was also below 0.01, so the overall regression model was significantly better than would be expected by chance and we can reject the null hypothesis of no linear relationship of e-commerce adoption to the three independents. Moreover, the standard error of the estimate was 0.29 units, which was remarkably less than the standard deviation of the dependent variable and thus an indicator of goodness of the model. We can therefore be 95% confident that the actual mean of e-commerce adoption would be within plus or minus 1.96*0.29 = 0.57 units around the observed mean of this sample.

Table 5-2: Multiple regression model of the EIU 2003 data

Model	R CaseID ~= 7 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.862ª	.743	.737	.51403323	.743	130.164	1	45	.000
2	.959ᵇ	.920	.915	.29284018	.177	47.827	2	43	.000

a. Predictors: (Constant), Zscore: Log (GDP per capita)

b. Predictors: (Constant), Zscore: Log (GDP per capita), Zscore: Supportive legal & policy environment, Zscore: Social & cultural compatibility

6.2. Phase-II (2007)

6.2.1. *Descriptive statistics*

The descriptive statistics of the variables used in the EIU 2007 data analysis are shown in Table 6.

Table 6: Descriptive statistics of the EIU 2007 data (N2=69)

Variable	Item	Minimum	Maximum	Mean	Std. Deviation
LE	Legal environment	2.10	9.70	6.73	1.84
GP	Government policy & vision	2.50	9.85	6.33	2.08
SCI	Social & cultural infrastructure	3.00	8.80	6.01	1.53
EA	E-commerce adoption	2.50	9.50	6.37	2.08

Since several variables had the normality problem in this EIU dataset, transformation was necessary and performed using different normalizing methods. Specifically speaking, the square root was used to transform the variables of governmental support and social & cultural compatibility plus 0.5; quartic root was used to transform e-commerce adoption; and power of 2 was used to transform legal environment plus a constant of 0.5. After transformation, all variables' distribution statistics fell in the normality range of -2 to +2.

Both the ANOVA test of linearity and the linear curve fitting scatterplot show a linear association between each IV and e-commerce adoption. The runs test showed the randomness of the sample of the EIU 2007 dataset.

6.2.2. *Pearson's correlations and partial correlations*

First, the Tukey's nonadditivity significance of three IVs was 0.957, showing no interaction effects between them. Second, Pearson's correlation results were presented in Table 7. All IVs had strong positive linear relationships with e-commerce adoption. All three correlations were statistically significant at $p<0.01$ level (a p value of less than 0.017 was required). Whenever the country had a more supportive legal environment, more governmental support, and more compatible social culture, the actual utilization and implementation of e-commerce was at a higher level in that country. The legal, governmental and cultural factors could in turn explain about 77%, 82% and 82% of the variance in e-commerce adoption in different countries, in their respective linear relationships with e-commerce.

Table 7: Pearson's correlations between IVs and DV in the EIU 2007 data (N2=69)

	E-commerce adoption
Legal environment	0.881**
Government policy & vision	0.910**
Social & cultural infrastructure	0.909**

**$p<0.01$

In the partial correlation, the result showed that government policy & vision had a significant correlation with e-commerce adoption; social & cultural infrastructure also showed a significant correlation with e-commerce adoption; however, the relationship between legal environment and e-commerce adoption became insignificant after controlling for other effects. Government policy & vision accounted for about 22% of the variance in e-commerce adoption and social & cultural infrastructure accounted for 7% of the variance in e-commerce adoption.

6.2.3. *Multiple regression model*

Based on the research model and its relevant hypotheses, the multiple regression equation using the EIU 2007 data was specified as follows:

E-commerce adoption= b1 * legal environment + b2 * government policy + b3 * social & cultural compatibility

+ b4 * GDP per capita + c + e   (3)

First, all residuals statistics were used to check for multivariate outliers. No outliers were identified; however, the case of Bermuda was excluded from the analysis due to its missing value on GDP per capita. Second, the simple residual plot showed a random pattern and thus no problems of nonlinearity and heteroscedasticity. Third, the multicollinearity problem was assessed in several ways. The absolute values of coefficient correlations between four independents were all below 0.6. All VIF values were less than 10 and no condition indices approached 10. Fourth, although the histogram of standardized residuals failed to show a good normal curve, the normal P-P plot of the standardized residuals showed close enough normality and the formal Shapiro-Wilk test confirmed the normal distribution of the standardized residuals (W=0.977, Sig.=0.244). Lastly, the Durbin-Watson statistic was 1.743, within the range between 1.5 and 2.5 and showing the independence of all cases.

The final multiple regression model is shown in Tables 8-1 and 8-2. Government policy was the most significant predictor of e-commerce adoption ($p<0.01$) in 68 countries of the EIU sample in 2007. Social & cultural infrastructure was also marginally significant ($p<0.1$). The positive coefficients of both IVs confirmed their roles as e-commerce facilitators. The effect of the legal environment on e-commerce adoption was not significant. The relative importance of three IVs in predicting a country's e-commerce usage in this given model was about 2.9:1.4:1, corresponding to the ratio of unique contributions of government policy, social & cultural infrastructure, and legal environment, respectively.

Table 8-1: Multiple regression coefficients for the EIU 2007 data

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.073E-15	.057		.000	1.000
	Zscore: Log (GDP per capita)	.884	.058	.884	15.330	.000
2	(Constant)	1.178E-15	.036		.000	1.000
	Zscore: Log (GDP per capita)	.329	.073	.329	4.524	.000
	Zscore: Power of 2 (supportive legal environment+0.5)	.131	.086	.131	1.531	.131
	Zscore: Sqrt (Governmental support)	.379	.088	.379	4.303	.000
	Zscore: Sqrt (Social & cultural compatibility+0.5)	.184	.095	.184	1.942	.057

a. Dependent Variable: Zscore: Quartic root (E-commerce adoption)

Accordingly, the original regression equation (3) is re-specified using the regression coefficients as follows:

$$\text{Quartic root (E-commerce adoption)} = 0.131 * \text{Power of 2 (legal environment+0.5)}$$
$$+ 0.379 * \text{Sqrt (government policy)}$$
$$+ 0.184 * \text{Sqrt (social \& cultural infrastructure+0.5)}$$
$$+ 0.329 * \text{Log (GDP per capita)} + e \qquad (4)$$

Note: All variables in this equation are standardized scores.

In the model summary (see Table 8-2), R^2 in the full regression model (with all three IVs and control variable) indicated that 91% of the variance in e-commerce adoption in the EIU 2007 sample was explained jointly by legal environment, government policy, social & cultural infrastructure and GDP per capita. There was a 14% increase compared with the first model with only the control variable. The significant change of F value further confirmed the significance of adding the three IVs into the regression model. In another ANOVA table, the significance of the F value itself was also below 0.01, so the overall regression model was significantly better than would be expected by chance and we reject the null hypothesis of no linear relationship of e-commerce adoption to the four independent variables.

Table 8-2: Multiple regression model of the EIU 2007 data

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.884ª	.781	.777	.47178898	.781	235.009	1	66	.000
2	.958ᵇ	.918	.913	.29516977	.137	35.205	3	63	.000

a. Predictors: (Constant), Zscore: Log (GDP per capita)

b. Predictors: (Constant), Zscore: Log (GDP per capita), Zscore: Power of 2 (supportive legal environment+0.5), Zscore: Sqrt (Governmental support), Zscore: Sqrt (Social & cultural compatibility+0.5)

The standard error of the estimate was 0.30 units, which was much less than the standard deviation of the dependent variable and thus an indicator of the goodness of the model. We could be therefore 95% confident that the actual mean of e-commerce adoption would be within plus or minus 1.96*0.30 = 0.59 unit around the observed mean of this sample.

6.3. Cross-phase Data Analysis on the Laggard Effects of Institutional Factors

Legal and regulatory changes, government policies and programs, and even social and cultural transformation are commonly believed to be slower than the technological developments in our society. It was theoretically necessary to test whether the national information environment had lagging effects on e-commerce adoption. The availability of secondary data in two phases provided us with the opportunity to check the time-sensitive impacts of institutional environments. Similar to the concept of two-stage regression analysis, we used the independent variables in Phase I (2003) to assess their predictabilities on the dependent variable of e-commerce adoption in Phase II (2007). The time interval of four years should be appropriate for testing the institutional environments at a macro-level. If one factor had no remarkable impact on e-commerce in the early phase but had a significant effect in the second phase, we would conclude that the institutional factor had a laggard effect on e-commerce.

Accordingly, two IVs in the EIU 2003 dataset, legal & policy environment and social & cultural infrastructure, replaced the independents in the EIU 2007 dataset. The DV of e-commerce adoption and control variable of GDP per capita used in the 2007 dataset remained in the cross-phase analysis. We began with a sample size of 60 countries, which were all cases in both the 2003 and 2007 datasets.

The square root transformation was performed on e-commerce adoption minus 0.5 and two outliers were dropped. The Tukey's nonadditivity significance of two IVs was 1.000 so we assume there are no interaction effects. Both Pearson's correlations and partial correlations between each IV and DV are shown in Table 9. Social & cultural infrastructure in 2003 had a significant positive relationship with e-commerce adoption in the year of 2007. The effect size of their correlations became even stronger in 2007. On the other hand, the relationship between legal & policy environment and e-commerce adoption was weakened in 2007, although it was still positive and marginally significant.

Table 9: Correlations between each IV and DV in the EIU cross-phase analysis

E-commerce adoption 2007	Legal & policy environment 2003	Social & cultural infrastructure 2003
Pearson's correlation	0.900**	0.936**
Partial correlation	0.263*	0.452**

**$p<0.01$; *$p<0.1$

Multiple regression was then performed with the cross-phase dataset. After one influential outlier of Iran was dropped, the final regression result is shown in Table 10. Compared with the result in the original EIU 2003 analysis, both the legal & policy factor and the social & cultural factor were significant predictors in the years of 2003 and 2007.

Table 10: Multiple regression coefficients for the EIU cross-phase analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.026	.057		.457	.649
	Zscore: Log (GDP per capita 2006)	.868	.057	.899	15.200	.000
2	(Constant)	.023	.037		.607	.546
	Zscore: Log (GDP per capita 2006)	.251	.081	.260	3.087	.003
	Zscore: Supportive legal & policy environment 2003	.212	.097	.219	2.181	.034
	Zscore: Social & cultural compatibility 2003	.499	.117	.515	4.248	.000

a. Dependent Variable: Zscore: Sqrt (E-commerce adoption-0.5)

b. Selecting only cases for which CaseID ~= 25

6.4. Meta-analysis

First, for each pair of corresponding variables in different phases, the reliability (or consistency), Pearson's correlation, and mean difference of the measurement across two phases were evaluated. The results are shown as follows in Table 11 for the EIU 60 countries sample.

Table 11: Paired variables statistics of the EIU sample (N=60)

	Variables	Cronbach's alpha on standardized items	Pearson's correlation	Mean difference	Std. deviation	Std. error mean	t
Pair 1	Legal environment 2003—2007	0.967	0.935**	-0.363	0.734	0.095	-3.825**
Pair 2	Government policy 2003—2007	0.950	0.904**	-0.025	0.931	0.120	-0.208
Pair 3	Social & cultural infrastructure 2003—2007	0.973	0.947**	0.443	0.671	0.087	5.116**
Pair 4	E-commerce adoption 2003—2007	0.969	0.940**	-0.832	0.863	0.111	-7.461**

**$p<0.01$

The results indicate that the measurements used in the secondary analyses for the legal, governmental and cultural factors are consistent and accurate across different points of time. The results also reveal that e-commerce adoption and legal environment improved significantly over the past four years around the world, while governmental support did not show a significant increase and the social & cultural infrastructure had been found significantly less compatible with e-commerce adoption between 2003 and 2007.

After evaluating all the variables across time, the standardized multiple regression coefficients of these variables for e-commerce adoption across time are summarized in Table 12. In sum, the results show that the government factor and the cultural factor are both important facilitators of global e-commerce adoption over the past four years. The effect of the legal environment, however, had faded away.

Table 11: Meta-analytic table of regression coefficients of all secondary analyses

	Phase I	Phase II	Cross-phase
Independent variable	EIU 2003 (N1=47)	EIU 2007 (N2=68)	EIU (N=59)
Government policy	0.556***	0.379***	0.219**
Legal environment		Insig.	
Social & cultural infrastructure	0.288**	0.184*	0.515***

***$p<0.01$; **$p<0.05$; *$p<0.1$

7. Discussion and Conclusion
7.1. Discussion of Findings
7.1.1. *Phase-I (2003)*

The secondary data analysis at this phase confirmed strongly the research hypotheses with respect to legal & policy environment and social & culture infrastructure (see Table 12). In other words, the supportive legal framework and government policy did exert a substantial positive impact on e-commerce adoption around the world at the startup stage of e-commerce (the worldwide average score for e-commerce was only 5.51 out of 10 in the EIU 2003 dataset). Government promotions, financial incentives and encouraging policies fostered companies in many countries to engage in e-commerce around 2003. This finding proved the critical role of government in driving companies' investment in e-commerce. Meanwhile, if a national legal system was adequate and effective for e-commerce practice, consumers and businesses in that country might have more confidence to engage in e-commerce operations. A good legal system is a safeguard for online commercial transactions.

The finding also suggested that the social and cultural value is a significant factor of national information ecology in e-commerce adoption. If a national culture is compatible with e-commerce practices, it is likely to support e-commerce initiatives in that country.

Table 12: Summary of hypotheses and results at Phase-I

Hypothesis	Independent variable	Measurements for IV	Dependent variable	Supported	Effect size
H1	Government policy	• Government priority/ vision • Government promotion • Government role model		Yes	0.56***
H2	Legal environment	• Supportive/effective legal framework • E-commerce laws	E-commerce adoption	Yes	0.56***
H3	Social & culture infrastructure	• National "e-literacy"		Yes	0.29**

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

7.1.2. *Phase-II (2007)*

The worldwide average score for e-commerce diffusion improved in 2007 (6.37 out of 10 in the EIU dataset). The research finding at this phase (see Table 13) showed that, as e-commerce became more prevalent in the world, supportive government policy and cultural infrastructure still provided powerful explanations for variations in e-commerce adoption around the world. On the other hand, the impact of the legal environment was reduced. A possible explanation from the perspective of institutionalism is that a predictive and effective legal environment was important to reduce the institutional uncertainty and ensure the trust and confidence in e-commerce activities during the initial stage of e-commerce development. Nevertheless, the encouraging influence of legal environment would be diminished as people understand e-commerce better and e-commerce becomes a common practice in the society.

Table 13: Summary of hypotheses and results at Phase-II

Hypothesis	Independent variable	Measurements for IV	Dependent variable	Supported	Effect size
H1	Government policy	• Government priority/ vision • Government promotion • Government role model		Yes	0.38***
H2	Legal environment	• Supportive/effective legal framework • E-commerce laws	E-commerce adoption	No	0.13
H3	Social & culture infrastructure	• National "e-literacy"		Yes	0.18*

*: $p<0.1$; ***. $p<0.01$.

7.2. Managerial Implications

Davenport expounded that all companies must be informed about the outside world, such as what regulators insist they do [Davenport 1997b]. The external environments can consequently motivate organizational decisions and actions. Consistently, this study shows managers that consumers and businesses do not make their e-commerce decisions independent of their external environments, nor are they powerful enough to ignore the external environment. Managers play the role of organizational architects who design an organization in a way that improves

its ability to adapt to its environment [Ancona et al. 2001]. They should therefore ensure that they are well-informed of the national information ecology, including government policies and initiatives, legal and regulatory changes, and local culture values. Based on the information and understanding of the external environment, managers should be able to design and implement their "e-strategies" that "fit" the environment and the e-strategies could be more efficient and successful. Managers will expect congruence or "institutional isomorphism" of e-commerce in businesses. If this is the case, managers could also expect the maximization of benefits offered by e-commerce.

7.3. Policy Implications

An effective research project is not only used to explain and predict social phenomena, but also to help humans achieve social objectives through yielding useful policy recommendations [Evera 1997]. All sound policy prescriptions should rely on a solid theory base, valid data analysis, and rational discussion. In reality, however, policymakers generally lack adequate scientific evidence and knowledge for making crucial decisions on e-commerce development. The application of institutional theory in e-commerce adoption and the empirical findings in this study have a clear relevance to policy makers. If we understand better at the theoretical level how institutional factors affect e-commerce adoption, we then have the basis for a conditional prediction in the real world on how e-commerce will develop in certain national information ecology. It will help policy makers to formulate appropriate policies to accelerate e-commerce adoption.

Experience has taught us that it is important to build a friendly climate for innovation diffusion. The effects of the national information ecology will depend to a significant extent on how policy-makers, business players and other stakeholders act. Policies must be designed, articulated in coherent e-strategies and implemented in partnership with all relevant players to ensure that the opportunities provided by e-commerce are taken advantage of to improve the productivity of national economy and the enterprises within it [UNCTAD 2001]. In our study, e-commerce adoption at the startup stage could be credited to supportive legal environments and government policies. In particular, proactive government policies were the prime mover of e-commerce in many developing countries, and it is still a driving force of e-commerce adoption today.

The fosterage of government policy is summarized as follows. First, government policies that encourage investment in IT adoption, particularly the financial incentives, are stimulating to e-commerce development. Second, government efforts to promote an open and free trade environment, including deregulating telecom markets, improving IT infrastructure, and conducting e-procurement itself, will encourage e-commerce adoption and diffusion. Third, government's assurance on recognizing e-contracts and providing legitimate legal frameworks will facilitate e-commerce activities. Fourth, government's educational and training program will foster "e-literacy" and greater awareness of e-commerce among businesses. Last, cooperation between government and private sector is a key to e-commerce.

This study also shows that the lack of an adequate legal framework might be a concern for engaging in e-commerce at first, but that the lack thereof would not deter the society from further e-commerce diffusion. Thus, after an initial push on e-commerce adoption, legislation should not interfere directly in private investments in e-commerce unless there is a clear sign of market uncertainty and disturbance. The representative example here is the U.S. E-commerce has flourished in the U.S. for many years without much legislative intervention.

7.4. Limitations and Recommendations for Future Research

Designing and conducting such a series of empirical studies on the relationship between national information ecology and e-commerce adoption over time is extremely difficult, partially because any kind of influence of environmental factors is hard to observe and measure. Using and analyzing secondary data also reveals some weaknesses. Measurements were not always consistent from one time period to another and certain variables did not perfectly match the research model.

The evidence provided in this study is relevant to the specific case of e-commerce adoption. It will be interesting and valuable to assess whether and how this outcome and relationship between national information ecology and e-commerce holds in other cases. Therefore, future studies could extend the dependent variable from e-commerce to general IT adoption and innovation, and to intellectual property (such as open source movement) and outsourcing activities.

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