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Exploring the Digital Divide in Mobile-phone Adoption Levels across Countries

Do Population Socioeconomic Traits Operate in the Same Manner as Their Individual-level Demographic Counterparts?

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Although the adoption of mobile phones has been skyrocketing globally during the current decade, present adoption levels are quite uneven across countries. Such disparities are also found over a range of other information and communications technologies and have been characterized as a "digital divide." Although the adoption of mobile phones has been the focus of numerous studies, relatively few have systematically and comprehensively investigated the adoption of this technological innovation at the country level of analysis and over a broad range of nations. This study addresses this research gap by examining the effects of three country-level socioeconomic factors paralleling the individual-level demographic traits that in past studies have predominantly predicted early adoption of innovations. We rely on secondary data obtained from several reputable sources to examine this phenomenon across 170 nations. Theoretical, managerial, and policy implications based on our empirical findings, along with directions for future research, are presented.

Keywords: *mobile telephone; country-level adoption; digital divide; information and communications technologies*

Mobile phones[1] came into being when AT&T introduced its first network to approximately two thousand customers in 1977 (Oneupweb 2005). Since then, mobile phones have been adopted worldwide at such a rapid pace that the penetration rate of cellular phones now has outstripped that of landline telephones and even exceeds the level for televisions. Today, there are more than three billion mobile subscribers throughout the world, and this figure is expected to double by the end of 2011 (Global Information Inc. 2006; World Cellular Information Service 2008). Subscriber growth has been rapid in almost all areas and especially in the Asia Pacific region. Diffusing globally faster than any other communication technology to date, mobile communication has become an essential part of many consumers' daily lives throughout the world (Castells et al. 2007). However, the penetration rates for mobile are uneven across regions and countries (Kauffman and Techatassanasoontorn 2005; van Dijk 2005). Generally speaking, the historically wealthy and powerful countries predominate, with low-income countries' having a little more than a 4 percent penetration rate while high-income countries have neared 77 percent (Goggin 2006). Even within the same region, such as the European Union or Latin America, country penetration rates vary quite widely. For example, in Latin America, Brazil accounts for more than one-third of all the mobile users in the entire region, yet its mobile penetration rate is merely on par with Venezuela (46 percent) while trailing Chile (67 percent) and Argentina (56 percent) but greatly outdistancing Peru's 22 percent level (Wireless World Forum 2005).

When first introduced, mobile embraced analog technology, which was an expensive service with limited capabilities and infrastructure. With the advent of digital technologies in the early 1990s and their evolution through new generations of technologies, both the capabilities and costs of mobile service have improved dramatically, thereby hastening its diffusion throughout both developed and developing nations (Rouvinen 2006).

Goggin (2006) contends that the mobile phone has become a central cultural technology in its own right. For consumers, it plays an indispensable role in their everyday lives since it facilitates a variety of uses. Mobile enables consumers to stay in constant contact with others; allows them to gather information, entertain themselves, and engage in transactions; and serves as an important element of identity construction and expression for many individuals. As consumers all over the world continue to embrace mobile technology in its various forms, m-commerce transactions are expected to continue to increase, especially because a mobile phone is an ideal medium for consumers to receive instantaneous information in the form of short messages adapted to individual requirements (Buellingen and Woerter 2004; Dholakia and Dholakia 2004).

Mobile has also been recognized for its expected ability to diminish the "digital divide." Defined as the division between those who have real access to and are effectively using information and communications technology (ICT), the digital divide is considered to separate countries into the "haves" (largely comprising developed nations) versus the "have nots" (mostly developing countries; see Bagchi 2005; Hill and Dhanda 2004; Kauffman and Techatassanasoontorn 2005; OECD 2001; van Dijk 2005). Unlike the digital divide represented by other ICTs, such as personal computers (PCs) and the Internet, using mobile does not require a high degree of user technical proficiency, nor does mobile rely on landline telephone infrastructures, which are often lacking in developing nations (Bagchi [2005] cites World Bank estimates that nearly 80 percent of the world's population is without telephone connections). In fact, mobile holds the potential for developing nations to leapfrog technologically since they are able to bypass the development of landline telephone systems.

The aspiration of diminishing the digital divide is not simply found in academic and policy circles. *The Economist* ("A Spiritual Connection" 2005, March 12–18) dedicated its front cover to the topic and in an editorial posited that the mobile phone, rather than the Internet, could be the key technology for helping the world's poor move out of poverty.

Given the significant and growing impact of mobile communications, understanding different countries' socioeconomic profiles and their mobile telephony adoption patterns merits special attention for several reasons. One is because of the reciprocal relationship between technology and quality of life (United Nations Development Programme 2008; Hill and Dhanda 2004). Since mobile does not suffer from the infrastructure restrictions of landline telephones, it provides greater communications access than previously available, especially in developing nations. Another reason is that marketers are increasingly turning to the mobile screen for marketing opportunities and are trying to capitalize on the unique advantage mobile terminals offer—by allowing message recipients to be contacted at times, with more media options, and in situations in which it would not be possible to reach them with other methods (Balasubramanian, Peterson, and Javenpaa 2002; van Dijk 2005). As one may expect, marketing activities can have substantial influence on consumer well-being (Pan, Zinkhan, and Sheng 2007). Investment in mobile technologies and wireless networks has the potential to create time, place, and information utilities, thus expanding economic activity, creating wealth, and enhancing perceived quality of life around the globe (Peterson and Malhotra 1997).

With an increasingly integrated worldwide market thanks to globalization and advancement in ICT, more macromarketing research is needed, since the extent to which mobile has been embraced varies considerably from country to country. Reflecting the historical call made by Wood and Vitell (1986) for research on aggregate consumption patterns and the more recent research agenda espoused by Cornwell and Drennan (2004) to improve our understanding of the effects of globalization, there is a pronounced need to better appreciate why the populations of many countries are lagging behind others with regard to the adoption of ICT innovations, and in particular, mobile. As Peterson and Ekici (2007) have noted, more research efforts should be directed at learning about consumers in developing countries since issues there may be strikingly different from those in developed countries. More specific to the digital divide is the call by DiMaggio et al. (2001) for more empirical research into the determinants of digital inequality among social units of varying sizes, including nations. Hill and Dhanda (2004) drew a similar conclusion in their study of globalization and technological achievement.

Thus, the intent of the present study is to examine country adoption levels (penetration rates) for mobile and determine whether country-level socioeconomic factors parallel the findings of numerous individual-level studies in which demographic factors have been shown to be related to propensities to adopt innovative ICT products and services. Reflecting the call by Cornwell and Drennan (2004) for more research that conceptually links micro- and macro-variables, we seek to determine whether the three most prevalently found individual-level predictors associated with early adoption (i.e., the demographic factors of age, education, and income) hold true when the level of analysis shifts to a country's population. By doing so, we address a gap in the literature by empirically investigating the effects of age on mobile-adoption levels across a broad range of countries.

Secondary data across 170 countries have been drawn from several reputable sources, including the International Telecommunication Union (ITU), the World Bank, the United Nations Development Programme (UNDP), and the 2005 Central Intelligence Agency (CIA) Factbook, and are used to test the research hypotheses. In the following section, we briefly review the individual-level and country-level product-adoption literatures, along with the nascent digital-divide literature, and articulate a series of testable propositions. Following that, we present the results of an empirical test of our model using secondary data we assembled from the aforementioned sources, discuss the implications of these findings, and tender recommendations for future research.

Literature Review

During the past three decades, an extensive literature has developed to address new-product adoption behaviors among individuals and diffusion patterns among groups of people within and between countries. At the forefront of this literature have been the seminal conceptualizations of Everett Rogers (1962). During the ensuing decades, the adoption and diffusion of innovation literatures have spawned considerable theoretical development and an extensive body of empirical evidence. Moreover, this literature has bifurcated into two prevalent approaches: the individual level (such as studies that measure the effects of adopters' demographic traits or the perceptions of an innovation's characteristics on adoption patterns or that compare the adoption rates of different innovations) and the system level (such as studies that consider the nature of a social system and the relative extent to which an innovation is adopted within communities, countries, or other social units having different economic, demographic, and cultural characteristics).

Factors Influencing Mobile Adoption at the Individual Level

During the past three decades, a wide variety of technological-product innovations, particularly those involving ICT and ICT-mediated services, have been the focus of empirical research. Illustrative of these studies have been those that pertained to computers (Stoneman 1983), the Internet (Kiiski and Pohjola 2002), automatic teller machines (Murdock and Franz 1983), and Internet banking and shopping (Eastin 2002).

From this empirical literature and the conceptualizations on which it is based, we now know that new-product adoption among individuals is a function of consumer demographics (e.g., age, income, education, mobility), personal characteristics and psychological factors (e.g., general and domain-specific innovativeness, involvement, social interaction, attitudes toward risks, and opinion leadership), and perceived product attributes (e.g., relative advantage, compatibility, complexity, trialability, communicability; see Im, Bayus, and Mason 2003; Rogers 1983, 1995; Tornatzky and Klein 1982; Uhl, Andrus, and Poulsen 1970; Venkatraman 1991). While the findings related to demographic traits have not always been consistent, there is a substantial body of evidence that suggests that consumer innovators and early adopters tend to be younger, have higher levels of income, and are more educated (Dickerson and Gentry 1983; Gatignon and Robertson 1991; Rogers 1995).

Turning specifically to mobile adoption, studies have also shown mixed results on the impact of demographic variables. For example, Ahn (2001) found that age, sex, and education are all important determinants of current and intended mobile subscription among Korean consumers. His research revealed that the intended subscription rate is generally higher among younger people, men, and those who have received some post–high school education. Wareham and Levy (2002) found that mobile adoption is positively correlated with income and occupation but not age or education. Rice and Katz (2003), in their study of Americans, found that age, work status, and marital status are predictors for mobile-phone adoption and reported a gap between mobile-phone users and nonusers that was associated with income, work, and marital status.

To recap this stream of individual-as-adopter research focusing on ICT innovations, three conclusions can be drawn: (1) more often than not, these studies have involved data from a single or only a few countries; (2) this research has largely appeared in marketing and technology journals; and (3) few studies in the broader global setting have attempted to apply the findings in consumer innovativeness to ICT innovations other than the Internet.

Factors Influencing Mobile Adoption at the Country Level

As revealed in reviews conducted by Kauffman and Techatassanasoontorn (2005) and Rouvinen (2006), the relatively limited number of country-level studies that deal with ICT have primarily been published since the mid-1990s and tend to be concentrated in technological or econometric journals. In general, the country-level literature provides evidence that adoption and diffusion of new ICT products and services are influenced by myriad factors that can be summarized by four broad themes: socioeconomic, political, cultural, and technological or structural factors. Past studies have focused on country demographic predictors such as population levels; GDP per capita; education and literacy level of the population (Baerwald 1996; Lee 1991; Maitland and Bauer 2001; Nunberg 2000; Robison and Crenshaw 2002; Yeniyurt and Townsend 2003); life expectancy, urbanization, cosmopolitanism, mobility, and women in the labor force (Gatignon, Eliashberg, and Robertson 1989; Helsen, Jedidi, and DeSarbo 1993; Yeniyurt and Townsend 2003); religion (Maslen 1996); media access (Maitland and Bauer 2001; Tellefsen and Takada 1999); and service-sector development (Robison and Crenshaw 2002). Others have concentrated on political factors, such as political history and stability (e.g., being a former colony of a Western nation or member of the Soviet bloc or the absence of internal or external military conflict; see Groth and Hunt 1985; Kshetri 2001; Maslen 1996; Dekimpe, Parker, and Sarvary 1998); type of government (e.g., democracy or autocracy; see Groth and Hunt 1985; Kshetri 2001; Kshetri and Dholakia 2001; Maslen 1996); political and legal support (Kshetri and Dholakia 2001; Stephens 2001); and international trade and tariff policies (Kshetri 2001). A limited number of studies have considered cultural factors, such as compatibility with societal values, cultural norms, and communications preferences (Rogers 1983; Erumban and de Jong 2006). Studies from the final group have included predictors such as technological skills, standards, and compatibility (Dholakia et al. 2002; Gatignon and Robertson 1985; Kauffman and Techatassanasoontorn 2005; Koski and Kretschmer 2005; Rogers 1983); market structure and competition (Ingelbrecht and Trivedi 2004); and other structural factors such as PC ownership, electricity consumption, telephones per capita, and physicians per capita (Helsen, Jedidi, and DeSarbo 1993; Maitland and Bauer 2001).

Turning to studies that have specifically addressed mobile adoption or diffusion, in addition to embracing country demographic predictors and additional factors common to other ICT innovations, research on the development of mobile telephony has looked into some of the unique aspects related to the telecommunication industry of a country, such as network effects (Birke and Swann 2006; Doganoglu and Grzybowski 2007; Grajek 2003; Kim and Kwon 2003; Madden, Coble-Neal, and Dalzell 2004; Wareham, Levy, and Shi 2004) and the effects of regulation, competition, and technological progress (Gruber and Verboven 2001; Koski and Kretschmer 2005).

Research results on the influence of country-level factors on mobile adoption in a global setting are also mixed. For example, Jha and Majumdar (1999), who posited that greater GDP per capita should signify greater affordability and hence lead to increased demand for mobile telecommunications services, found that mobile penetration varied substantially among the twenty-three Organisation for Economic Co-operation and Development (OECD) countries of different GDP per capita. Madden, Coble-Neal, and Dalzell (2004), using global telecommunications panel data from fifty-six countries, reported that GDP was important in explaining mobile network diffusion. Quibria et al. (2003) provided evidence that country income is a determining factor for national levels of adoption for older technologies. Conversely, Gruber and Verboven (2001) found no empirical support for such a relationship for Central and Eastern Europe. Appendix A, which builds on the review by Rouvinen (2006), summarizes recent major studies of mobile adoption and diffusion in global settings.

It is worth noting several important gaps that exist within the country-level literature. One is that nearly all these empirical studies have included a limited number of countries (only two have examined more than seventy-five nations). Second, while GDP per capita and a population measure are the common socioeconomic explanatory variables shared across many of these studies, none of them has explicitly focused on investigating the effects of age on levels of mobile adoption across countries. Another gap is that much of this literature is dominated by purely descriptive studies, often with little conceptual development undergirding them. A notable exception is the nascent literature on the anthropology of mobile communications (Horst and Miller 2006).

"Digital Divide" Literature

Construed as a disparity in the access and actual use of ICT innovations, which separates individuals, organizations, social groups, and nations into "haves" and "have nots" (Dewan and Riggins 2005; van Dijk 2005), the digital divide has spawned considerable attention by academicians, policy makers, businesses, nonprofit and government leaders, and others. A vast literature now exists on the digital divide that draws on a variety of theoretical perspectives and research methods (Dewan and Riggins 2005). While a review of these studies reveals that a considerable body of literature now exists on the digital divide, relatively little of it comprises empirical studies that have used countries as the unit of analysis. This empirical research on the country-level digital divide can be characterized in three ways: (1) whether the focus is a single nation or multiple nations, (2) whether the research addresses a specific technology versus a group of technologies, and (3) whether the digital divide is growing or shrinking (Bagchi 2005). In sum, most of the country-level studies on the digital divide have focused on the Internet or ICT in general (typically a composite measure), featured a limited number of countries, and included a variety of operational measures of ICT access or use.

In the next section, our conceptual model of country-level adoption of mobile phones is advanced. We use as our theoretical foundation the model developed by van Dijk (2005), who postulates that the digital divide, or participation within a society (or between societies), is a function of personal and positional categorical inequalities, distribution of resources, and access to ICT. Although van Dijk's model is essentially an individual-level framework, we propose that the underlying logic can also be applied at higher levels of social aggregation. While such an approach might be argued as succumbing to the "atomistic fallacy" (Diez Roux 2002), it is consistent with the approach taken by threshold models of innovation diffusion (Edwards et al. 2003).

Conceptual Model of Country-level Mobile-adoption Levels

We posit that country mobile-access levels (operationalized as mobile subscriptions per hundred inhabitants) will show a high level of association with three socioeconomic factors that capture categorical inequalities and different resource distributions (van Dijk 2005).

Age. How age relates to adoption behavior has long been of interest to researchers from marketing and other social sciences. As shown in Appendix A, most cross-country mobile studies have incorporated a limited number of socioeconomic factors, most typically GDP per capita (or similar measure) and population (or density), but age-related factors typically have not been included.

According to the consumer literature, young people are more favorably disposed toward change (Schiffman and Kanuk 2003) and have been found to be more receptive to new ICT technologies such as the mobile phone and ICT-mediated services such as automatic teller machines (ATMs) and Internet banking (Eastin 2002). Seeking to bridge the micro–macro dichotomy that macromarketing scholars have recognized (Gerstein 1987; Cornwell and Drennan 2004), we posit that nations with a relatively young population should be more receptive to adoption since country-level penetration rates are in part an aggregation of individual consumption decisions.

As noted by Castells and his colleagues (2007), a key factor in the rapid diffusion of mobile communications was because this technology has been embraced by the younger generation. In fact, despite the slowing rate of growth of the global youth and young adult population (i.e., ages five to twenty-four), the mobile youth population was predicted to reach 370 million by 2007, up from 257 million in 2005. In some markets, youth mobile penetrations have exceeded 85 percent across the entire five-to-twenty-four age segment, and the age of mobile-phone users has been observed to be constantly decreasing (Wireless World Forum 2005). As such, understanding the imperatives behind youth adoption and use of mobile phones has become one of the most common research priorities (Horst and Miller 2006; Ito, Okabe, and Matsuda 2005; Kasesniemi and Rautiainen 2002; Ling 2004; Taylor and Harper 2003; Weilenmann and Larsson 2001).

The phenomenal increase in mobile ownership and acceptance levels among youths worldwide has led to the mobile phone's being dubbed a cultural icon of the younger generation in the twenty-first century. This "mobile culture" has been largely determined internally by the youths themselves (Castells et al. 2007; Goggin 2006; Wireless World Forum 2005). In contrast, owing to the physical features of the mobile handset, many elderly people find it difficult to operate the device (Castells et al. 2007). It has been reported that these difficulties exceed the generational gap common to other new ICT gadgets (Lobet-Maris and Henin 2002; MGAIN Consortium 2003). We label this phenomenon the age effect on mobile adoption. Hence, we propose the following:

> *Hypothesis 1:* The median age of a country will be inversely related to its adoption level of mobile phones.

Education. In a review of the literature, Rogers (1983) reported that 73 percent of past studies support a positive relationship between education and innovativeness. From a causal perspective, education and socioeconomic development are mutually related; that is, each fosters the other, and a compelling body of research links education to economic development and growth (Schweke 2004). Education facilitates socioeconomic development by "lubricating" the movement of workers between sectors by providing necessary skills and attitudes and encouraging rapid rural-to-urban migration as literate agricultural workers seek better lives in cities. An educated work force reduces training costs while at the same time allowing an accelerated pace of technological change in the workplace. By the same token, more affluent nations have higher levels of literacy, considerable public and private support for education, and extensive arrays of educational institutions. Thus, it is logical to expect that the demand of technological innovations and related skills will be driven, at least in part, by the degree of education in a population (Robison and Crenshaw 2002). Despite the inherent logic of this rationale, Kauffman and Techatassanasoontorn (2005) note that the role of education on technology growth is mixed, which may be a function of whether or not special skills are required to use the innovation. At its most rudimentary use as a verbal-communications device, mobile requires no more skill than one would need to use a landline telephone. Thus, education may not be a determining factor. In light of these conflicting expectations, we take a conservative stance and propose the following:

Hypothesis 2: The level of education attainment of a country's population will be unrelated to its adoption level of mobile phones.

Wealth (GDP per capita). According to Rogers (1995), studies of innovation diffusion also revealed that early adopters tend to have greater wealth. Individuals with higher income have the financial resources to invest in new technologies even before the advantages of the innovation are recognized by other adopters, and because of their financial strength, they are better able to afford the risk associated with early adoption (Maitland and Bauer 2001). At the national level, one measure of a country's wealth is its GDP per capita, which is frequently used in empirical studies. Such a national measure is in part an aggregation of individuals' wealth and should predict adoption just as the individual-level measure (i.e., annual personal or household income) would. According to Beise (2004), countries with high income per capita command a demand advantage for an innovation. Jha and Majumdar (1999) argue that greater GDP per capita signifies greater affordability for more members of a country's population. Thus, we propose the following:

Hypothesis 3: The level of a country's wealth (GDP per capita) will be positively related to its adoption level of mobile phones.

Control variables. We also include other country-level variables in our model to account empirically for extraneous factors that may influence adoption levels. These include population density, GDP percentage from the agricultural sector, the incidence of landline telephones, and the introduction date for digital mobile telephony. Population density, common to many other country-level ICT-adoption studies, is used to account for the potential influence derived from inherent market potential, which may evoke greater marketing efforts on the part of mobile providers. Denser markets also hold the potential for faster diffusion since there are more opportunities for individuals to be exposed to the new technologies being used by innovators and others within their social circles (Wareham, Levy, and Shi 2004). The composition of a country's economy can also be expected to influence the use of mobile phones. The percentage of GDP coming from agriculture is used as a (negative) proxy for the overall technological receptivity of a country and the reliance on ICT to support economic activities in the manufacturing and service sectors. Moreover, a high dependence on agriculture is likely to be negatively correlated to a country's urbanized population. The number of landlines is used to control for competing telecommunications networks and also as a proxy for the infrastructure investments in legacy systems that suppliers have made that may impede the diffusion of mobile (Kauffman and Techatassanasoontorn 2005). The introduction date for digital mobile telephony is included to account for the length of availability of digital service that is technologically superior to the first-generation analog systems. This factor also serves to capture target market biases of technology innovators, given their early focus on developed versus developing nations (Rouvinen 2006).

Tests of Hypotheses and Empirical Findings

Since it is a challenge to collect data for a multivariate analysis on a global scale, we use secondary data from several reputable sources, namely the International Telecommunication Union (2006) for mobile-phone subscription levels (per hundred inhabitants), population density (per square kilometer), and total landline telephone subscribers; the World Bank for 2005 GDP per capita (World Bank 2005)[2]; the United Nations Development Programme Human Development Report for the education index[3]; and the 2005 CIA Factbook for population median age and the percentage of GDP derived from the agriculture sector. Dates for the year of commercial introduction of digital mobile telephony were drawn from Rouvinen (2006).[4] Altogether, complete data are available for 170 countries. The list of countries in this study can be found in Appendix B; the correlation matrix and descriptive statistics for the variables in our model are listed in Table 1.

The hypotheses were tested in a hierarchical fashion using ordinary least squares (OLS) regression. In the initial run, the main effects of the four control variables were

Table 1
Correlation Matrix and Descriptive Statistics

	1	2	3	4	5	6	7	8
1) Mobile subscriptions	1.00							
2) Median age	0.80 *	1.00						
3) EDI	0.69 *	0.78 *	1.00					
4) GDP per capita (in thousands)	0.69 *	0.65 *	0.50 *	1.00				
5) Population density	0.22	0.18	0.08	0.14	1.00			
6) GDP percent from agriculture	–0.72 *	–0.63 *	–0.67 *	–0.53 *	–0.14	1.00		
7) Landlines installed (in millions)	0.09	0.21	0.14	0.11	–0.02	–0.14	1.00	
8) Introduction year for digital mobile telephony (DMT)	–0.53 *	–0.54 *	–0.50 *	–0.53 *	–0.16	0.39 *	–0.23	1.00
	1	2	3	4	5	6	7	8
Mean	52.86	23.74	0.78	9,307.48	207.08	16.42	22,505.49	1,996.37
Standard deviation	40.24	8.15	0.180	14,400.86	757.89	14.87	75,885.71	2.63

Note: EDI = education index.
$^*p < .01$.

Table 2
Multivariate Regression Results

Independent Variables	Hypotheses	Control Variables Only	Control Variables & Main Effects	Controls, Main Effects, & Interaction
Intercept		— (6.54)***	— (1.29)*	— (1.62)*
Median age	H1: (–)		.43 (5.86)***	.50 (6.80)***
Education	H2: (–)		.03 (0.48)	–.03 (–0.47)
GDP per capita	H3: (+)		.20 (3.65)***	.21 (3.88)***
Median age × GDP per capita				–.15 (–3.52)***
Population density		.13 (2.66)***	.06 (1.42)*	.06 (1.47)*
Percentage of GDP from agriculture		–.55 (–10.59)***	–.30 (–5.33)***	–.24 (–4.23)***
Landlines		–.06 (–1.18)	–.09 (–2.14)**	–.08 (–2.14)**
Introduction year DMT		–.34 (–6.49)***	–.07 (–1.30)*	–.08 (–1.63)*
F value (*df*)		*F*(4, 183) = 67.60***	*F*(7, 162) = 70.82***	*F*(8, 161) = 67.86***
R^2		.60	.75	.77
Adjusted R^2		.59	.74	.76
Adjusted R^2_{Δ}			.15	.02

Note: Standardized parameter estimate (*t*-value) shown.
$^*p < .10$; $^{**}p < .05$; $^{***}p < .01$.

assessed. The main effects of the three socioeconomic factors were then added, and the model was re-estimated. The significant overall *F* tests in both runs are indicative that interpretation of the individual regression models and parameter estimates for the independent variables is warranted. Results are displayed in Table 2.

As we can see from Table 2, the addition of the main-effect terms relating to the three socioeconomic variables results in a significant improvement in the explanatory power of the models. Adjusted R^2 improved to .74 from .59.

Contrary to our expectations, median age had a significant but *positive* effect on mobile-adoption level ($b = .43$, $p < .01$). Thus, Hypothesis 1 is not supported, since the results indicate that mobile-adoption levels are higher among countries with older populations. Hypothesis 2, which related to education levels, was supported given the nonsignificant parameter estimate ($b = .03$, $p > .10$).[5] As expected, GDP per capita has a significant positive effect on mobile adoption level ($b = .20$, $p < .05$). Thus, Hypothesis 3 is fully supported. Overall, median age was found to be the strongest determinant of mobile-communications subscription levels.

Turning to our control variables, population density and the date digital mobile was introduced were found to be insignificant ($b = .06$, $p < .10$; $b = –.07$, $p < .10$), whereas the remaining two controls were both found to negatively impact mobile-adoption levels (percentage agriculture: $b = –.30$, $p < .01$; landlines: $b = –.09$, $p < .05$).

Post hoc analysis. In light of the unexpected positive result found for median age, an additional analysis was performed to see if this effect was constant in all countries. We therefore reran our model to add an interaction term between the two significant focal variables, median age and GDP per capita.[6] Since this was an exploratory analysis, no hypothesis of the expected relationship was posed. As shown in Table 2, the introduction of this interaction term modestly improved the explanatory power of the model (adjusted R^2 improved to .76 from .74). More notable is the fact that the interaction term was negative and significant ($b = –.15$; $p < .01$), which indicates that a contingent relationship exists. Hence, we can conclude that the effect of median age on mobile-communications subscriptions varies depending on the level of GDP per capita. To make further sense of this finding, we performed a quadrant analysis by using a mean split on both median age and GDP per capita; the resulting four cells from this 2 × 2 matrix were then used in a one-way analysis of variance (ANOVA). This ANOVA produced significant results, both overall ($F_{[3, 196]} = 105.93$; $p < .01$) and from the Scheffé post hoc test that was performed, which proved to be very diagnostic. We found that the High/High cell represented the "ultra haves." This cell, consisting of fifty-five countries with relatively high GDP per capita and also relatively high median ages, enjoyed the highest average mobile-subscription levels (97.97), a value that was significantly different from the averages of the other three cells. Conversely, we found that the Low/Low cell, that is, the 111 countries with relatively low GDP per capita and relatively low median ages, had the lowest average mobile-subscription levels (24.13), a value that also was significantly different from the other three cells. This cell clearly represented the "have nots." Interestingly, the means of the two mixed cells, Low (median age)/High (GDP per capita)—five countries—and High (median age)/Low (GDP per capita)—forty countries—were not significantly different from one another (64.40 versus 65.05), which suggests that these two factors tend to counterbalance one another when they are asymmetric. Together, these two cells represent the "moderate haves" with regard to mobile subscriptions.

Overall, these results are intriguing since they seem to be indicating an important implication for marketers and government policy makers: combining median age and the more traditional focus on affluence (GDP per capita) is significantly more predictive of country-level adoption levels for mobile telephony than earlier models that only considered the main effect of GDP per capita and a limited number of other variables.

Discussion

Our study extends and enriches the research literature related to the digital divide and the adoption of ICT and mobile telephony in particular. We sought to provide an answer to the question of whether socioeconomic factors predict country mobile-adoption levels and parallel the patterns related to three individual-level demographic traits, that is, age, education, and income, which have long been associated with the early adoption of technological innovations at the individual unit of analysis.

Theoretical implications. Similar to other diffusion studies (e.g., Dekimpe, Parker, and Sarvary 1998; Ahn and Lee 1999; Madden, Coble-Neal, and Dalzell 2004), we found that wealth (operationalized as GDP per capita), as a main effect, is an important determinant of mobile-penetration rates, which is consistent with the individual-adoption literature. Understandably, a country's GNP per capita reflects its economic and technological resources and capabilities, and thus, positively boosts mobile-phone adoption.

We also found that the level of education at the country level did not affect the adoption levels of mobile phones significantly. This finding is not consistent with previously reported results at the individual level, which indicated that there are strong correlations between education and innovativeness (Rogers 1983), but it does provide additional credence to lack of a significant effect for education reported in the review of country-level studies by Kauffman and Techatassanasoontorn (2005). One possible explanation for this result is that education is highly correlated with GDP per capita and median age (see Table 1), which could mean that the latter variables act as a suppressor in the regression analysis. Another reason may be that our measure of the level of education in a country reflects the development and status of the country's education system but not necessarily the actual degree of literacy of individual consumers, which is critical to their innovativeness. Still another reason may be that compared to other ICT innovations, mobile telephones requires less skill to use (Quibria et al. 2003). Future research needs to further look into the role of education at the country level and perhaps include multiple measures of this predictor.

A more intriguing finding is that we discovered that a population's median age had a significant but *positive* main effect on mobile-phone adoption levels. This contradicts the results of past studies at the individual level, which typically suggest that younger consumers tend to be more open-minded and receptive toward technological innovations.

This effect, however, was found to be contingent on whether the country also enjoys a relatively high GDP per capita. Our post hoc analysis revealed that first-tier markets, which we called the "ultra haves," are countries with both high GDP per capita and populations with a high median age. Second-tier markets, the "moderate haves," are either relatively affluent but with a younger population or less affluent with older populations. Laggards, or the "have nots," comprise more than one hundred nations that are less affluent and have younger populations.

This suggests that one-size-fits-all interventions to foster growth of individual national mobile telephony markets could be ineffective. Instead, more nuanced government programs may be in order. Having an older population makes a significant difference in terms of mobile-adoption rates among less wealthy nations; that is, country adoption levels of mobile phones are positively associated with the population's median age. So, the older the population is, the higher the adoption rate for mobile phones in low-income countries. One possible explanation is that in those less affluent countries, mobile affordability is more likely to be an issue for the young people. In other words, the older a person is, the more likely he or she has a job and/or is heading up a family unit and thus has more economic means to be a mobile-service subscriber. Another explanation could be that a country with a relatively low median age may imply that a relatively small portion of its population is found in middle and upper class households that can afford mobile phones. This may also be a function of the GDP per capita income measure's being a poor vehicle to capture income disparities within nations (Hill and Dhanda 2004; Kotler, Roberto, and Leisner 2006). Nevertheless, one important implication of our finding is that by failing to explicitly articulate and test contingency models, past studies may have been flawed.

In sum, our study was able to confirm some of the findings (e.g., wealth and income) of past studies at the individual level but refute others (e.g., education and age). An obvious conclusion is that the results of previous research at the individual level may not be automatically extendable to the country level. Careful interpretations of similar socioeconomic factors at the country level and potential interaction effects between these factors are particularly warranted.

Managerial implications. Our results have implications for venture-capitalist communities and m-commerce business strategists. First of all, as venture capitalists and ICT businesses increasingly look for overseas investment opportunities, our results imply that they should examine more than just main effects of socioeconomic factors to better predict if a country will be conducive for mobile telephony, and implicitly, the m-commerce that can be built on this ICT backbone. Hence, the interrelationships among socioeconomic characteristics of countries should also be used as screening criteria. Specifically, our study suggests that simplistic screening solely on GDP per capita should be avoided. Multinational corporations (MNCs) could use our findings to segment countries into more refined market segments that could facilitate better resource allocations across different countries.

Policy implications. Our findings also have important implications for policy makers. As world economies increasingly converge, it is important that no country is left behind as we move toward a more advanced digital era. We can expect to see increasing returns with more people connecting to the digital networks but should recognize also that technology does not create inclusive opportunities without human intervention (Fulton 2000). As mentioned earlier, mobile has been recognized to have greater potential than the Internet to help diminish the digital divide, and consequently, to foster economic and social benefits. To do so, governments and corporations may need to develop unique actionable policies and programs that seek to bridge the digital divide in this mobile age and move more people toward greater mobile access, use, and commerce opportunities. For example, initiatives in less affluent nations might include more favorable policies toward foreign investment in mobile telephony infrastructure, calls for the support of both private and corporate philanthropic organizations, creation of innovative content, development of pedagogy and training to educate the young about technological know-how, or provision of subsidized access to disadvantaged people and communities. No doubt, what policy makers do to engender mobile diffusion will have a critical impact on how the mobile as a medium can and will live up to its capacity to benefit the society.

Limitations and directions for future research. As with any research, this study has several limitations. First, this study used secondary data, which have been criticized for being inconsistent and unreliable (Yeniyurt and Townsend 2003). Furthermore, while our dependent measure (mobile subscriptions) was from a credible secondary source, alternative adoption measures, such as use-volume data compiled by the ITU and the World Cellular Information Service, could be incorporated into future research. As conceptualized by van Dijk and colleagues (van Dijk 1999, 2000, 2005; van Dijk and Hacker 2003), physical or material access alone is a simplistic measure. Moreover, it is problematic to rely solely on mobile-subscription data, since the correlation between access and use is likely to be greater in developed countries than in developing ones such as India, Pakistan, and the People's Republic of China (James 2004). Development of more comprehensive, multidimensional measures that capture the multifaceted nature of the digital divide, such as motivational (mental), physical, skills, and use-access measures (van Dijk and Hacker 2003; van Dijk 2005), should be the goal for future mobile-adoption and digital-divide research at the country level.

Second, we used a cross-sectional design, which can only capture a snapshot of mobile adoption at a single point in time. Future analyses could shift to examining diffusion rates using longitudinal designs, which could use the time-series data available from the ITU.

In addition, the adoption rate of only one technological innovation, mobile telephony, was investigated. Hence, generalizability of our findings is limited. At a minimum, this study should be replicated using other ICT products and services to see if the factors that influence mobile adoption operate in the same manner relative to other ICT innovations.

Finally, only one pair of socioeconomic variables was examined for its moderating effect on mobile-phone adoption rates. Future research should also incorporate a broader range of country-level analogs to individual-level demographics and personal characteristics, such as a nation's cultural dimensions (Erumban and de Jong 2006; Hofstede 1991; Schwartz 1994; Smith and Schwartz 1997) along with other political factors, and explicitly articulate and test contingency hypotheses.

Despite these limitations, the results from this exploratory study are important and quite revealing. The interrelationships among factors that influence mobile-adoption rates are crucial for policy makers, marketers, and business strategists to understand in regard to ICT commercialization and subsequent m-commerce strategy development and implementation, and ultimately, to bridging the digital divide to ensure greater social and economic welfare for the populations of all countries.

Appendix A
Major Studies of Mobile Adoption or Diffusion in Global Settings

Study	Dependent Variables	Independent Variables (IVs) and Control Variables (CVs)	Number of Countries or Regions Covered	Time Frame	Relevant Findings
Dekimpe et al. (1998)	Mobile penetration	IVs: GNP per capita, population growth, # of major population centers, # of competing systems, death rate, communism dummy, # of ethnic groups	184 countries	1979-1992	High wealth, ethnic homogeneity, and low death rate promote diffusion
Jha and Majumdar (1999)	Mobile subscribers	IVs: # of total mainlines, total employees, time CVs: time of entry, investment per mainline, population, GDP, tariffs, liberalization, # of cellular operators, private operator dummy, # of Internet hosts, global system for mobiles (GSM) dummy, interactions between cellular technology, total mainlines, and total employees	23 OECD countries	1980-1995	Cellular subscription, investment per mainline, population, GDP, tariff, liberalization, and private-operator presence are factors positively influencing telephone-sector productive efficiency
Ahn and Lee (1999)	Mobile penetration	IVs: GDP per capita, fixed penetration and digitalization rate, mobile user cost	64 countries	1997	High GDP per capita and fixed penetration promote diffusion
Burki and Aslam (2000)	Mobile users	IVs: GDP, population, fixed penetration, digital mobile dummy, analog and digital mobile competition dummies	25 (Asian) countries	1986-1998	GDP, population, fixed penetration, digital mobile dummy, analog and digital mobile competition dummies
Gruber (2001)	Mobile penetration	IVs: GDP per capita, share of urban population, fixed penetration & wait time, digital mobile competition dummy, # of mobile operators, market transition index	10 (EU accession) countries	Introduction 1997	Late mobile adoption and multiple operators, as well as high fixed penetration and long wait times, promote diffusion
Gruber and Verboten (2001)	Mobile users	IVs: GDP per capita, fixed penetration, digital mobile technology dummy, analog/digital mobile competition dummies	15 (EU) countries	1992-1997	Analog to digital mobile transition and competition promote diffusion; late entrants adopt mobile faster
Liikanen, Stoneman, and Toivanen (2001)	Change in analog and/or digital mobile users	IVs: GDP per capita, population, share of urban population and population over 65, fixed users/ penetration, analog/digital users/penetration, # of analog/digital standards and years since introduction, Nordic Mobile Telephone (NMT) and GSM dummies, 5 measures of mobile telephony operation, age-dependency ratio, surface area	80 countries	1992-1998	Digital mobile introduction hinders analog mobile diffusion; generation-specific (analog vs. digital) results differ from generic (analog + digital) results: technology shifts should be accounted for

(continued)

Appendix A (continued)

Study	Dependent Variables	Independent Variables (IVs) and Control Variables (CVs)	Number of Countries or Regions Covered	Time Frame	Relevant Findings
Koski and Kretschmer (2002)	Mobile penetration, user cost, and entry	IVs: GDP per capita, share of urban population, telecom regulator dummy and competition measure, analog mobile penetration, digital mobile subscriber and prepaid users, digital mobile standard dummy, market share of dominant digital mobile standard, more than 2 mobile operators dummy	32 countries	1991-1999	Incorporating the time of entry to digital mobile telephony study is important; both between- and within-standards competition promotes diffusion and lower user cost, particularly when more than 2 operators are present
Madden et al. (2004)	Mobile penetration	IVs: GDP per capita, population, mobile user cost	56 countries	1995-2000	High wealth, low users cost, and large user base promote diffusion
Banerjee and Ros (2004)	Cluster analysis based on teledensity, cellular density, CAGRs of teledensity, and cellular density		61 countries	1996-2001	Relatively fewer affluent countries appear to have favored the leapfrogging of fixed telephony by mobile telephony; the more developed and affluent countries show no evidence of any bias in favor of one form of telephony over the other
Garbacz and Thompson (2005)	Business and residential mainline demand, mobile demand	IVs: GDP per capita, monthly user cost, connection charge, population density, education, Internet users per capita lagged one period, index of economic freedom (regulation), time dummies	85 countries	1996-2001	A complementary relationship tends to exist between mobile service and fixed mainlines
Jang, Dai, and Sung (2005)	Mobile diffusion	IVs: GDP per capita, population density, switch to digital technology, competition (market openness and # of new vendors), payment options, fixed penetration	29 OECD countries and Taiwan	1980-2001	The switch to digital technology and competition accelerate mobile diffusion; payment options and fixed penetration also critically affect diffusion; population density and GDP per capita have no significant effect on mobile diffusion
Andonova (2006)	Mainlines, Internet hosts, Internet users, and cellular phone subscribers	IVs: cellular charge, cellular phone subscribers, user cost, GDP per capita (residual), illiteracy (residual), Internet hosts (residual), mainlines (residual), political rights and civil liberties (POLCON), urban population (residual) CVs: POLCON, price of telephony access and price of use, illiteracy, urban population	___	1960-2002	POLCON has a significant impact on mobile-phone subscription; institutional improvements associated with lower investment risks and better property-rights protection correlate less strongly with mobile diffusion; GDP per capita (residual) correlates positively with both Internet and mobile diffusion and illiteracy (residual) and shows a strong negative correlation with both Internet and mobile diffusion
Kenny and Keremane (2007)	Mobile footprint coverage	GDP per capita, GDP per km2, competition dummy	6 regions	2002-2004	Mobile-phone coverage can be predicted based on GDP, population, country area, and the status of reform

Appendix B
Countries Included in This Study

Afghanistan	Dominica	Libya	Samoa
Albania	Dominican Rep.	Liechtenstein	San Marino
Algeria	Ecuador	Lithuania	Saudi Arabia
American Samoa	Egypt	Luxembourg	Senegal
Andorra	El Salvador	Macao, China	Serbia
Angola	Equatorial Guinea	Madagascar	Seychelles
Antigua and Barbuda	Eritrea	Malawi	Sierra Leone
Argentina	Estonia	Malaysia	Singapore
Armenia	Ethiopia	Maldives	Slovak Republic
Aruba	Faroe Islands	Mali	Slovenia
Australia	Fiji	Malta	Solomon Islands
Austria	Finland	Marshall Islands	Somalia
Azerbaijan	France	Mauritania	South Africa
Bahamas	French Polynesia	Mauritius	Spain
Bahrain	Gabon	Mayotte	Sri Lanka
Bangladesh	Gambia	Mexico	St. Kitts and Nevis
Barbados	Georgia	Micronesia	St. Lucia
Belarus	Germany	Moldova	St. Vincent and the Grenadines
Belgium	Ghana	Monaco	Sudan
Belize	Greece	Mongolia	Suriname
Benin	Greenland	Montenegro	Swaziland
Bermuda	Grenada	Morocco	Sweden
Bhutan	Guam	Mozambique	Switzerland
Bolivia	Guatemala	Myanmar	Syria
Bosnia and Herzegovina	Guinea	Namibia	Taiwan, China
Botswana	Guinea-Bissau	Nauru	Tajikistan
Brazil	Guyana	Nepal	Tanzania
Brunei Darussalam	Haiti	Netherlands Antilles	TFYR Macedonia
Bulgaria	Honduras	Netherlands	Thailand
Burkina Faso	Hong Kong, China	New Caledonia	Timor-Leste
Burundi	Hungary	New Zealand	Togo
Cambodia	Iceland	Nicaragua	Tonga
Cameroon	India	Niger	Trinidad and Tobago
Canada	Indonesia	Nigeria	Tunisia
Cape Verde	Iran (I.R.)	Northern Marianas	Turkey
Cayman Islands	Iraq	Norway	Turkmenistan
Central African Rep.	Ireland	Oman	Tuvalu
Chad	Israel	Pakistan	Uganda
Chile	Italy	Palau	Ukraine
China	Jamaica	Palestine (West Bank/Gaza)	United Arab Emirates
Colombia	Japan	Panama	United Kingdom
Comoros	Jordan	Papua New Guinea	United States
Congo	Kazakhstan	Paraguay	Uruguay
Congo (Dem. Rep.)	Kenya	Peru	Uzbekistan
Costa Rica	Kiribati	Philippines	Vanuatu
Côte d'Ivoire	Korea (Rep.)	Poland	Venezuela
Croatia	Kuwait	Portugal	Viet Nam
Cuba	Kyrgyzstan	Puerto Rico	Virgin Islands (U.S.)
Cyprus	Lao P.D.R.	Qatar	Yemen
Czech Republic	Latvia	Romania	Zambia
D.P.R. Korea	Lebanon	Russia	Zimbabwe
Denmark	Lesotho	Rwanda	
Djibouti	Liberia	S. Tomé & Principe	

Note: Casewise deletion used for substantive analyses. Only 170 countries from this table had complete data. CAGR = compound annual growth rate; OECD = Organisation for Economic Co-operation and Development.

Notes

1. Throughout this article, we use the terms *mobile*, *mobile phones*, and *mobile telephony* interchangeably.

2. GDP per capita is expressed in U.S. dollar equivalents. Values listed in the 2005 CIA Factbook were substituted for GDP per capita values missing from the World Bank database.

3. Education index (EDI) is a composite index based on each country's adult literacy rate and combined gross enrollment ratio for primary, secondary, and tertiary education.

4. Rouvinen's (2006) table only included introduction dates through 2000. To allow the use of a larger overall sample in our analyses, we chose to provide conservative estimates of the twenty-one countries mentioned in the note to his table with no record of the introduction date (they were recorded as 2001). All remaining countries were recorded as 2002.

5. Another possible explanation for this result is the recognition that education is highly correlated with GDP per capita and median age, which could mean that one or both of the latter variables acts as a suppressor. We sought to be comprehensive and included all three substantive variables in our analysis while acknowledging that the threat of multicollinearity could make parameter estimates unstable (although each had an acceptable variance inflation factor value). We ran a series of additional regressions and determined that the parameter estimate for education was reduced substantially when median age was introduced to the equation, but this was not the case for GDP per capita. We also reran the main effects and subsequently described interaction models without the education measure; we determined that the parameter estimates for the remaining variables were largely unchanged.

6. Given the high degree of collinearity between multiplicative interaction terms and its corresponding main effects, the residual centering procedure was followed (Lance 1988).

References

A Spiritual Connection. 2005, March 12. *The Economist* 374 (8417): 13.

Ahn, Hyungtaik. 2001. A nonparametric method of estimating the demand for mobile telephone networks: An application to the Korean mobile telephone market. *Information Economics and Policy* 13:96-106.

Ahn, Hyungtaik, and Myeong-Ho Lee. 1999. An econometric analysis of the demand for access to mobile telephone networks. *Information Economics and Policy* 11:297-305.

Andonova, Veneta. 2006. Mobile phones, the Internet and the institutional environment. *Telecommunications Policy* 30:29-45.

Baerwald, Thomas J. 1996. Geographical perspectives on international business. In *International business*, 4th ed., edited by Michael R. Czinkota, Iikka A. Ronkainen, and Michael H. Moffett. Orlando, FL: Harcourt.

Bagchi, Kallol. 2005. Factors contributing to global digital divide: Some empirical results. *Journal of Global Information Technology Management* 8 (3): 47-65.

Balasubramanian, Sridhar, Robert A. Peterson, and Sirkka L. Javenpaa. 2002. Exploring the implications of m-commerce for markets and marketing. *Journal of the Academy of Marketing Science* 30 (4): 348-61.

Banerjee, Aniruddha, and Agustin J. Ros. 2004. Patterns in global fixed and mobile telecommunications development: A cluster analysis. *Telecommunications Policy* 28:107-32.

Beise, Marian. 2004. Lead markets: Country-specific drivers of the global diffusion of innovations. *Research Policy* 33:997-1018.

Birke, Daniel, and G. M. Peter Swann. 2006. Network effects and the choice of mobile phone operator. *Journal of Evolutionary Economics* 16 (1-2): 65-84.

Buellingen, Franz, and Martin Woerter. 2004. Development perspectives, firm strategies and implications in mobile commerce. *Journal of Business Research* 57 (12): 1402-8.

Burki, Abid A., and Shirin Aslam. 2000. The role of digital technology and regulations in the diffusion of mobile phones in Asia. *Pakistan Development Review* 39 (4): 741-48.

Castells, Manuel, Mireia Fernandez-Ardevol, Jack Linchuan Qiu, and Araba Sey. 2007. *Mobile communication and society: A global perspective*. Cambridge, MA: MIT Press.

Central Intelligence Agency (CIA). 2005. *The world factbook*. http://www.umsl.edu/services/govdocs/wofact2005/fields/ 2103.html (accessed June 1, 2007).

Cornwell, T. Bettina, and Judy Drennan. 2004. Cross-cultural consumer/consumption research: Dealing with issues emerging from globalization and fragmentation. *Journal of Macromarketing* 24:108-21.

Dekimpe, Marnik G., Philip M. Parker, and Miklos Sarvary. 1998. Staged estimation of international diffusion models: An application to global cellular telephone adoption. *Technological Forecasting and Social Change* 57 (1-2): 105-32.

Dewan, Sanjeev, and Frederick J. Riggins. 2005. The digital divide: Current and future research directions. *Journal of the Association for Information Systems* 6 (12): 1.

Dholakia, Nikhilesh, Ruby Roy Dholakia, Mark Lehrer, and Nir Kshetri. 2002. Patterns, opportunities, and challenges in the emerging global m-commerce landscape. Working paper, College of Business Administration, University of Rhode Island, Providence.

Dholakia, Ruby Roy, and Nikhilesh Dholakia. 2004. Mobility and markets: Emerging outlines of m-commerce. *Journal of Business Research* 57:1391-96.

Dholakia, Utpal M. 2001. A motivational process model of product involvement and consumer risk perception. *European Journal of Marketing* 35:1340-60.

Dickerson, Mary D., and James. W. Gentry 1983. Characteristics of adopters and non-adopters of home computer. *Journal of Consumer Research* 10 (September): 225-35.

Diez Roux, Ana V. 2002. A glossary for multilevel analysis. *Journal of Epidemiology and Community Health* 56:588-94.

DiMaggio, Paul, Eszter Hargittai, W. Russell Neuman, and John P. Robinson. 2001. Social implications of the Internet. *Annual Review of Sociology* 27:307-36.

Doganoglu,Toker, and Lukasz Grzybowski. 2007. Estimating network effects in mobile telephony in Germany. *Information Economics and Policy* 19:65-79.

Eastin, Matthew S. 2002. Diffusion of e-commerce: An analysis of the adoption of four e-commerce activities. *Telematics and Informatics* 19 (3): 251-67.

Edwards, Margaret, Sylvie Huet, François Goreaud, and Guillaume Deffuant. 2003. Comparing an individual-based model of behaviour diffusion with its mean field aggregate approximation. *Journal of Artificial Societies and Social Simulation* 6 (4). http://jasss.soc.surrey.ac.uk/6/4/9.html (accessed July 13, 2008).

Erumban, Abdul A., and Simon B. de Jong. 2006. Cross-country differences in ICT adoption: A consequence of culture? *Journal of World Business* 41:302-14.

Fulton, B. Keith. 2000. From digital divide to digital opportunity. 25th Anniversary AAAS Colloquium on Science and Technology Policy. http://www.aaas.org/spp/rd/ch21.pdf (accessed January 15, 2008).

Garbacz, Christopher, and Herbert G. Thompson Jr. 2005. Universal telecommunication service: A world perspective. *Information Economics and Policy* 17:495-512.

Gatignon, Hubert, Jehoshua Eliashberg, and Thomas S. Robertson. 1989. Modeling multinational diffusion patterns: An efficient methodology. *Marketing Science* 8 (3): 231-47.

Gatignon, Hubert, and Thomas S. Robertson. 1985. A propositional inventory for new diffusion research. *Journal of Consumer Research* 11:849-867.

———. 1991. Innovative decision processes. In *Handbook of consumer behavior*, edited by Thomas S. Robertson and Harold H. Kassarjian. Englewood Cliffs, NJ: Prentice Hall.

Gerstein, Dean R. 1987. To unpack micro and macro: Link small with large and part with whole. In *The micro-macro link*, edited by Jeffrey C. Alexander, Bernhard Giesen, Richard Münch, and Neil J. Smelser, 86-111. Berkeley: University of California Press.

Global Information Inc. 2006. Worldwide mobile market forecasts 2006–2011. January. http://www.the-infoshop.com/study/por35857-mobile-market.html (accessed June 1, 2007).

Goggin, Gerard. 2006. *Cell phone culture: Mobile technology in everyday life*. London: Routledge.

Grajek, Michal. 2003. Estimating network effects and compatibility in mobile telecommunications. *WZB Discussion Paper* SP II: 2003–26. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=501325 (accessed January 15, 2008).

Groth, Alexander J., and William. R. Hunt. 1985. Marxist-Leninist communications systems in comparative perspective. *Coexistence* 22:123-36.

Gruber, Harald. 2001. Competition and innovation: The diffusion of mobile telecommunications in Central and Eastern Europe. *Information Economics and Policy* 13:19-34.

Gruber, Harald, and Frank Verboven. 2001. The diffusion of mobile telecommunication services in the European Union. *European Economics Review* 45:577-88.

Helsen, Kristiaan, Kamel Jedidi, and Wayne S. DeSarbo. 1993. A new approach to country segmentation using multinational diffusion patterns. *Journal of Marketing* 57:60-71.

Hill, Ronald P., and. Kanwairoop K. Dhanda. 2004. Globalization and technological achievements: Implications for macro-marketing and the digital divide. *Journal of Macromarketing* 24:147-55.

Hofstede, Geert. 1991. *Cultures and organizations: Software of the mind.* London, England: McGraw-Hill.

Horst, Heather A., and Daniel Miller. 2006. *The cell phone: An anthropology of communication*. New York, NY: Berg.

Im, Subin, Barry L. Bayus, and Charlotte H. Mason. 2003. An empirical study of innate consumer innovativeness, personal characteristics, and new-product adoption behavior. *Journal of the Academy of Marketing Science* 31:61-73.

Ingelbrecht, Nick, and Girish Trivedi. 2004. Mobile and wireless services and service providers in Hong Kong. *Gartner research*, ID No. DPRO-90882, Stamford, CT.

International Telecommunication Union. 2006. http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx (accessed January 8, 2008).

Ito, Mizuko, Daisuke Okabe, and Misa Matsuda, eds. 2005. *Personal, portable, pedestrian: Mobile phones in Japanese life*. Cambridge, MA: MIT press.

James, Jeffrey. 2004. Reconstruing the digital divide from the perspective of a large, poor, developing country. *Journal of Information Technology* 19:172-77.

Jang, Show-Ling, Shau-Chi Dai, and Simona Sung. 2005. The pattern and externality effect of diffusion of mobile telecommunications: The case of the OECD and Taiwan. *Information Economics and Policy* 17:133-48.

Jha, Raghbendra, and Sumit K. Majumdar. 1999. A matter of connections: OECD telecommunications sector productivity and the role of cellular technology diffusion. *Information Economics and Policy* 11:243-69.

Kasesniemi, Eija-Liisa, and Pirjo Rautiainen. 2002. Mobile culture of children and teenagers in Finland. In *Perpetual contact: Mobile communication, private talk, public performance*, edited by James E. Katz and Mark Aakhus, 170-92. Cambridge, UK: Cambridge University Press.

Kauffman, Robert J., and Angsana A. Techatassanasoontorn. 2005. Is there a global digital divide for digital wireless phone technologies? *Journal of the Association for Information Systems* 6: 338-82.

Kenny, Charles, and Rim Keremane. 2007. Toward universal telephone access: Market progress and progress beyond the market. *Telecommunications Policy* 31:1-9.

Kiiski, Sampsa, and Matti Pohjola. 2002. Cross-country diffusion of the Internet. *Information Economics and Policy* 14 (2): 297-310.

Kim, Hee-Su, and Namhoon Kwon. 2003. The advantage of network size in acquiring new subscribers: A conditional logit analysis of the Korean mobile telephony market. *Information Economics and Policy* 15 (1): 17-33.

Koski, Heli, and Tobias Kretschmer. 2005. Entry, standards and competition: Firm strategies and the diffusion of mobile telephony. *Review of Industrial Organization* 26:89-113.

Kotler, Philip, Ned Roberto, and Tony Leisner. 2006. Alleviating poverty: A macro/micro marketing perspective. *Journal of Macromarketing* 26:233-39.

Kshetri, Nir B. 2001. Determinants of the locus of global e-commerce. *Electronic Markets* 11 (4): 250-57.

Kshetri, Nir B., and Nikhilesh Dholakia. 2001. Impact of cultural and political factors on the adoption of digital signatures in Asia. *Proceedings of the Americas' Conference on Information Systems*. Boston, August 2-5.

Lance, Charles E. 1988. Residual centering, exploratory and confirmatory moderator analysis, and decomposition of effects in path models containing interactions. *Applied Psychological Measurement* 12 (June): 163-75.

Lee, Chol. 1991. Determinants of national innovativeness and international market segmentation. *International Marketing Review* 7 (5): 39-49.

Liikanen, Jukka, Paul Stoneman, and Otto Toivanen. 2001. Intergenerational effects in the diffusion of new technology: The case of mobile phones. Swedish School of Economics and Business Administration Working Papers, 3. http://apps1.sordino.fi/db/hanken/crisuk.ns5/ (accessed June 1, 2007).

Ling, Rich. 2004. *The mobile connection: The cell phone's impact on society*. San Francisco: Morgan Kaufmann.

Lobet-Maris, Claire, and Jaurent Henin. 2002. Talking without communicating or communicating without talking: From the GSM to the SMS. *Revista de Estudios de Juventud* 57:101-14. http://www.itu.int/osg/spu/ni/ubiquitous/Papers/Youth_and_mobile_2002.pdf#page=99 (accessed Jan. 18, 2008).

Madden, Gary, Grant Coble-Neal, and Brian Dalzell. 2004. A dynamic model of mobile telephony subscription incorporating a network effect. *Telecommunications Policy* 28 (2): 133-44.

Maitland, Carleen F., and Johannes M. Bauer. 2001. National level culture and global diffusion: The case of the Internet. In *Culture, technology, communication: Towards an intercultural global village*, edited by Charles Ess, 87-128. New York: SUNY Press.

Maslen, Patrick. 1996. Control, change and the Internet. Honors thesis, unknown institution. http://quest-bird.com/qb-atwork/cci-intr.htm (accessed June 1, 2007).
MGAIN Consortium. 2003. Mobile entertainment industry and culture: A European commission user-friendly information society (IST) accompanying measure project IST–2001–38846. The Commission of the European Communities.
Murdock, Gene W., and Lori Franz. 1983. Habit and perceived risk as factors in the resistance to the use of ATMs. *Journal of Retail Banking* 2:20-29.
Nunberg, Goeffrey. 2000. Will the Internet always speak English? *The American Prospect*, March 27, April 10, 40-43.
Oneupweb. 2005. Mobile search and its implications for search engine marketing. http://www.mmaglobal.com/uploads/Oneupweb_Mobile_Search_Research.pdf (accessed June 1, 2007).
Organisation for Economic Co-operation and Development (OECD). 2001. Understanding the digital divide. Washington DC: OECD Publications.
Pan, Yue, George M. Zinkhan, and Shibin Sheng. 2007. The subjective well-being of nations: A role for marketing? *Journal of Macromarketing* 27:360-69.
Peterson, Mark, and Ahmet Ekici. 2007. Consumer attitude toward marketing and subjective quality of life in the context of a developing country. *Journal of Macromarketing* 27:350-59.
Peterson, Mark, and Naresh K. Malhotra. 1997. Comparative marketing measures of societal quality of life: Substantive dimensions in 186 countries. *Journal of Macromarketing* 17 (Spring): 25-38.
Quibria, M. G., Shamsun N. Ahmed, Ted Tchang, and Mari-Len Reyes-Macasaquit. 2003. Digital divide determinants and policies with special reference to Asia. *Journal of Asian Economics* 13:811-25.
Rice, Ronald E., and James E. Katz. 2003. Comparing Internet and mobile phone usage: Digital divides of usage, adoption and dropouts. *Telecommunications Policy* 27:597-623.
Robison, Kristopher K., and Edward M. Crenshaw. 2002. Post-industrial transformations and cyber-space: A cross-national analysis of Internet development. *Social Science Research* 31:334-63.
Rogers, Everett. M. 1962. *Diffusion of innovations*. New York: Free Press.
———. 1983. *Diffusion of innovations*, 3rd ed. New York: Free Press.
———. 1995. *Diffusion of innovations*, 5th ed. New York: Free Press.
Rouvinen, Petri. 2006. Diffusion of digital mobile telephony: Are developing countries different? *Telecommunications Policy* 30:46-63.
Schiffman, Leon, and Leslie L. Kanuk. 2003. *Consumer behavior*, 8th ed. Upper Saddle River, NJ: Prentice Hall.
Schwartz, S. H. 1994. Beyond individualism/collectivism: New cultural dimensions of value. In *Individualism and collectivism: Theory, method and applications*, edited by Uichol Kim, Harry C. Triandis, Cigdem Kagitcibasi, Sang-Chin Choi, and G. Yoon, 85-119. Thousand Oaks, CA: Sage.
Schweke, William. 2004. *Smart money: Education and economic development*. Washington, DC: Economic Policy Institute.
Smith, P. B., and S. H. Schwartz. 1997. Values. In *Handbook of cross-cultural psychology*, 2nd ed., edited by John W. Berry, Ype H. Poortinga, and J. Pandey, vol. 3, *Social Behavior and Applications*, 77-118. Boston, MA: Allyn & Bacon.
Stephens, David O. 2001. Digital signatures and global e-commerce: Part I—U.S. initiatives. *Information Management Journal* 3:1-68
Stoneman, Paul. 1983. *The economic analysis of technological change.* Oxford, UK: Oxford University Press.
Taylor, Alex S., and Richard Harper. 2003. The gift of the gab? A design oriented sociology of young people's use of mobiles. *Computer Supported Cooperative Work* 12:267-96.
Tellefsen, Thomas, and Hirokazu Takada. 1999. The relationship between mass media availability and the multicountry diffusion. *Journal of International Marketing* 7 (1): 77-96.
Tornatzky, Louis G., and Katherine J. Klein. 1982. Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management* 29 (1): 28-45.
Uhl, Kenneth, Roman Andrus, and Lance Poulsen. 1970. How are laggards different? An empirical inquiry. *Journal of Marketing Research* 7:51-54.
United Nations Development Programme. 2008. *Human development report 2007/08*, Table 1, p. 229-32.
van Dijk, Jan A. G. M. 1999. *The network society: Social aspects of new media*. London: Sage.
———. 2000. Widening information gaps and policies of prevention. In *Digital democracy, issues of theory and practice*, edited by Kenneth Hacker and Jan van Dijk, 166-83. London: Sage.
———. 2005. *The deepening divide: Inequality in the information society.* Thousand Oaks, CA: Sage.
van Dijk, Jan A. G. M., and Kenneth Hacker. 2003. The digital divide as a complex and dynamic phenomenon. *Information Society* 19:315-26.
Venkatraman, Meera P. 1991. The impact of innovativeness and innovation type on adoption. *Journal of Retailing* 67 (1): 51-67.
Wareham, Jonathan, and Armando Levy. 2002. Who will be the adopters of 3G mobile computing devices? A probit estimation of mobile telecom diffusion. *Journal of Organizational Computing and Electronic Commerce* 12 (2): 161-74.
Wareham, Jonathan, Armando Levy, and Wei Shi. 2004. Wireless diffusion and mobile computing: Implications for digital divide. *Telecommunications Policy* 28:439-57.
Weilenmann, Alexandra, and Catrine Larsson. 2001. Local use and sharing of mobile phones. In *Wireless world: Social and interactional aspects of the mobile age*, edited by Barry Brown, Richard Harper, and Nicola Green, 92-106. London: Springer.
Wireless World Forum. 2005. *Mobile youth 2005*. http://www.w2forum.com/ (accessed June 1, 2007).
Wood, Van R., and Scott J. Vitell. 1986. Marketing and economic development: Review, synthesis and evaluation. *Journal of Macromarketing* 6 (Fall): 28-48.
World Bank. 2005. http:// web.worldbank.org/ (accessed June 1, 2007).
World Cellular Information Service. 2008. http://www.wcisdata.com/ (accessed January 15, 2008).
Yeniyurt, Sengun, and Janeil. D. Townsend. 2003. Does culture explain acceptance of new products in a country? An empirical investigation. *International Marketing Review* 20 (4): 377-96.

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