What drives global ICT adoption? Analysis and research directions

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A B S T R A C T

Information and communication technology (ICT) adoption is increasing globally and offers unique opportunities for information systems (IS) and electronic commerce researchers to undertake research that will have an impact. The purpose of this article is to survey the academic literature on this topic and provide research directions for future work. We analyze economic, social and other factors that drive global ICT adoption and the individual, organizational, industry and economy impacts. We do this with respect to a set of relevant problems, technology opportunities, theories, research methods, and solutions. The integration of these areas enables us to establish a balanced picture of the current state of global ICT adoption research. It also offers a useful means to analyze the kinds of research that needs to be pursued to make additional progress in the related area of e-commerce research. With these ideas in mind, we present five emerging research directions in three different categories: new economic geography, rational expectations theory, and new empirical methods. We also analyze several topics in the global arena of emerging technologies.

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1. Introduction

Investments in information and communication technologies (ICT) around the world have grown at a staggering rate over the past two decades. Information technology (IT) industry consultant, Gartner, reported that worldwide spending in this area was on the order of US$3.4 trillion in 2010, rising by about 5.3% to US$3.5 trillion in 2011, reflecting a new emphasis on consumer mobile devices, virtualization solutions and security software (Burt 2010). In addition, the United States Census Bureau (2010) recently published survey figures from 46,000 organizations on domestic ICT spending for 2008. ICT expenditures are largely driven by five industries: information, finance and insurance, manufacturing, professional, scientific, and technical services, and health care and social assistance. These five industries account for 74.2% of all ICT spending in the US, and also make a large percentage of their capital expenditures on ICT.

Figures like the ones provided by the US Census Bureau in the 2008 data reveal valuable information on workforce and other costs of production. The information industry (with the two-digit NAICS code 51) capitalized 84% of its ICT spending in 2008, suggesting an emphasis on spending on new ICTs, with a relatively smaller amount of workforce and maintenance costs that were expensed. Comparing the information industry to the manufacturing industry (with two-digit NAICS codes 31, 32 and 33) tells a different story though. The manufacturing industry capitalized only 55% of its ICT spending that year, revealing relatively lower adoption of new technologies and higher spending on its workforce and maintenance of existing systems. The data suggest the high intensity of IT use in the information industry, which is among the most rapidly growing sectors in the US economy. The manufacturing industry, in contrast, has done a lot more spending on ICT over the years, and so its lower proportion of capital spending and technology adoption suggest that there is a lot more maintenance than new investments occurring.

Other countries can expect to see their economies evolve in similar ways. We expect that they will see higher proportional ICT capital spending than maintenance spending for existing systems. They also can expect to feel the impacts of capital and knowledge spillovers (Blöstrom and Kokko 1998, Coe and Helpman 1995), technology-led improvements in productivity and social welfare (Eamon 2004), and other technology-related benefits from foreign direct investment (FDI) (Glass and Saggi 1998). Nevertheless, some developing countries still lag far behind the nations of the developed world. For example, Laos had just four Internet users per 1000 people in its population in 2005 (United Nations Development Programme 2007). As a result, it cannot be expected to compete in a progressively technology-intensive global economy with countries like Sweden, which had 764 Internet users per 1000 people in its population in the same year. This is a potentially insurmountable difference between the two countries – a dramatic “digital divide” – and these kinds of disparities occur around the
world in different nations, in different ways, and to different de-
grees (Hoffman and Novak 1988, Mehra et al. 2004, Pew Internet
2003, Eamon 2004, Dewan et al. 2005). This kind of virtual inequality
is crippling for a country like Laos, considering the necessity of
Internet-based technologies to power all kinds of consumer, orga-
nizational, industry and economy-level activities (Mossberger et al.
2003). Both Laos and Sweden adopt technology in a similar pattern,
although they are in different maturity stages of their adoption and
their industry make-up differs dramatically. ICT adoption and the
capacity of a nation or a geographic region to produce technologi-
cal innovations are of the utmost importance when comparing the
social welfare and economic growth potential between different
countries (Saxenian 1994, 2007, Rai et al. 1998, Kauffman and

Crowded Planet, suggests that sustainable development in the
“network age” is based on eight different contributions from ICT.
The first four are: (1) the ubiquitous connectivity of regions
through ICT to the world of global politics and culture, (2) the
effective division and allocation of local and global labor through
the coordination of work via the Internet, (3) scale size in terms of
the reach and range that ICT offers across networks for global
communication, and (4) global replication of standard processes
supported by ICT. The final four include: (5) ICT’s role in providing
a platform for accountability, monitoring and evaluation of eco-
nomic, healthcare and other human and organizational activities,
(6) the matching of buyers and sellers for economic exchange,
(7) building communities of interest via the tools of social net-
working on the Internet, and (8) education and training in the con-
text of distance learning. Westland (2008) echoes the critical
importance of global technology innovation and adoption, and
the ingredients that need to be in place to create the basis for an
“innovation society” in his book, Global Innovation Management: A
Strategic Approach. Others have discussed the important roles
of regional networks in agglomerations and clusters of firms in dif-
f erent industries, which, along with the role of government poli-
cies, also support technological innovation and economic growth

In spite of the emphasis that these observers have put on
investments in various kinds of technologies, still economists re-
port that we do not truly understand the extent to which ICTs –
or the use of the Internet – are driven by national characteristics
or the presence of different forms of government regulation (Wall-
sten 2003). For example, the growth of technology-based corre-
spondent banking has been reported to have created the
conditions for economic growth and greater prosperity to different
regions in rural Brazil (Diniz et al. 2008). The same observation
holds at the household level, where research efforts have recently
begun to establish a more refined understanding of the key uses
and drivers of Internet adoption (Kraut et al. 1996, 1999, Brown
and Venkatesh 2003, 2005). Returning to the case of Laos, even
though the figures that we quoted are sobering, the numbers alone
are insufficient to analyze and predict the situation there or in
other rapidly developing economies. The new economic geography
theory (Krugman 1998, Ottaviano and Puga 1998, Baldwin and
Martin 2004, Brühlhart and Sbergami 2009) argues that “distance”
is a key economic variable. So it is important to recognize the prox-
imity of Laos to the other East Asian “development miracles” of Ja-
pan, Taiwan and South Korea (Duranton 1999, Parente and Prescott
1994). This sets up the likelihood that these countries will make
investments in Laos and other developing nations in the region,
so there may be an opportunity for Laos to achieve dramatic improvements in its economic growth, based on the involvement of
external partners for trade and development.

For this research, we define information and communication
 technologies (ICT) as technologies that support data and informa-
tion processing, storage and analysis, as well as data and informa-
tion transmission and communication, via the Internet and other
means. ICT adoption occurs in a country when organizations invest
in technology to support their business activities, and when people
begin to use it. In the presence of an increasingly “flat” world, it
is important to study ICT adoption at the multiple levels of the
individual, the organization, the industry and the economy (Friedman
2005). In this article, we will analyze how these levels of impact
are represented in the existing IS and e-commerce literature, as
well as in other literatures that represent the bodies of knowledge
associated with other theoretical perspectives. We also use them
as a lens through which to view and suggest future research. We
do the same with the predictive factors for ICT adoption. We use
factor categories and levels of impact to shape our discussion
and to analyze the existing literature. We also point out where
relationships exist among the factors and the levels of impact,
revealing theory gaps and areas for future research. In addition,
there is also a paramount necessity to understand ICT adoption
in the global context. Changes in the global landscape due to ICT
adoption are numerous and significant, with the growth of digital
wireless phones in Europe and Asia as one of many examples
(Burki and Aslam 2000, Gruber and Verboven 2001, Kauffman and
Techatassanasoontorn 2005a, 2005b).

A visit to a foreign country – especially a developing country –
typically is sufficient to convince most skeptics that the global
spread and diffusion of ICTs is occurring at a high rate and the ef-
effects of their adoption are prominent, even if they are regionally
spotty and path-dependent (Liebowitz and Margolis 1995, Varian
et al. 2004). The motivation for this article stems from our recogni-
tion that the changes in the global landscape of ICT adoption can be
evaluated in a way that will help to reveal the relevant issues and
opportunities for research. We are less interested in ICT adoption
research in specific countries or specific regions than we are in
the general questions that relate to the spectrum of issues about
how global ICT adoption works, and how it can be made to work
even better.

A number of themes occur in this article that we would like to
point out to the reader at the outset. (1) Global economic growth
and social welfare depend on the adoption of technologies that
transform labor efficiency and create value. (2) New technology
adoption predisposes individuals, organizations, industries, and
countries to adopt other kinds of technological innovations that
are beneficial for them. (3) The economics of technology adoption
provides a micro-foundation for understanding how technology
creates value through enhanced economic growth and higher so-
social welfare. (4) Economic, social and other factors seem to influ-
ence adoption differently at each of the levels where impacts
occur: the individual, the organizational, the industry, and the
country levels. (5) In addition, new research in this area provides
new theories, models and methods for explaining the past, inter-
preting the present, and predicting the future of technology adop-
tion. Each of the sections of this article, beginning with Section 3,
strikes a major theme from this list, and touches on some of the
others as well.

The research questions that we seek to answer are: What are
the categories of key factors that drive global ICT adoption? What
are the different levels of analysis at which we can observe pat-
terns of ICT adoption in the global setting? Based on these con-
cepts, and the areas of theory that are available for developing
explanations and predictions, what are the research directions that
emerge? In Section 2, we introduce our research approach, which
includes categories of factors that are related to global technology
adoption. Section 3 discusses a number of theories that are related
to ICT adoption from behavioral and economics research. Section 4
examines research on different kinds of factors that drive or inhibit
ICT adoption in the global context and Section 5 discusses other
research on some of the impacts of global ICT adoption. Section 6 proposes several emerging areas of theory and methodology that may be of interest for future research in the global ICT adoption arena. In Section 7 we discuss the application of our research directions to three emerging areas of technology. We conclude in Section 8 with a discussion of the contributions to theory and practice from the present research.

2. Survey approach

To survey research on the adoption of ICT in the global context, we offer a set of factors and levels of impact for analyzing the literature and determine what conclusions we can draw from it. The properties of such an approach should include elements that can uniquely classify technology adoption problems, the relevant theories and methods, the contents of the studies that are reviewed, and the research directions that are offered.

The adoption factors that these studies recognize can be classified as follows. Economic factors include all income and cost-related factors, including financial, risk, wealth, trade and competition (Pohjola 2003, Xu et al. 2004), and are often relevant in explaining firm performance in different national settings (Zhu and Kraemer 2005). Social factors often are identified by the levels of access to technology and education observed for different groups of people and societies (Hargittai 1999, Robison and Crenshaw 2002). Other factors consist of aspects of a country that also affect technology adoption (Gibbs et al. 2003), including legal factors (laws, regulations, court cases), environmental factors (family, religion, way of life), and cognitive factors (innovativeness of the people, openness to foreign ideas). These three areas of factors reflect a superset of the variables that Dewan et al.’s (2005) survey of dozens of prior studies identified in the area of the global digital divide for technology access.

Research focused on the impacts of global ICT adoption has suggested that these impacts occur at different levels of analysis: at the individual level, the organizational level (firms, standard-setting organizations, non-governmental organizations, and other international organizations), the industry level, and the country level. Our aim here is not to classify the technology adopters themselves. Instead, we aim to identify the different levels at which the impacts of ICT adoption in a country occur. They may include a country’s citizens, its organizations, its domestic industries, or the society and economy as a whole.

We further frame our discussion on global ICT adoption by looking at the related problems, opportunities with technology, relevant research methods, and ways to create solutions. A number of individual, business, social and economic problems that arise can be addressed by the adoption of different kinds of technologies, reflecting different ways to create value through their implementation and use. These are research opportunities that can be taken up through the use of different theory and research methods. As an example, consider the requirements for a study of the impacts of economic factors of technology adoption that involve the production of agricultural products that are increasingly expensive to produce on the farm. This problem arises from the scarcity of natural endowments (including fertile soil and ample water), financial capital (for hybrid seeds, and fertilizers and farm equipment), skilled labor (for veterinary medicine and plant genomics) and relevant technologies that provide decision support. The use of global positioning systems (GPS)-based mapping of nitrogen fertilizer requirements and crop yields in farmers’ fields represents a technology innovation of exceptional potential impact. Technology adoption research in this area can implement a variety of theories for impact evaluation, as well as different research approaches including secondary data collection, empirical analysis, and spatial econometrics, to work toward building an understanding of the leverage for crop yield performance that GPS’s role supports. Finally, the solution to this problem can be framed in such a way that we might come to understand that the farming industry might be able to implement improvements in crop planting and fertilization, achieving land use efficiencies and greater productivity along the way, thus lowering the costs of farm production.

3. Theories of technology adoption

To answer questions of how and why adoption occurs, it is necessary to turn to the available theory. Many theories that deal with technology adoption are not specific to global ICT adoption, yet they still have relevance when we view them in a global context. Some of the theories were specifically designed for use at the aggregate level, in the context of economies and countries. A large stream of technology adoption theory literature has evolved over the years in different disciplines. Some of the perspectives that have been offered are theories about diffusion, and these explain and predict how and why a technology is adopted through different channels. Other theoretical perspectives involve human behavior and the impacts they have on an individual’s willingness to adopt and their likely effectiveness in using a technology. There are also economic theories that explain technology adoption decision-making and firm actions in valuation terms, patterns of technology diffusion in the marketplace that result from information transmission and competition, and the role of technology adoption for the promotion of economic development. Through the findings of the relevant areas of the literature, we can establish some of the key principles that underlie our understanding of global ICT adoption. The major theme of this section is that the economics of technology adoption provides a micro-foundation for understanding how technology creates value by enhancing economic growth and improving social welfare.

3.1. Theories about diffusion

Beal and Bohlen (1957) made two early contributions to technology adoption theory. The first of these categorizes five chronological stages in the diffusion process (see Table 1). Comparisons between countries can be made using the authors’ stages. For example, one country may be in the trial stage of mobile payments technology adoption, while a second country has only just entered into the interest stage. As a result, we would characterize the first country as being farther along towards adoption for mobile payments technology than the second country. The authors also were the first to note differences in adoption timing for technological innovations across countries. Rogers (1995) developed the perspective that countries can be identified in terms of their progress with technology diffusion across five different adopter categories (see Table 2).

Again, comparisons can be made among countries. For example, one country would be an innovator if it were among the first to implement mobile payments technology, while the second country would be in the early majority if it began to adopt the technology at

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<th>Table 1</th>
<th>Beal and Bohlen’s (1957) stages of technology adoption.</th>
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<td>Stage</td>
<td>Stage when a country</td>
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<tr>
<td>Awareness</td>
<td>Learns of the existence of a new technology</td>
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<tr>
<td>Interest</td>
<td>Gathers information on the new technology</td>
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<tr>
<td>Evaluation</td>
<td>Analyzes the new technology</td>
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<tr>
<td>Trial</td>
<td>Tries out the new technology</td>
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<tr>
<td>Adoption</td>
<td>Engages in full-scale use of the technology</td>
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the same time as the majority of other countries. The difference in the timing of adoption among the population of adopters is the emphasis of Rogers’ description of the patterns of adoption.

Rogers’ empirical work showed that adoption follows an S-shaped curve pattern, as we have seen with the Internet (Gurbaxani 1990) and many other technologies. The percentage of technology adopters starts out small and increases, and typically is followed by a rapidly increasing percentage of adopters; however, adoption will level off as greater participation ensues. Every country adopting a new technology is hypothesized to follow this pattern – as well as individuals, organizations, and industries within a country. It also is expected that the pattern will be similar for the global economy, based on how the adoption of specific technologies plays out across countries in the world.

In 1969, Management Science published a much-cited article proposing a theory that would later be referred to as the Bass diffusion model (Bass 1969). The model categorized technology adopters into two categories: innovators and imitators. Innovators in the global ICT adoption context are firms or countries that base their technology adoption decisions independent of the decisions of other firms or countries. Innovators are likely to be earliest adopters or pioneers. Imitators, in contrast, are influenced by other firms or countries in their decisions to adopt. This category is made up of an aggregate of the final four categories in Rogers’ S-curve: the early adopters, the early majority, the late majority, and the laggards. The categories are often depicted graphically as being normally distributed in a bell curve, with the early majority and the late majority accounting for the greatest percentage of adopters. The theory that underlies the Bass diffusion model implies that the timing of a firm’s or a country’s initial adoption of a technology is related to the number of firms or countries that already have purchased the technology. In addition, the observed technology diffusion will grow exponentially to a peak, and then will be followed by a period of exponential decay.

Bass refined his theory 25 years later and introduced endogenous decision variables such as marketing effort and price into a new model, the generalized Bass model (Bass et al. 1994). He concluded that marketing effort and price decision variables affected time to technology adoption. The original model and the newer model only provided the same fit so long as marketing effort remained constant.

Dekimpe et al. (2000) further examined the Bass model’s stages and stated that global adoption is comprised of two separate, but closely linked stages. The first is the implementation stage, which is defined as the time between an innovation’s first availability in the world and its first appearance in a country. The second is the confirmation stage, which is the time between the innovation’s initial trial in a country and its full adoption or substitution. The duration of these two stages has been studied as a means of describing diffusion patterns. The new methodology proposed in the study was referred to as a coupled-hazard approach. It was used to explain the timing of technology diffusion phenomena, including immediate adoption that did not follow the hypothesized S-curve, as we have seen in other recent work by Kauffman and Techatasana-soontorn (2005a). They used this approach to study international diffusion patterns of digital mobile technology. They found fewer adoption driving factors during early diffusion, including GNP per capita and analog mobile phone penetration, than in the partial diffusion stage, where the mobile phone industry competition was more important.

3.2. Theories involving behavioral perspectives

Related theories of technology adoption may be useful to explain and predict adoption outcomes in the global context. Behavioral theories typically focus on the individual analysis level, where human behavior, rather than organizational behavior or aggregate economic behavior, has its impacts.

The theory of reasoned action (Ajzen and Fishbein 1973) posits that attitudes and subjective norms influence behavioral intention. Davis (1989) applied this theory to the individual level of technology adoption behavior. The resulting outcome was one of the most recognizable behavioral theories of technology adoption, the technology acceptance model (TAM). Two key constructs influence an individual’s intention to use a technology: perceived usefulness and perceived ease of use. Extensions to TAM have introduced factors from related models, incorporated alternative belief factors, and examined antecedent and moderating factors to the existing usefulness and ease of use constructs (Venkatesh et al. 2003, Wixom and Todd 2005). An example of this approach resulted in the unified theory of acceptance and use of technology (UTAUT). It uses constructs including performance expectancy, effort expectancy, social influence, and facilitating conditions, with moderators of gender, age, experience, and voluntariness of use ultimately influencing technology adoption intentions. The result outperformed eight existing models in predicting technology acceptance.

There have been several attempts to extend TAM to a global context. Researchers found that TAM holds in other countries, including Malaysia (Ndubisi and Jantan 2003), Hong Kong (Chan and Lu 2004), and Egypt (Kamel and Hassan 2003). McCoy et al. (2005) compared TAM in two countries, Uruguay and the US. They found that Hofstede’s (1980) cultural dimensions of uncertainty avoidance, power distance, masculinity and femininity, and individualism and collectivism moderate individual behavioral intentions to adopt technology. We expect TAM to have varying degrees of success in predicting adoption intentions given the varied cultural dimensions of the individuals in the adopting country.

Another relevant perspective, task-technology fit theory, asserts that task and technology characteristics influence the use and performance of different technologies by human users (Goodhue and Thompson 1995). Various researchers have explored its strengths and weaknesses for application in the international context. For example, Vatanasakdakul and D’Ambra (2007) have argued that utilization, national culture, business relationships, and technological infrastructure are precursors to task and technology fit between organizations. Massey et al. (2001) found that cultural differences, especially with respect to country of origin significantly impact individual perceptions of task-technology fit theory in international virtual teams.

Related to task-technology fit theory, Dennis et al. (2001) proposed a fit appropriation model that suggested fit is a necessary, but not a sufficient condition to improve performance. Appropriation support is related to user experience, process routines that are in place, the available software support, and other support that comes from training and exposure. Task-technology fit theory points to such relevant constructs as quality, locatability, authorization, compatibility, ease of use, production timeliness, systems reliability, and relationship with users. Among these things, culture

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<td>Innovators Innovators</td>
<td>Early adopters</td>
<td>Countries adopting new ICT immediately after the innovators</td>
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<tr>
<td>Early adopters Early adopters</td>
<td>Countries adopting new ICT immediately after the innovators</td>
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<td>Early majority Early majority</td>
<td>Countries beginning to adopt ICT at the same time as majority</td>
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<td>Majority Late majority</td>
<td>Countries adopting ICT later with majority of other countries</td>
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<tr>
<td>Non-adopters Laggards</td>
<td>Non-adopters and countries adopting much later than majority</td>
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appears to be an important construct that is worthy of further study to determine the likelihood of fit appropriation. Consider the following example of a rural village in India. A representative of an international aid organization suggests that the people in the village could use an Internet-capable computer to support the purchase of farming tools. Even though this kind of technology would be viewed as having good task-technology fit properties based on what we know from prior theory, its fit appropriation characteristics may be less apropos. Why? An important cultural element in rural village life in the countries in South, Southeast and East Asia involves the development of an interpersonal relationship between the buyer and the seller. Without a face-to-face contact, the buyer may not feel comfortable to engage in this kind of economic exchange. This is also true with the extension of small amounts of credit to poor people, in amounts that might represent credit card transaction loans in developed countries. More generally, this is common in business and cultural settings where contracts are unenforceable, in spite of the laws that are in place, and the perceived honesty and integrity of counterparties in business dealings are paramount.

3.3. Theories involving economic perspectives

There are many theories that we can point to that involve economic perspectives on technology adoption and diffusion. They typically involve models of decision-making and technology adoption actions that are based on expected value and returns, and competition considerations. Some of the most well-known ones include network externality, installed base and compatibility-theoretic explanations (Katz and Shapiro 1985, Economides 1996). These enable managers to time their adoption of technology based on circumstances that are conducive to value maximization in the presence of different kinds of uncertainty. Another group of theoretical perspectives focuses on innovation returns (Reinganum 1981a) and market crowding and competition theories (Reinganum 1981b, Jensen 1983, Hagedorn 1989).

Others have developed models that involve representations of individual and firm heterogeneity that influence adoption decision-making, including the probit model (not to be confused with the probit model in econometrics for estimating discrete choices). The probit model hypothesizes a distribution for a firm-level decision-making, including imitative behavior. The probit model illustrates the richness of economic thinking as a basis for explanatory theory for technology adoption and diffusion phenomena. For example, epidemic theory suggests that the cause of technology adoption is mostly environmental (Mansfield 1961, Geroski 2000). Related work in the IS discipline has sought to understand and model the contagion effects that are involved (Angst et al. 2010, Kauffman and Techatassanasootorn 2005b, Mann et al. in press). Other alternative explanations suggest that technology adoption may be influenced by subsidies, including firm-to-consumer or firm-to-firm incentives (Riggins et al. 1994), and other complementarities that exist in an economy, such as its infrastructure, level of skilled labor, and the extent of investment in R&D, are critical in supporting technology adoption (Cortes et al. 2010). We expect that many of these ideas will be operative in the global technology adoption context, which we address in more detail next.

In contrast, trickle down diffusion theory suggests that the most developed countries with stronger economies are the first to produce and adopt new technologies, and that only later will the technologies trickle down to other countries that lag economically,
where further adoption will be observed (Caselli and Coleman 2001, Comin and Hobijn 2003, Saxonhouse and Wright 2004). In addition, innovator–imitator models have been proposed, which argue that leading economies are the innovators, and the reason why less developed countries are unable to adopt immediately is because replicating the innovation will cause them to experience high imitation costs, resulting in a lagged pattern of adoption over time (Barro and Sala-i-Martin 1997, Eeckhout and Jovanovic 2002).

Another source of theory for technology adoption in regions and countries is political economy. In the political economy perspective, influences on technology adoption and diffusion can develop from government policies and incentives. For example, one concern is that technology adoption may proceed either too quickly or too slowly. This implies that there might be some social welfare-maximizing rate of diffusion in an economy that should be sought after (Stoneman and Diederan 1994). Research has shown that firms do not always invest in new technologies to the extent that social welfare considerations might prefer, largely due to problems with uncertainties about the appropriability of the returns from R&D investments (Stoneman and Vickers 1988). Dewan and Kraemer (2000) found that level of development impacts the returns that a country can expect from IT investments. In addition, other government-level political factors, political regimes and domestic institutions (Corrales and Westhoff 2006), and various kinds of political interest groups may also speed or slow technology adoption (Milner 2006, Comin and Hobijn 2007). For example, government support of infant industries has had profound support on technology adoption in many parts of the world (Easterly et al. 1994).

There are also a number of theoretical perspectives that offer other explanations of technology adoption at the more aggregate level of analysis of the economy or the country. See Comin and Hobijn (2003), who more fully explain the theories that we discuss below, and what is known about how well they perform. In the past, macroeconomists have pointed to vintage capital theory as a means of explaining why the quality of capital goods and technology adoption grow over time (Johansen 1959, Solow 1960, Parente and Prescott 1994, Gilchrist and Williams 2001). Capital goods quality growth occurs through technology investments at the intensive margin where there are higher expected risk and return. Firms in an economy will tend not to invest in the vintage capital stock, since the expected returns will be lower. Comin and Hobijn (2003) have pointed out that vintage capital theory fails to explain technology adoption lags and faster adoption by more developed economies. An alternate perspective is vintage human capital theory, which suggests investments in the newest technologies in an economy will be slowed by the inertia of the vintage skills of the labor force and the high levels of use of existing technologies. “Leap-frogging” technology adoption from the vintage generation to the newest generation of technology, possibly skipping some steps in the middle, is predicted as the inertial forces in a developing economy are released (Brezis et al. 1993, Saxonhouse and Wright 2004). For example, international trade flows can influence economic growth (Balassa 1986, Grossman and Helpman 1991, Coe and Helpman 1995), and affect the adoption of new technologies in the process, making it possible for an economy to exhibit adoption patterns beyond what might be expected on the basis of factor endowments alone (Acemoglu 2002, Basu and Weil 1998).

### 4. Adoption factors

Many studies have aimed at identifying economic, social, and other factors that relate to global ICT adoption, which we use to frame our discussion (Parente and Prescott 1994, Karahanna et al. 1999, Dewan et al. 2005, Crenshaw and Robison 2006). These studies emphasize factors that can be used for theory development or by national and international policy-makers to show how political and economic decisions impact country development. We examined a group of studies that represent different kinds of internal and external factors, varying methods used to validate the factors, and the impact they have had on the IS and e-commerce literature. The studies deal with the determination of factors (Hargittai 1999), the categorization of factors (Dewan et al. 2005), and the impact of factors on technology adoption timing (Helsen and Schmittlein 1993).

Many studies have focused on a single emerging technology. The archetypal approach is that the authors gather data on the rates of adoption on a country-by-country basis, and then use regression or some other form of econometric analysis to determine the significant predictor variables of ICT adoption. Although these studies have followed the same pattern, each is unique in terms of the sample of countries and years that are used for modeling, the independent variables analyzed, the dependent variables explained, and the modeling techniques used. And, as a result, they help researchers and practitioners to develop a rich understanding of what drives the observed technology adoption outcomes (see Table 3).

Models for predicting ICT adoption have practical applications. Countries and economies use models to support decision-making on optimal taxation structures and as a basis of predictions for the effects of the formation of strategic trading relationships with other countries that supply or demand complementary technologies. Industries and organizations use models to predict their revenues and costs and to make staffing decisions, and to plan employee training. Organizations can use hazard models like the ones we have discussed to determine when to increase or decrease their workforce or when to strategically decide on their entry timing.
for service or product offerings. This enables practitioners to understand more about the “inner workings” of technology adoption and to gain a managerial understanding of how it is related to their business outcomes. Factors such as network size and network effects are important to practitioners at all of the different levels of analysis. The main theme of this section is that economic, social, and other kinds of factors influence adoption differently at each of several levels of impact – individual, organization, industry, country – and the minor themes are technological innovation and the economics of technology adoption.

4.1. Adoption factor categories

4.1.1. Economic factors of ICT adoption

We next consider economic drivers of adoption to highlight research problems that deal with reductions in employment, rising costs, and limited trade. Technology offers opportunities for education, cost reduction, and the diminution of the effects of distance. The research techniques that have been used in studies regarding economic factors that drive adoption often vary by level of analysis, but secondary data are appropriate to use at each of these levels. The relevant economic factors include GDP, the Gini coefficient, income, revenue, return on investment, wealth, rank, etc. These typically are available publicly to researchers also, making secondary data an appropriate and often low-effort option for research on the economic factors related to global ICT adoption.

4.1.2. Social factors of ICT adoption

With social drivers of adoption, we recognize different patterns related to the research. The relevant research problems focus on the digital divide, security, and lack of education. Technology has the potential to increase privacy through standards, provide opportunities for education through online earning, and access to the Internet through telecenters. As was the case with the economic drivers of technology adoption, the relevant empirical analysis methods vary according to the level of analysis used in the research.

4.1.3. Other factors of ICT adoption

Other drivers of global technology adoption include factors that do not fall in the economic or social categories, such as legal, environmental, and cognitive factors. The research problems evident in this area deal with cultural barriers, corporate risks, and declining environmental resources. Here one can observe specific technologies that address some of these problems. They include hardware advances for lower energy use, mobile technologies for bill payment, and telecommunication methods and technologies that build demand for related services, and thus increase employment. Unlike the economic and social drivers of technology adoption, the research techniques that are used in this category do not vary as much by analysis level. Data from case and field studies, interviews, and analytical models are characteristic of and appropriate for these studies. This is not surprising considering that legal, environmental, and cognitive factors are seldom represented numerically or available publicly, so obtaining information about them requires more inventive data collection methods.

4.2. Research on the factors of technology adoption

Many of the studies cover multiple factors of technology adoption. For example, Hargittai (1999) analyzed a set of OECD countries and found that GDP and telecommunications policy were the most significant factors for technology adoption. Robison and Crenshaw (2002) analyzed technology adoption in 74 countries from 1995 to 1999. In contrast, their results suggested that development level, political freedom, and education were the most significant drivers. They concluded in a later study that elements of structural conduciveness and globalization are key drivers to technology adoption (Crenshaw and Robison 2006). Finally, Kiiski and Pohjola (2002) examined 60 countries from 1995 to 2000 and concluded that GDP and Internet access costs were the most salient input variables to explain technology adoption.

Dewan et al. (2005) surveyed input variables taken from dozens of studies in this research area. They categorized global IT adoption input factors into economic, demographic, and environmental factors. Using these input factor categories, they created a model to quantify the global digital divide, which is the variation in access to technology among different countries across successive IT generations. Their conclusions were based on evidence that the digital divide is narrowing, and that the dynamics of the diffusion of the Internet seem different from the patterns of diffusion of earlier technologies that were observed.

Other researchers have examined adoption factors from a different point of view by analyzing their role in the timing of adoption. Helsen and Schmittlein (1993) used hazard rate modeling to determine how duration times to adoption are the result of related variables in marketing. The authors stated that observed durations may be different, and that different measures of duration are likely to yield different results. One example of this is with time-varying covariates, which are explanatory variables that change over time (Wooldridge 2002), such as a firm’s age, or the interest rate environment in the economy, or the emergence of competing technologies. Time-varying explanatory variables have high relevance with respect to technology adoption studies, more so than time-fixed covariates, which may include firm type, firm location and so on (Forman et al. 2005a, 2005b). A contribution is the extent to which hazard rate models are more effective than other statistical methods to estimate the influence of the factors that determine the time duration to adopt technological innovations by consumers and firms.

Montealegre (1999) also examined the relationship between adoption factors and adopting timing and emphasized the role of firms with respect to the adoption of sophisticated IT innovations. He concluded that different input factors have differing effects in the early, middle, or later stages of technology adoption. In the early stages, knowledge building was found to have the greatest effect. In the middle stages, subsidies had the greatest effect. In the latter stages, knowledge deployment and innovation had the greatest effects on adoption. The author also investigated the role of adoption support from a nation’s government, academic community, and private sector. In spite of their obvious importance, these complementarities represent factors that are much more difficult to assess quantitatively. As a result, interview source data was used.

Finally, Parente and Prescott (1994), whom we mentioned earlier related to theories of technology adoption, also explored the impact of the barriers that are present in technology adoption in the global setting. The authors showed that greater barriers to technology adoption seem to be associated with higher levels of required investments in other complementary factors before a country is seen to adopt a new technology. The result is that an income disparity among countries arises, a phenomenon that also has been studied for non-technology contexts (Deeinger and Squire 1996, Barro 2000, Bouchaud and Mezard 2000). Parente and Prescott (1994) were unable to explain two observed phenomena. One was the difference in country income levels that were larger than might have been expected in the empirical data. A second was the existence of a number of instances of stunning successes in economic development among developing countries, such as post–World War II Japan in the 1960s and 1970s and South Korea in the 1980s and 1990s.

As we noted earlier, in the global context, network externalities can play a role. An example of this comes with the Internet-based
telephony and messaging service, Skype (www.skype.com), which supports free to low-cost voice, text, and data communication capabilities. Its value is proportional to some limit of the number of users on its network in other countries, for whom long distance phone calls are too expensive. Voice over Internet protocol (VoIP) offers unique opportunities for transforming communications access in under-served and rural areas (Chetty et al. 2006, Varshney et al. 2002). Network externalities are operative within countries also, and have the capacity to produce the kinds of technology-led endogenous growth "chain reactions" that Sachs (2005) has referred to.

Dekimpe et al. (2000) recognized the strong influence of contagion effects, based on an analogy to disease-related contagion effects in the epidemiology literature (Van den Bulte and Lilien 2001, Bae et al. 2003). The authors provide evidence that the more countries that have adopted or the more international experience a country has with a given technological innovation, the higher are the chances that other countries will implement the innovation.

Katz and Shapiro (1986) discussed the effects that different kinds of technologies have on the outcomes of adoption. Sponsored technologies have costs associated with supply-side market entry and require standards that are promoted by a sponsor, whose goal is ensuring the success of the technology. Un-sponsored technologies are distinguished by free market entry, are not subject to standards, and lack a sponsor. The authors report two findings that are important to this survey of global IT diffusion. The first is that currently superior unsponsored technologies will dominate the market. The second is that a sponsored technology often will be adopted when competing with an unsponsored technology, even if the sponsored technology is perceived to be inferior. This was the case with the QWERTY keyboard (David 1985), although this was later shown to not be the case (Liebowitz and Margolis 2001, Spulber 2001). We expect the opportunities for sponsorship of technology to be as relevant internationally as they are in any domestic country setting.

Other research has determined that IT adoption occurs earlier if there are expectations of a large network to support the new technology (Saloner and Shepard 1995, Kauffman et al. 2000). Externalities that have a negative effect on adoption, such as switching costs, also may be influential. So even if a new technology is superior to a country's existing technology, there may be a delay in adoption due to the unwillingness of different stakeholders in the market and the firm to accept these switching costs. This was the case with Merrill Lynch, which avoided switching costs for itself and its customers by maintaining a suboptimal proprietary network for several years, while new competitors (Charles Schwab, E*Trade, Ameritrade, ScottTrade, etc.) introduced the revolution of Internet-based stock trading. These kinds of switching costs can be extrapolated to the global IT adoption context as costs associated with switching from an existing technology that is commonly used in a country to a new technology that is relatively unfamiliar to the citizenry. They include exit fees in IT services outsourcing (Barrar and Gervais 2007), search costs (Hoque and Lohse 1999), learning costs (Cabral and Riordan 1997), equipment costs (Teo 2003), installation and start-up costs (Hawley 1997), and financial risk (Benaroch 2002).

Eaton and Kortum (1999) posited that the expected levels of patent protection of a technological innovation in a country affect the rapidity and extent of its diffusion. They concluded that research done overseas only is two-thirds as effective as research conducted in a given country. In addition, multiple observers and interpreters of economic history research have shown that a direct relationship exists between national productivity and a nation's ability to adopt new ideas (De Long 1988, David 1991).

Finally, economic factors often breed creativity that supports technology innovation and adoption. Seabright (2004) has suggested the following drivers in this context. Creativity for technological innovation comes from individuals and groups who have new ideas that they put into action in the economy, creating new jobs at start-up firms, and producing new sources of wealth in the economy. Creativity in R&D also is supported by the capabilities of mobile immigrant populations who are willing to challenge the status quo in an industry. Examples are the British IT professionals who went to Wall Street security firms in the US in the 1980s to build the first generation of financial markets analytics systems. They were followed in the 1990s by Russian and Indian contract software engineers and network specialists, and some of these people were among the first to establish multinational outsourcing companies that served the US. A third key driver is a population that is large enough to maintain a sufficient body of talent to be attractive to firms that are interested in producing technological innovations.

In contrast, Landes (1998) took an historical approach to understanding global innovation and creativity. He looked at the era in history where European societies witnessed growth far greater than the rest of the world. His research identified 14 characteristics of nations in which creativity thrives in support of technological innovation. Florida (2002, 2005) offered a different perspective on R&D-related creativity and technology innovation that is based on global demographic data and empirical analysis of his theoretical perspective. He argues that technology, talent, and tolerance (the "three T's") in a regional economy provide a uniquely effective backdrop for R&D creativity and technological innovation. These also are precisely the kinds of characteristics of a region that are supportive of the adoption of new technology by its population. Florida makes the connection that the "three T's" are all associated with the presence of universities, as research institutions and centers of tech knowledge dissemination. These attract a diverse population. Florida notes that universities usually have the resources to encourage the development of emerging technologies, as well as the growth and development of talented thinkers and technologists. So it is natural that these conditions also create the impetus for high levels of ICT adoption.

A final issue that deserves consideration is related to how different kinds of products that are developed and exported by countries around the world may affect their economic performance. In a recent series of articles by Hidalgo et al. (2007) and Hidalgo and Hausman (2008), the authors proposed the concept of proximity, as a means of explaining why a country's capacity to produce different kinds of products depends on its capacity to produce other kinds of related products. The authors focus on the export patterns of such products, and model the probability between two products as the "pairwise conditional likelihood probabilities of a country exporting one good given that it exports another" (Hidalgo et al. 2007, p. 484). They also discuss another construct that ties in with proximity called density, which describes the average proximity of a "potential product" to the country's basket of current products that are produced for export, as a means of characterizing the country's relative comparative advantage to other countries in product exports. The authors use an innovative technique involving network graphs (Hidalgo et al. 2007, p. 486) as a means of representing the capacity that a country has to produce and export new and related product innovations. The perspective that is offered in this research has a profound interpretation for ICT adoption that can be developed by analogy: the greater the "connectedness" of a country's prior adoption of related technologies, especially those that it imports, the more likely it will be able to adopt new ICTs that are available for import and deployment within the country. If related ICTs have not been adopted, then this will result in barriers to adoption and diffusion, which will cause the technological innovativeness of countries to be held up, even if they possess managers and a workforce that exhibits creativity and expertise.
4.3. Gaps in this area of the literature

Using our ICT adoption factor categories as a tool, we were able to identify gaps in the literature on the drivers and impacts of global ICT adoption. For example, we have seen comparatively little research that has focused on the social factors of technology adoption. ICT is increasingly used as a social tool and not just a business tool. Thus, we expect the extent of research on global ICT adoption related to social factors to increase with the recent popularity of social networking, and also on how relationships, access to technology, and privacy all play roles in its adoption.

As shown in Table 3, no study in our sample utilizes adoption factors from all three categories. Most utilize just two factor categories. We recognize a gap here since, after looking at the research, we see that certain adoption factor variables require the inclusion of variables in other factor categories to provide a fuller explanation. This is evident, for example, in Hargittai (1999), who included the social factors of adoption for education and the use of the English language, as well as two economic factors of technology adoption, GDP and Gini coefficient, which were significant in their model. The author noted that there are likely to be nuances that need to be “teased” out of the relationships among the variables, so we can more thoroughly explain and predict global ICT adoption based on three-factor category models. Estimating models that span more categories of variables also has the added benefit of fewer pairwise correlations and less multicollinearity among the explanatory variables, which introduce undesirable bias in empirical estimation. In addition, using predictor variables from multiple factor categories will also increase the richness and predictive strength of the regression models in terms of the applicable measures.

External factors to a country that may affect its ICT adoption can include the environmental characteristics of the bordering countries and other countries that are in the geographic region (Singapore and Malaysia or Indonesia versus Japan and Malaysia or Indonesia). Many studies include variables that drive adoption within a country and the current diffusion of technologies in surrounding countries. Economic, social, and other factors that describe these surrounding countries can also play a role in predicting whether countries adopt certain technologies, as suggested by the research on relative comparative advantage in international trade. Borrowing from new economic geography theory and network externality theory, among other economic theories we that we have discussed, researchers can address this gap by including representative relationships and variables in the models they build. These might include, for example, a bordering country’s GDP, the dominant religion in the region, or trade flows with the least geographically-distant economic superpower.

5. Global impacts of ICT adoption

The global impacts of technology adoption are diverse and substantial. We have chosen a selection of representative works that represent a balance across the different levels of analysis, the types of impact, and the methodologies that are used for obtaining evidence of the impacts that have occurred. Although there are many more works that qualify for inclusion, we did not wish to be exhaustive. Instead, we hope that the reader will recognize our coverage as illustrative. With additional effort to expand on our survey of the literature, we would expect to be able to present a more refined view of the various academic studies that have aimed to quantify, define, measure, and categorize the impacts of global ICT adoption at different levels of analysis.

Identifying the impacts that result from technology adoption and where these impacts occur is of importance to practitioners. Policy-makers, investors, and firm decision-makers need to recognize that different kinds of impacts occur at different levels of analysis, and that they may have different degrees of economic importance. For example, online product reviews may decrease information asymmetries and inform consumers, but they may also set up a “perfect storm” for online retailer profitability due to the increased competition and informational transparency that develops in the marketplace. Similarly, social networking technologies may encourage greater interest about a country’s capabilities as a trade partner or as a location for foreign direct investment, but these may also have negative cultural impacts that should not be dismissed by the stakeholders who are involved. This section further builds on a major theme of this article: that the factors of adoption influence technology adoption differently at each of the levels of impact.

5.1. Adoption levels of impact

We can now identify patterns and trends that appear across the different levels of impact.

5.1.1. Individual level of impact

Individuals adopt technology for personal utility, which will differ according to the technology. An individual purchasing an MP3 player adopts the technology for entertainment. An individual buying a computer adopts it to telecommute or possibly to aid in a job search. An individual who signs up a Facebook account probably adopts the technology for social purposes. The impacts that occur at the individual level affect the individuals’ productivity. Not all of these impacts, however, are beneficial. Home broadband Internet connections may bring out reclusive tendencies in individuals, for example. And MP3 audio compression and peer-to-peer file sharing may reduce revenues for recording artists.

5.1.2. Organizational level of impact

Organizations experience different impacts of technology adoption. The benefits of adoption on an organization’s productivity, efficiency, and security are reasons why organizations implement software, add server storage space, and join standard-setting organizations. Brynjolfsson et al. (1994) explained why firm size may be impacted. ICT adoption also leads to increased transparency (Porter 2001, Granados et al. 2006), since technology acts as a means to communicate firms’ product offerings and data to large audiences at little cost and effort. Researchers typically use case studies, field studies, and secondary data to determine organization level impacts.

5.1.3. Industry level of impact

Industries see impacts of technology adoption largely through technology and process standards adoption that create consistency for how organizations in a particular industry approach different business problems (Kauffman and Tsai 2010). These consistencies can range from common financial reporting standards, to network standards for mobile phones, to computer code peer review processes, etc. These standards, along with new efficiency-enhancing technologies (e.g., GPS mapping of crop yields in the agricultural industry) improve industry-level performance and economic contribution, even as technology commoditizes their processes and makes it more difficult for individual firms and organizations to achieve competitive advantage (Davenport 2005).

5.1.4. Country level of impact

Countries experience economic shocks and cultural impacts from ICT. At the economy level, impacts include changes in economic growth, increased trade with other countries, and greater opportunities for global information sharing. Cultural impacts on
language and culture are common with ICTs, when countries increase the extent of their external communication linkages. Finally, government policy is impacted as a result of technology adoption, both in beneficial proactive ways, and potentially harmful reactive ways. With the Internet, it is now difficult for governments to restrict the influx of undesirable information and political messages from others around the globe.

5.2. Research on the global impacts of ICT adoption

Many research papers on the impacts of global ICT adoption have been published in top journals. We discuss a representative sample of these studies. For example, Kapur (1995) noted the social learning impacts of technology adoption. By observing the adoption process by other nations, a country will experience social learning before undertaking its own adoption of a new technology. Therefore, there is a preference for all countries to delay the adoption process so they can experience the benefits of social learning and reduce uncertainty costs. Learning is a key thread that also relates to the development of expectations of benefits from an IT's diffusion in an economy (Soete 1985, Ganesh et al. 1997, Au and Kaufman 2003).

Another impact that countries experience from ICT adoption is indigenous technological development. Class and Saggi (1998) modeled a relationship between foreign direct investment from technologically advanced countries and the ability for a country to develop new technologies of their own. Developing countries that receive foreign direct investments will also experience some motivation for making government policy changes to persuade firms to invest in domestic R&D activities (Javorcik et al. 2004).

Palvia (1997) made a contribution to global IT adoption impacts literature by developing a global IT strategy model to assess the strategic impact of technology adoption. The author limited the analysis to the firm level. He included variables from the strategic IS for competitive advantage literature to cover the domestic market landscape, from the global IT literature, and also a number of technology variables. His model is useful for identifying strategic IT impacts that are relevant for the global context.

As indicated by Giovannetti (2000), quality-improving technology adoption has resulted in asymmetric regional productive structures. Large innovations have high adoption costs. They include the direct infrastructure and technology purchase costs, and also the indirect education, training, switching, and opportunity costs of introducing a new foreign technology. Given the diversified geographical pattern of technology adoption, quality asymmetries are likely to occur when adoption costs are high. For technology to diffuse uniformly across countries, progressive reduction in adoption costs is required.

Productivity impacts of IT investments, in units of output per unit of input, represent a heavily studied area in IS research. Park et al. (2007a, 2007b) assessed IT-led productivity in a macro-level global context with a panel data set containing 39 countries of varying developmental status from 1992 to 2000. Although previous studies concluded that IT is a driver of national productivity (Dewan and Kraemer 2000, Oliner and Sichel 2003), Park et al.'s (2007a, 2007b) studies are the first to conclude this based on robust empirical evidence. Another important contribution of this paper was evidence that technology adopted from IT-intensive economies has a greater impact on national productivity than technology adopted from less IT-intensive economies.

Global IT adoption impacts the home nation, the source of the technological innovation, as well as the host nation, where adoption of the technological innovation occurs (Blöstrom and Kokko 1998). For host nations, the authors made an interesting observation. They reported that a liberalization of government policy to restrict foreign direction investment tends to encourage foreign direct investment due to the influence of multinational corporations. The authors stated that, in home nations, productivity and growth benefits impacted both the multinational corporation and its domestic suppliers of value in the economy. This phenomenon is commonly referred to as a spillover effect. When a country’s R&D efforts are concentrated at home, the spillovers are greater than when the R&D investments are positioned internationally.

DiMaggio et al. (2001) recognized several social impacts from technology adoption. In their study of the implications of Internet use, they classified impacts into several categories. The first was impacts on time use, including time displacement, community, and social capital. Another was impacts in the political realm, including effects on informedness and engagement of the public, political polarization, and deliberative democracy. A final category looked at impacts on culture and how low barriers to entry, combined with the individualistic and personalized nature of the Internet, resulted in segmented markets.

A framework for measuring the impacts of global IT diffusion was introduced in a study by Wolcott et al. (2001). They used Kivi diagrams with each spoke representing a measure of the impact of technology, including pervasiveness, geographic dispersion, sectoral absorption, connectivity infrastructure, organizational infrastructure, and sophistication of use. The authors used their framework to examine differences in these measures among countries and to track changes over time for a single country.

5.3. Gaps in this area of the literature

Our sample of the literature shows relatively even coverage across the levels of impact of ICT adoption, except for organizational impacts, which seem to be over-represented. This may be because the impacts of ICT adoption first affect the firms that adopt them, while individual, industry, and country-level impacts come later and are secondary and tertiary by nature. This was true for firms in their adoption of computers, databases, and telecommunications. The first firm-level impacts came in operations, accounting and human resources, and over time have been extended to many other aspects of the firms' business processes. These occurred before the impacts of standards adoption in industry or the individual impacts of almost-free long-distance communication via social networks were felt.

Another area lacking in research is related to the impacts of technology adoption on community and culture. The research generally has been more concerned with the economic analysis of individual adoption of ICTs. A case in point is the Internet, which has provided individuals with information about the world outside their own locales. These individuals may learn about all sorts of things that run counter to the norms of their traditional cultures, including new political and religious thinking, and different youth culture and sexual mores. Drastic cultural changes can occur with the newly-found freedom of information that the Internet brings. This impact probably will be higher among young people who are more open to influences and changes, and are less set in their cultural norms.

Studies on the long-term impacts of ICT adoption also are lacking in the global context. Most of the research works on the impacts of ICT are variance studies (Van de Ven 2007) that address how different drivers explain the variations in ICT adoption outcomes variables or their impacts. They typically do not track the longer-term evolution of the process of adoption for different ICTs as time passes, as process studies (Van de Ven 2007) typically would. Process studies in global ICT adoption research can be helpful in answering questions about why the observed impacts happen as they do, and have the potential to yield a richer understanding of the issues than variance studies alone can.
6. Future research directions

Through the process of analyzing the literature, we recognized some gaps in the global ICT adoption literature that offer a basis for identifying new directions for future research that will contribute to our theoretical and managerial knowledge in this area. In this section, we will emphasize the extent to which some new directions for research on global technology adoption have the capacity to provide new theories and methods for explaining what we have observed in the past better, interpreting the present world around us more fully, and predicting the future with greater confidence.

6.1. New theoretical and methodological perspectives

We next discuss a proposed agenda for future research that is relevant for the global ICT context. Several theoretical perspectives that we have discussed deserve more consideration in the global ICT adoption and diffusion research context, and reflect the upwelling of new thinking that has developed across the disciplines of IS, e-commerce and economics. This work is exemplified by the recent research of Duan et al. (2009), Walden and Browne (2008) and others who are exploring the use of rational expectations, and informational cascades theories. The key insight that these theoretical perspectives offer for understanding the global adoption of ICT is that we should begin to focus less on what drives adoption decision-making, as opposed to how the process of adoption decision-making works in the presence of whatever factors are relevant.

6.1.1. Methodological perspectives

Similar to theorists in other disciplines such as political science, labor relations, and operations management, researchers who study ICT adoption and diffusion most often think in terms of continuous processes (Hoppe 2002, Swanson et al. 1997). Nevertheless, a variety of empirical analysis methods from statistics and epidemiology now permit us to think in terms of the frequency of ICT adoption events, and to summarize them based on how frequently they occur (King 1989, Twisk 2003). Most empirical analysis works on the diffusion of ICT have largely implemented models that draw upon statistics and econometrics techniques that are more appropriate for data that are created in continuous distributions. The result, from our viewpoint, is a mismatch between the theories for the studies and the associated assumptions that are necessary when some of the typical analysis methods are applied. Our key observation is that inconsistencies often will arise.

This prompts us to advocate newer statistical and econometric methods for empirical research on the global adoption of ICT that involve event study methods. They include survival analysis and duration modeling (Harrell 2001, Klein and Moeschberger 1997, Le 1997), as well as count data and event frequency modeling (Cameron and Trivedi 1998, Hille 2007, Winkelmann 2003). For a survey of these methodologies in the IS research, IT adoption and electronic commerce contexts, the interested reader should see Kauffman et al. (2010).

6.2. Research directions for the global adoption of ICT

We next discuss several future research directions. They include the new economic geography theory (Krugman 1991, Ottaviano and Puga 1998), the rational expectations and informational cascades theories (Bikhchandani et al. 1992, Au and Kauffman 2003), and the contextual use of methods that emphasize discrete events and their frequency (Schkodtp and Mintz 1988, Grinois and Perrelli 2006). By considering the research directions in terms of our previously identified factors of adoption and levels of impact, the reader should recognize that we are offering a balanced research agenda across these areas.

6.2.1. Distance measures and the new economic geography

The recent literature on the new economic geography (Krugman 1991, Ottaviano and Puga 1998) and spatial economics (Greenhut et al. 1987, Fujita et al. 2001) seeks to provide explanations for regional industry agglomeration in different economies. It uses explanatory factors that are based on location and other forces that bind firms together geographically or that permit them to be some distance from one another, and still be able to effectively gain knowledge that supports innovation effectively. It is also possible to look at technology adoption from this standpoint. We propose:

• Research Direction 1 (Distance Measures and the Economic Geography of Global ICT Adoption). Research on the impacts of new economic geography variables should be undertaken to understand the effects of economic distance measures, geographic distance measures, and other conceptual distance measures on the global adoption of ICT.

The new economic geography perspective will provide a useful basis for the definition of new research in the area of global ICT adoption (Audretsch and Feldman 1996, Feldman 2003). Many of the countries of the world differ in terms of variables such as proximity to other countries that act as technology leaders, the extent of the agglomeration of the ICT-related production and consumption activities, and the migration and movement of high-tech workers (Kauffman and Kumar 2008). We expect that the new economic geography-driven thinking can play an important role in providing an innovative theory base, help to identify relevant new drivers of ICT adoption, and provide a means for modeling the impacts of ICT adoption. Technology adoption and diffusion rates are higher in industry and regional clusters (Bapista 2000). Moreover, leading strategy and economics researchers (Audretsch and Feldman 1996, Porter 2002) have established empirical evidence to suggest that innovation, which we argue leads to technology adoption, is also greater in industry clusters. Therefore, tracking where these clusters form and how they spread have important theoretical interest, along with applications for practitioners involved in the research, development and marketing of high-technology goods.

Some related research questions immediately come to mind. For instance, where within a country will the adoption factors for ICT have the greatest impact? In large metropolitan areas, where population density is highest? Along a country’s borders with its main trading partners? Along the routes of its primary international trade flows? Do island nations experience different impacts of ICT adoption than ones that are landlocked? The kinds of questions that should be examined will need to be identified based on their theoretical significance, their business and development policy relevance, and their situational uniqueness to improve the understanding of business and government leaders. This research direction is concerned with the influence of economic and other factors of technology adoption at the organization, industry, and country levels.

6.2.2. Rational expectations theory and clustered adoption

Path-breaking research by Muth (1961) and others (Lucas 1975, Sargent and Wallace 1976, Fryman 1982) on situations in which rational expectations are appropriate for interpreting how the economy works provides a useful theoretical perspective for the study of global ICT adoption phenomena. We have shown the relevance of understanding managerial decision-makers’ propensity to base their ICT adoption decisions on perceptions about the value...
of a technological innovation in the marketplace in the eyes of other potential adopters (Au and Kauffman 2003). Are rational expectations-based explanations of the adoption of global ICT relevant? We suggest:

- **Research Direction 2 (Rational Expectations Theory, Herd Behavior and Clustered Adoption):** Research should be undertaken to explore the extent to which rational expectations of value on the part of key agents in the economy, including consumers, organizations, industries and governments, are operative in global ICT adoption.

Interesting examples are the phenomena of informational cascades (Walden and Browne 2008), herd behavior (Scharfstein and Stein 1990), and clustered adoption of technology (Au et al. 2006). These are related to anomalies in information transmission that arise among people and organizations in the global marketplace of technology adoption. Information transmission anomalies that affect technology adoption may occur on the basis of population, communication, geographic, or other country characteristic-based dimensions that lead consumers, managers in organizations, and government leaders to reach aligned expectations of when the adoption of a given ICT is appropriate and valuable in time (Au and Kauffman 2005).

The related research questions that arise again seem to emphasize important human welfare, firm innovation and national development issues. For example, do the consumers of technology-based products in different national settings develop their expectations about ICT adoption in a similar manner? How are they different? How are they similar? In addition, do firms benchmark the potential business value of new technology adoption in a similar way across countries and regions relative to the rational expectations of value they develop? To what extent does evidence of clustered adoption behavior in time, place or technology type within or across countries provide a basis for understanding differences in the formation of rational expectations for ICT adoption? Such questions offer rich opportunities for new research. The research direction associated with rational expectations theory underscores the importance of understanding the economic and social factors of adoption at the individual and organization levels of analysis.

Another related area that warrants further exploration is related to the anomalies that often occur with ICT adoption. An anomaly that we are referring to is the adoption of the “wrong” technologies, which is often driven by bandwagon effects and information cascades (Bikhchandani et al. 1992, 1998). Consumers and decision-makers misperceive the true signals that they need to attend to in order to make value-maximizing ICT adoption decisions (Walden and Browne 2008).

### 6.2.3. Fit appropriation theory and cultural effects

The fit appropriation model (Dennis et al. 2001) posits that, in addition to the constructs of task and technology fit, appropriation support is required to solidify a good fit between task and technology among individuals and groups. It combines task-technology fit theory with adaptive structuration theory to gain the benefit of both approaches (Zigurs and Khazanchi 2008). Fit appropriation theory identifies new appropriation constructs that supplement traditional task-technology fit constructs. In a recent example, the fit of media capabilities to communication needs were shown to influence the appropriation and use of media, which in turn influence communication performance (Dennis et al. 2008).

This research used appropriation factors that are applicable in a national context: familiarity, training, past experience, and social norms. But are there fit appropriation support elements at work with technology adoption in the international context? Thus, we assert:

- **Research Direction 3 (Fit Appropriation and Its Technology Adoption Effects):** Research should investigate the influence of fit appropriation elements to determine the role of culture and other constructs on the fit between tasks and technologies for technology adoption globally.

In this research direction, we propose research to identify appropriation constructs in an international setting. Is there evidence, for example, for the fit appropriation constructs of language, culture, political openness, and individual versus group-based societies to have an impact on how adoption proceeds? How might the consideration of these kinds of factors enter into our understanding of how to model the decision-making process for ICT adoption at the individual or firm levels, or the patterns that emerge at the industry or economy levels?

Fuller and Dennis (2009, p. 8) point out that “[f]it is capable of being altered or controlled by outside forces and has a capacity for adaptive change.” So the sequence of task-technology fit and fit appropriation matters, because technology adoption happens over time. Initially, task-technology fit should influence appropriation. Later, the relationship will shift and appropriation will influence fit. This is because fit appropriation creates the capacity for a human user to overcome poor task-technology fit over time. Researchers can work toward discovering whether such effects will be operative for technology adoption in a variety of international environments involving ICT. We can imagine the kinds of settings that would motivate the use of such a theoretical perspective. For example, with the support of increasingly inexpensive and effective communications and image-sharing support, it has become possible for teams of professionals from multiple nations to work together in virtual teams. Their tasks may involve activities as varied as analyzing complex medical data, to solving challenging bridge design problems, to developing innovative software programs. When cross-cultural virtual teams of people work together, the problem of technology adoption becomes more complex, since it is possible that fit appropriation will be blocked by a variety of cultural factors that may operate differently at the group level than they would at the individual level. Thus, researchers should further explore the fit appropriation theory perspective to see what new knowledge it can yield in the global ICT adoption context.

#### 6.2.4. New empirical methods

The first and second lines of offense in research that will enable us to understand global ICT and diffusion phenomenon are empirical analysis and case studies as a basis for building new theories. The next line of attack will come with new ideas for how to conduct empirical research to obtain unique and insightful results. There are many opportunities in the global ICT context to leverage methods associated with empirical research in other disciplines that have developed methods for making sense of large volumes of data that have interesting patterns of behavior underlying them. Although these research directions do not necessarily map to specific factors of adoption or levels of impact, they apply to the research methods that academics consider will be most effective in answering their research questions and testing their hypotheses. We suggest:

- **Research Direction 4 (Event History Modeling Approaches for Understanding Global ICT Adoption Patterns):** It will be useful to explore the modeling of technology adoption and diffusion phenomena in terms of variables such as adoption timing and frequency of adoption over time through the use of duration modeling, survival analysis and count data modeling as a means to understand their observed patterns and underlying explanatory factors.
These event history methods offer researchers opportunities to probe global ICT adoption and diffusion with more well-tuned tools that traditional regression models involving time-series, cross-sectional and panel data research designs cannot provide. The new empirical modeling approaches can shed light on the study of adoption and diffusion-related events, which offer a natural analogy for what actually happens in the real world. Countries experience different start times for the adoption of various kinds of ICTs, and also may experience lesser or greater densities of adoption events at different points in time.

The duration modeling and survival analysis methods that we advocate for further exploration in the global ICT adoption context have been applied in political science (Box-Steffensmeier and Zorn 2001), biostatistics (Harrell 2001), public health and epidemiology (Klein and Moeschberger 1997) and elsewhere when event history analysis is used (Aalen et al. 2008, Le 1997). These methods take a refined approach to temporal events, and the connections among them. Moreover, ICT adoption and diffusion researchers will benefit from implementing an analogical reasoning approach to their research designs. How? They can seek out other settings where the interrelationships between events are structured in a way that supports rich analogies to ICT adoption settings. This makes the methods that were used immediately available as is, or with modifications in their application, able to bring researchers to an in-depth understanding of the data and what drives the outcomes that are studied. We have seen this in Han et al. (2008), who leveraged an analogy involving the contagion effects of riot diffusion in the United States.

The same opportunities for innovation in global ICT adoption and diffusion research will come through the study of the frequency of adoption. Again, the use of modeling analogies will be helpful, as we have seen with King (1989) in international relations, Ezell et al. (2003) and Bhati (2008) in criminology, and Christakis and Allison (2006) in healthcare. We advocate the use of a subcategory of event history analysis methods that involve count data processes (Cameron and Trivedi 1998). Winkelmann (2003) points to the arrival of telephone calls at a help desk during a period of time as an example of a count data process. There are many apt applications of count data process modeling in global ICT adoption, for example, when it is appropriate to think about adoption event counts being conditional on the duration since first observed adoption — what Winkelmann (1995) calls duration dependence. Another related research question involves what drives dispersion in count data processes. So, how might we explain why ICT adoption events exhibit different patterns in different countries? There are methods that were developed to handle such issues (Hilbe 2007). Event history modeling research techniques are appropriate in studies across all of the factor categories at the organizational and country levels of analysis. With this in mind, we offer another research direction to the reader, as follows:

- Research Direction 5 (Geographic Analysis of Spatial Relationships Underlying Global ICT Adoption and Diffusion). A final methodology-focused research direction for the study of global ICT adoption is to study the related technology, national, regional and global patterns of diffusion using the emerging methods of spatial statistics.

A growing area of scholarship in statistics and economics, and the related disciplines of geography, regional analysis, urban planning and economic development has centered on spatial statistics (Ripley 2005). The analyst must distinguish between different kinds of data (Fotheringham et al. 2002). Aspatial data involve the characteristics of countries, firms and technologies based on variables that carry no geographical or locational contents. Spatial data contain a blend of attributes, similar to what we just noted, and other location-based information. They can be local or global, although the latter does not have the same sense in its meaning as we have been using it for our discussion of global ICT adoption. In spatial statistics, the distinction between local and global focuses more on the extent to which a phenomenon can be understood in terms of variations in local observations. Think of individual observations describing ICT adoption behavior of cities in a country, or countries among nations versus aggregate observations, which average local and individual observations. When there is local variation, spatial statistics provide methods to drill information from geospatial relationships that pure attribute-based data cannot reveal.

The applications of these kinds of methods approaches are likely to be varied in the global ICT adoption context, even though we have not yet seen any very meaningful application of them to date. We foresee applications in parallel with some of the methods advances discussed by Anselin et al. (2004). It may be possible to study rural–urban linkages at the country level, and how they affect the diffusion of different kinds of ICT, for example. We may also be able to study the economic geography of ICT-related labor, and the extent to which ICT adoption and labor have intertwining effects nationally and regionally. Another interesting possibility is to study the connection between economic growth at the national level and the convergence across countries of their adoption of e-commerce technologies, digital wireless phones, or other ICTs (Capolupo 1998, De Long 1988, Sala-i-Martin 1996). Again, we see opportunities to leverage recent developments in statistics and econometrics methodologies, and explore how they might be able to support the development of new knowledge about global ICT adoption patterns. Spatial econometric research techniques are particularly useful in studies that assess different theories of development involving different economic and social drivers of ICT adoption at the industry and country levels of analysis.

7. Discussion

We next will discuss adoption factors in the economic, social, and other factors categories in several different applied domains. We also emphasize the adoption impacts of these technologies on individuals, organizations, industries, and countries. In this context, technological innovation, economic growth and social welfare are important secondary themes. The five research directions in Section 6 permit us to suggest future research issues to study that are specific to each context. We have not tried to be exhaustive in the application of the suggested theories and methods to the topics. Instead, we identified theories and methods that are appropriate for the different settings. Table 4 shows the mapping of Section 6’s research directions to the application examples to orient the reader.

7.1. Location-based services

Location-based services are IT services that utilize the geographic location of a device to determine the source of the service that might be provided to offer value to its user (Küpper 2005). The benefits include content delivery customized to the user’s location without requiring the user to manually enter it (Bennett and Capella 2002). They include many applications for wireless phones, including AroundMe (www.tweakersoft.com) to identify location-specific attractions, and UrbanSpoon (www urbanspoon.com) to find nearby eateries. Location-based services adoption has been increasing, as more mobile device manufacturers embed GPS capabilities in their wireless phones, and software vendors make more content-aware mobile applications available. In fact, Juniper
Research has reported that mobile location-based services are forecasted to generate revenues on the order of US$12.7 billion by 2004 (Wauters 2010).

Location-based services have unique factors contributing to their diffusion. Economic factors including country wealth play a leading role. Individuals, businesses, and countries need to be able to afford the variety of devices that benefit from location-based services. A business owner in a developed country will be more likely to afford a location-aware mobile phone than one in a developing nation, who will opt for a cheaper device with fewer features.

Social factors also may play an important role. People in different cultures may express concern about the personal information privacy protections that are available to them in different locations (Mayda and Rodrik 2005). For example, Europeans consumers typically must “opt in” to company programs that capture and use their private information, while in the US consumers often have had to “opt out” – which makes the adoption of some location-based services give rise to substantial privacy issues. An interesting example is Google Latitude (www.google.com/latitude), which permits a user to see where their friends are via Google Maps on a computer or cell phone. More collective cultures may prefer to receive and transmit information about the location of people around them, which may account for the great popularity and rapid diffusion of mobile location-based services in East Asia. Finally, other factors related to location-based services adoption in the cross-country context may also be relevant. These may include existing technical infrastructure, the availability of GPS-enabled hand-held device vendors, local regulations and so on. Also a country needs to have terrain with relatively unobstructed line-of-sight to GPS satellites, cell phone towers need to be matched with location coordinates, and broadband networks require complex maintenance (Rao and Minakakis 2003).

Since location-based services are infrastructure-dependent and typically are tied to specific locations, into which the available services have been mapped, the diffusion of the technology will occur in clusters, where users develop rational expectations of the growth in installed base of the services. These clusters may develop in a way that is related to a period of time (when the infrastructure is in place and operational), location (where the infrastructure exists in a geographical region), and use level (based on the expressed demand of adopters who have a need for access to the services made available through the technology). Adoption also may cluster among different consumer segments if the location-based service addresses segmented consumer needs. Examples are local maps for travelers, driving directions for specialty store shoppers, or entertainment for young adults. The clustering of adoption can also occur at the organizational or industry level, if the location-based services address business needs. Additional examples are supply chain and shipping tracking, inventory management, and customer relationship management (Rao and Minakakis 2003).

Event history modeling is an effective approach for analyzing global location-based services adoption, since technology adoption in almost any applied context involves a sequence of temporal events that can be modeled as a means to understand what factors are responsible for diffusion. This approach also has the capacity to highlight the connections among temporal events. This will be beneficial for different stakeholders that are involved in location-based services. These include the government and the military for GPS satellite construction and maintenance, businesses that provide the location-based services, location-aware device manufacturers, software developers and vendors, and business and consumer end-users.

A main characteristic of the data provided by location-based services is that it supports spatial queries (Cai et al. 2006, Liu et al. in press). The user’s geo-coordinates drive the information that is processed about changing locations. This data can be used to track changes in other information, like the geographic locations of mobile users who check local movie show times or the locations of a company’s emerging clients. Location-based services also represent an enabling technology for managers and analysts to acquire data that are relevant for the geographic analysis of spatial relationships in other areas.

7.2. Cloud computing

In the past fifteen years, organizational computing has almost completely migrated from mainframe-based to client–server based. Today, we are in the midst of another paradigm shift: from client–server computing to cloud computing. In cloud computing, processor power, software, and data are provided via the Internet – “the cloud” – and shared among end-users. The cost benefits of cloud computing have been widely recognized (Bardhan et al. 2010, Demirkan et al. 2008), and include thinner clients that are less resource-intensive and offer data accessibility from anywhere that the Internet can be accessed.

Cloud computing is still in the early stages of adoption, and it presents an interesting technology adoption prospect for individuals, organizations and industries in different countries. For example, in the university setting, students have to evaluate whether a service like Google Docs is an appropriate alternative to the current client-based word processor on a laptop. Another example is the film industry in Hollywood. These days, the processor-intensive rendering of movie film on local clients is cost-prohibitive in comparison to some of the new service capabilities that are emerging on the Internet. Dreamworks Animation SKG (www.ldreamworksanimation.com) did this with two recent movies, “Shrek Forever After” and “How to Train Your Dragon” (Mellor 2010).

At the country level, energy consumption for powering data centers is an increasing target of legislation and regulation in Europe and North America (Goadoff and Forsling 2006). The European Union, for example, adopted the European Commission’s (2008) Code of Conduct on Data Centres Energy Efficiency in October 2008. In a similar time frame, other countries including India have been considering legislation to limit energy and cooling costs of server installations, which have grown rapidly with the IT services industry boom in the country during the past ten years. The expectation is that server operations will need to be located away from environments that require a lot of energy use for cooling.

These examples both play up and downplay the issue of physical location, which is an environmental factor for the adoption of cloud computing practices. In previous mainframe and client–server environments, end-users had to remain in close geographic proximity to hardware, software, and data. The new economic geography theory suggests that parties interested in adopting cloud computing should not be concerned with physical location to an great an extent as before. The benefits of physical proximity to computing assets have diminished with the new technology approaches, such that the high-tech capabilities are increasingly

| Table 4  
Mapping the research directions to application examples. | Application contexts | Research directions |
| Location-based services | Spatial relationships | Event history modeling |
| Cloud computing | Rational expectations and clustered adoption | New economic geography |
| Social networking | Spatial relationships | Fit appropriation |
| | | New economic geography |
being pushed from central locations such as Silicon Valley by the centrifugal forces associated with global ICT innovations to many other places around the world. An example is Microsoft’s September 2009 decision to locate a very large new cloud computing and service initiatives data center in Dublin, Ireland, where there are natural environmental factors that support green IT and sustainability practices for the operation of a high electricity consumption facility (Josefsberg 2009).

Another thing to look at with cloud computing is the impact of adoption factors that relate to its supporting technologies. Cloud computing offers potentially great benefits, but they cannot be realized without the effective implementation of complementary technologies by organizations. Most people won’t trust cloud computing with their word-processed documents if data storage is insecure. Nor will Hollywood film editors wish to offload the process of firm rendering to the Internet if connection speeds and bandwidth are insufficient to make the process efficient. So even though cloud computing may reduce the load on local processors, the benefits will be squandered if the complementary capabilities of the business process support system are not in sync with the operational requirements for producing high quality services (Tuazon 2010). Also, other improvements must be made in the current systems before cloud computing systems will be truly effective, with appropriate data security and protection measures a paramount concern.

7.3. Social networking

The impacts of social network adoption occur at several different levels of impact. At the individual level, more international users have connected with one another through Facebook. In 2008, Facebook had 34 million international users and the number grew to over 400 million by 2010 (Smith 2010). At the organizational level, the results are similar, with business-oriented sites such as LinkedIn that have 51% of the user base located outside the US. Jose Mallabo, International Corporate Communications Director of LinkedIn, said in a 2010 interview that “LinkedIn’s growth internationally has been entirely demand-led by its growing international subscriber members” (GlobalStrat.org 2010). Other improvements must be made in the current systems before cloud computing systems will be truly effective, with appropriate data security and protection measures a paramount concern.

As social networking involves technologies that connect users, there are interesting research questions and practical areas to explore by considering new economic geography-related variables. For example, is social networking as a marketing tool more effective for businesses on island nations with greater geographical barriers to trade than mainland countries? Cairncross (2001) has written that, with advancements in technology, it does not matter anymore where people, firms, and assets are geographically located. She points to the “death of distance” due to the revolution in communications, in particular. Do the same rules apply as in physical social networks? Can we extend the concept of spatial data into the virtual world? To what extent does language play a role in decisions on adoption of social networks?

Following our discussion of fit appropriation, it also makes sense to consider factors influencing diffusion rates of social networks that support appropriation beyond the considerations of fit. Researchers and practitioners alike will benefit from knowing which appropriation factors have influenced adoption and supported the tremendous changes and impacts of social networking technologies on young people.

8. Conclusion

An extensive body of literature on global ICT adoption is available to researchers for guiding theory development, application, and follow-on research. In this article, we considered theoretical research that discusses economic, social and other factors related to global ICT adoption. We also considered the level at which the impacts of ICT adoption in a country occur, including the individual, organization, industry, and national levels.

Our assessment of some of the key studies in the literature on global ICT adoption suggested that there are a number of areas of study where it may be appropriate to conduct new research with different theoretical and different methodological perspectives. We expect that new technology adoption theories will be mapped out in the future to explain the relationships between specific categories of factors and specific levels of analysis for impacts in regions within countries, across multiple countries, and in key global regions as well. This is consistent with the views of Burki and Aslam (2000), Gruber and Verboven (2001), Ho et al. (2007), and Jang et al. (2005). Most of the theories that we surveyed were general in their application: they extended across several factors and impacts. More specific theory will aid future researchers for developing, for example, a model for identifying the social factors of global ICT adoption at the industry level for different kinds of industries.

With ICT use increasing and connecting more individuals and groups of people, identifying some of the relevant fit appropriation constructs based on fit appropriation theory for the global context will aid practitioners in determining the proper fit of tasks and technologies where traditional task-technology fit ideas fail. Considering ideas associated with the new economic geography in the context of cloud computing will prompt practitioners to be less concerned with geographic proximity to their computing assets. In addition, businesses can look at social networks from this perspective and will be able to gauge whether their involvement in a domestic or international social network will have the greatest impact. Data available from location-based service users and spatial relationship analysis will be of interest to practitioners in marketing and supply chain management.

We close this article with two final thoughts. One of the major social issues of our time in global terms is the digital divide (Norris et al. 2001, Van Dijk and Hacker 2003, Forman 2005). Research on global ICT adoption offers those of us who work in university research an opportunity to move to the leading edge of policy issues, as suggested by Dewan and Riggins (2005) and Mariscal (2005). We can do this by tying research that we conduct on adoption and diffusion of technology to policy studies that are being undertaken in the major international institutions – by the World Bank, the United Nations agencies, and other non-governmental organizations (NGOs). Although equality of access will continue to be a difficult issue across the countries that span the spectrum of wealth and education levels, there nevertheless is a great impetus to more closely examine what it will take to understand why technology does not diffuse, or does not get adopted as an outside observer might think that it should. Technology adoption and innovation around the globe have the ability to increase economic growth and improve social welfare in developed nations, as well as in developing nations, where large percentages of the populations live in poverty. We are encouraged that technology adoption is a complement to many current initiatives in place to provide affordable housing, access to clean water, and grass roots support for the development of local economies. With a greater understanding of issues, theories, and research related to global technology adoption, we expect business and government leaders to leverage their ability to improve the quality of life for the citizens in developing nations (Kauffman and Kumar 2008).

For this reason, it will be useful for researchers to think much more about what we can do at the lowest levels of analysis – for example, at the individual and small business levels, and in the villages and towns – where the adoption of ICT can form the basis for dramatic changes. Just as we have seen with new directions in
research and policy-making that support microfinance (Firpo 2005, Mia 2005, Parikh 2005) and micro-regional development (Diniz et al. 2008, Kauffman and Kumar 2008, Lyman et al. 2008), so too should we be on the lookout for opportunities to perform case studies, do ethnographic research, and develop an understanding of the micro-level processes associated with ICT adoption in the global setting. The outcomes of this endeavor will make our work highly relevant where relevance is most needed – in the global settings where ICT adoption is early, and where the related transformation and positive impacts on the human condition will be the greatest (Warschauer 2004, Yunus 2007a, 2007b).

References


