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ABSTRACT

Despite the increasing importance of the Internet, there is little work that addresses the degree to which the models and theories of Internet diffusion in *developed countries* can be applied to Internet diffusion in *developing countries*. This paper presents the first attempt to address this question through modeling Internet diffusion via a set of variables from social, technical, and environmental determinants. A set of regression analyses and a radar graph are used to analyze the hypotheses. The findings suggest that the factors affecting the Internet diffusion in developed countries do not provide a good fit for modeling Internet diffusion in developing countries. Alternative approaches to modeling Internet diffusion in developing countries are suggested.

Keywords

Internet diffusion, modeling, developing countries

INTRODUCTION

The rapid diffusion of the Internet is a universal phenomenon. The number of hosts connected to the Internet has increased almost three times since 1991, and more than 600 million people are using the Internet (ITU 2004). Today, the Internet is not only playing an important role in education and research (Ruth 2000) but also serving as a vehicle to a country's economic productivity (Wong 2003), organizational empowerment and even democracy (Madon 2000).

Although the potentials of the Internet to accelerate development and welfare seem great, a closer look reveals a critical discrepancy of the global penetration and use of the Internet among countries. Less than 30% of the total Internet users are located in developing[1] countries even though more than 70% of the world population lives in those countries (ITU 2004). This "digital divide," the gap between technology haves and have-nots, also exists among the developing countries; due to the introduction timing of the Internet (e.g., Chile adopted Internet in 1992, Egypt in 1993, and Congo in 1996), and the diversity in the number of current Internet users for each country (e.g. 80 million users in China, and 35,000 users in Gabon) (ITU 2004). In developing countries with high GDP, the Internet may lead to improved economic productivity, awareness of the world, and quality of life, reducing the gap from the developed countries. In contrast, comparatively poor countries with low GDP are still facing a variety of problems in connection to the Internet such as a lack of telecommunication infrastructure and extremely high access costs, making it difficult to catch up with the fast global growth of the Internet.

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[1] Developing countries and developed countries are classified based on lists developed by the Food and Agriculture Organization of the UN.

Without immediate and appropriate support to those countries, the rapid diffusion of the Internet may widen the multidimensional gap, separating them from other nations, exacerbating an already significant moral and practical problem (Wilson 1999).

The goal of this research is to investigate a theoretical framework that can systematically identify the Internet diffusion process in order to help developing countries improve on those factors that are most likely to spur Internet diffusion. Therefore, our main research question is, can we develop a global Internet diffusion model that can fit well in both developing countries and developed countries?

BRIEF REVIEW OF PAST RESEARCH ON INTERNET DIFFUSION

Previous Internet diffusion research can be grouped into two categories: 1) study of general diffusion patterns; and 2) contextual analysis of contributing factors to the diffusion process.

Diffusion pattern studies are generally based on network externalities (Katz et al. 1985), and diffusion of innovation (Rogers 1995). We learn from these theories that the value of a product increases as the number of users increase (Katz et al. 1985) and that late adopters of an innovation are affected by early adopters over time because of the contagion effects of the spread of adoption between people(Rogers 1995). Research in this area has been focusing mainly on descriptive models of the Internet growth, providing insights into mechanical aspects of the diffusion process. The goal of this research stream is to fit a curve to the diffusion pattern using different mathematical models. The pioneering study of the BITNET growth (Gurbaxani 1990) was followed by other models of the diffusion pattern (e.g., Rai et al.). Although these models provide ample information regarding the overall picture of diffusion itself, they tend to offer a simple view to explain the complex aspects of the Internet diffusion process.

To overcome the limitations of these prior studies, contextual analysis of contributing factors have been researched. For instance, rather than focusing on the diffusion phenomenon itself, Dutta et al (2003) created a feedback loop structure of Internet growth to understand the broaden sociotechnical aspects of Internet growth. It was observed that technology, as well as social factors such as economic development and social norms influence the diffusion of the Internet. The role of the government and its policy were also recognized as critical factors in the evolution of the Internet (Kahn 1994; Kraemer et al. 1992). Cost and pricing of the Internet services as well as the degree of competition of the Internet Service Providers (ISPs) have been documented as serious obstacles to the rapid diffusion of the Internet (Petrazzini et al. 1999). Beyond the influence of socioeconomic factors, Zhu et al (2002) provided an evidence for the impact of user's psychological perception and satisfaction on the adoption of the Internet. For instance, the more beneficial, compatible, and easier to use a person considers the Internet, the more likely the person is to become an adopter. A few econometric regression models were also used either to find the statistically significant factors of the Internet diffusion or to forecast the number of users/hosts in the future (Beilock et al. 2003; Hargittai 1999; Kiiski et al. 2002; Lucas et al. 2003; Press 1997). Hargittai (1999) regressed the number of Internet hosts per capita on a number of explanatory variables including income, education level, and telecommunication policies and infrastructures. She concluded that economic wealth and telecommunication policies are the most salient predictors of a nation's Internet connectivity.

Overall, several diffusion models were developed based on the rigorous diffusion of innovation theory and many studies noted that Internet growth could be influenced by various important factors. Nevertheless, little research has been conducted to compare the difference in Internet diffusion between developed and developing countries.

MODEL DEVELOPMENT

Determinants of the Internet Diffusion and Research Hypotheses

Drawing mostly on the research for developed countries, we propose that Internet diffusion is determined by five prevailing factors: economic factors, technology infrastructure, social and cultural factors, user cognition and use of the Internet, and government policies and regulations. These factors lead to the following testable hypotheses.

Economic Factors

Previous research has shown a relationship between a county's economic strength and its Internet penetration (Beilock et al. 2003; Hargittai 1999). GDP per capita is an important predictor of the level of Internet penetration (Arnum et al. 1998; Beilock et al. 2003).The development and deployment of new technologies require large amounts of capital, and the necessary resources such as government investment are more likely to be present in richer countries. More formally stated,

H1: The wealthier a country the higher the Internet penetration.

Technology Infrastructure

The Internet must be readily available to expect its adoption. Thus, widespread diffusion of the Internet is associated with a country's technology infrastructures. The number of existing phone lines and mobile phones (Mutula 2002; Press 1997; Zhao 2002), number of cable subscribers (Zhao 2002), broadband connections (Mutula 2002), and bandwidth of the network (Goodman et al. 1994) were studied as a relevant infrastructures to access the Internet. Moreover, the lack of interregional infrastructures such as fiber optical backbones in developing countries makes it difficult for them to communicate with their neighboring countries since the connections need to be routed through industrialized countries with higher costs (Petrazzini et al. 1999). In addition to the physical infrastructures, there must be qualified personnel (Goodman et al. 1994; Press 1992). Therefore,

H2: The better the telecommunication infrastructure in a country the higher the Internet penetration.

Social and Cultural Factors

The relationship between the social and cultural environment and the use of Internet has also been studied. For example, peoples' innovativeness to accept new ideas and technologies might increase the use of the Internet (Zhu et al. 2002). Kim suggested that modernity invokes people's tendency to escape into alienated spaces of the virtual Internet world (Kim 2003). The United Nations Development Program (UNDP) Human Development Index (HDI)[2] (Ivanova et al. 1999) has been widely adopted to identify the relationship between a nation's current social status and Internet diffusion (Madon 2000; Press 1997). In addition to HDI, Beilcock et al. (2003) suggested that the Freedom House's Index (House 2000), which indicates the degree to which people within a society are encouraged to access and use new ideas and information from various sources, can also be used to find the relationship between social/cultural factors and the Internet diffusion. Therefore, we expect:

H3: The higher a country's human development the higher the Internet penetration.

User cognition and Needs for Internet

An Internet user's cognition and needs play an important role in the diffusion process. According to Zhu and He(2002), the diffusion process is affected by three cognitive factors: perceived characteristics of the Internet (e.g., relative advantage, compatibility, ease of use), perceived popularity of the Internet (e.g. the proportion of Internet users among relatives/friends/acquaintances), and perceived need for the Internet (e.g., need for news, personal information, entertainment). Du(1999) tested the importance of the language and technical skills required to use the Internet, and Goodman examined human-computer interface and user friendliness to connect to the Internet. Aladwani(2003) tested user's perception about the ecommerce, including benefits of ecommerce as well as internet security, information privacy, and diversity of the services. Zhao(2002) also addressed that China's recent rapid growth of the Internet is mainly affected by wide popularity of ecommerce and online banking. In addition, the spread of online game and video/audio streaming (Lee et al. 2003) and the number of people engaged in information related occupations (Madon 2000) were studied to analyze the perceived popularity of the Internet. Thus, we expect that:

H4: The higher the level of user's cognition and needs of Internet the higher the Internet penetration.

Government Policies and Regulations

The existence of government support is critical for the successful Internet diffusion in a country. For the successful Internet usage in a nation, government has to lead in building and maintaining national backbones (Goodman et al. 1994; Press 1997), balance the development between rural and urban areas (Mutula 2002; Zhao 2002), and support organizations such as schools to access the Internet (Goodman et al. 1994; Press 1997). Deregulations in the Internet market, and incentives such as reduction of duty levies and other tariffs on telecommunications industry can also encourage Internet diffusion (Lee et al. 2003; Mutula 2002). As an example, China tried national wide E-business projects called "Golden programs", and South Korea held government-led education program of IT literacy and a Cyber-building certificate program to expedite Internet

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[2] HDI is calculated based on a nation's life expectancy, adult literacy, and school enrollment

adoption (Lee et al. 2003). Intellectual property rights(Goodman et al. 1994; Press 1997), trans-border data flow (Goodman et al. 1994; Press 1997), privacy and censorship (Goodman et al. 1994; Press 1997), credit systems (Zhao 2002), and regulations on online sales such as audio visual products (Zhao 2002) were found to be highly correlated with the Internet diffusion. We, therefore, expect:

H5A: Higher levels of government support lead to higher levels of Internet penetration.

The differences in business environments and market characteristics between various countries are mainly decided by the government's relevant regulations (Petrazzini et al. 1999), creating great disparity in Internet access cost between countries. Generally, in low-income countries, monopoly conditions are still the prevailing type of telecommunication industries (Petrazzini et al. 1999). Hence, the lack of competitiveness is perhaps the biggest single factor responsible for the high costs to access the Internet. Lee (2003) observed that aggressive strategies and promotions between ISPs under competitive market structures promoted quicker Internet adoption in South Korea. Thus:

H5B: The more competitive a country's market structure the higher the Internet penetration.

Data and Variables

To test the above hypotheses, a total of 181 countries were studied. These countries were separated into three categories for comparison purposes. First, 52 *developed countries* were selected based on the list made by the UN (United Nations 2004). A set of 129 *developing countries* were further divided into two categories using a median split of GDP. There were 65 (Group I) countries with GDP per capita higher than $1,201.5 and 64 (Group II) countries with GDP per capita lower than $1,201.5. The data were collected from the Worldbank, UN, and ITU. Appendix A provides details about the selected variables and data sources.

Outcome variables

To measure the level of Internet diffusion for each country, the number of individual computers connected to the Internet per 10,000 inhabitants in 2003 was used. The reason why this variable was used in the model is that the number of hosts (i.e., the number of PCs that are connected to the Internet) is normalized by dividing it with each country's population to reduce the exogenous effects of population size.

Explanatory variables

As mentioned earlier, we considered five explanatory factors of the Internet diffusion: economic factors, technology infrastructure, social and cultural factors, user cognition and needs for the Internet, and government policies and regulations. Each factor was operationalized using proxy variables. The mapping of these variables is shown in Table 1, and details about the data source and year of measurement is given in Appendix A.

GDP per capita was used to measure the economic wealth of the country. Technological infrastructure was calculated by summing up the number of main telephone subscribers and cellular phone subscribers. The important social and cultural factor relevant to the Internet diffusion is educational environment, which was coded as a combined gross enrollment ratio for primary, secondary, and tertiary schools. An Internet user's cognition and needs for the Internet is assumed to be related with a person's eagerness to get the latest technology or tendency to get information from a communication media. Therefore, we used the number of TV sets in use per 1,000 people, and number of PCs in use per 1,000 people as a measurement. Note that the number of PCs is used as a proxy variable of user cognition and needs for the Internet rather than that of technology infrastructure since PCs are not necessarily connected to the Internet and are therefore different from the number of Internet hosts. Finally, we use the public expenditure on education as % of GDP and access price as the sum of charges from ISPs and telephone usage to measure the government's efforts to expedite the Internet diffusion, assuming that the lower access price will result in a more competitive market structure.

Explanatory Factors	Variables in Study
Economic Factors	⊔ GDP Capita
Technology Infrastructure	⊔ Telecom Density
Social Cultural Factors	⊔ School Enrollment Ratio
User Cognition and Needs for the Internet	⊔ PCs
	⊔ TV Sets
Government Policies and Regulations	⊔ Public Expenditure on Education
	⊔ Access Price

Table1. Mapping of Explanatory Factors and Variables

Regression Model

The regression model used in this study is motivated by the classical Bass model which is one of the best-known diffusion models in the marketing literature (Bass 1969; Bass et al. 1994). This model is most appropriate for forecasting services or products for which no closely competing alternatives exist. The underlying premise of the Bass model is that the probability of adoption at time *t*, given that it has not yet been adopted, would depend linearly on the previous adopters. Bass separates the driving forces of the adoption into people's tendency of innovation and imitation. However, we will simplify the above model as the following equation:

$$\frac{f(t)}{1 - F(t)} = pF(t) \qquad (1)$$

where *p* is constant, *f(t)* is the unconditional probability of adoption at time *t*, and *F(t)* is the accumulated probability of adoption up to time *t*, hence *f(t)/(1-F(t))* is the likelihood of adoption or hazard rate at time *t* given no adoption has been made before.

To derive the explicit expression of the adoptions at *t*, we can define the following: *M* is the total number of long-run potential adoptions, and *S(t)* is the adoption rate at time *t*, that is, the number of adoptions at *t*. Then, we derive:

$$S(t) = Mf(t) \qquad (2)$$

To apply regression techniques, let *N(t)* denote the cumulative number of adoptions in all years up to *t*, that is, *N(t)= MF(t)*. Hence, from (1) and (2)

$$\Rightarrow pF(t) - p[F(t)]^2 = f(t)$$

$$\Rightarrow pMF(t) - \frac{p}{M}[MF(t)]^2 = Mf(t)$$

$$\Rightarrow pN(t) - \frac{p}{M}N(t)^2 = S(t) \qquad (3)$$

$$\Rightarrow \ln N(t) = \alpha_0 + \alpha_1 \ln S(t)$$

We assume that log of the adoption rate can be formulated as following with given defined variables.

$$\ln S(t) = \sum_{k=1}^{K} \gamma_k \ln X_k + \sum_{t=K+1}^{T} \gamma_t Y_t \qquad (4)$$

Where X's are variables that have somewhat skewed distribution (TV sets, PCs, Access Price, Technology Density, and GDP), and Y's are those that do not have skewed distribution (Enrollment Ratio and Expenditure on Education).

Finally, we can get the following regression model.

$$\ln N(t) = \beta_0 + \sum_{k=1}^{K} \beta_k \ln X_k + \sum_{t=K+1}^{T} \beta_t Y_t \qquad (5)$$

Following equation (5), each hypothesis was at first tested separately for the three groups of countries (developed, developing Group I, and developing Group II) (Models 1-5). For those five models, the analysis of VIFs showed no problem with multicollinearity (VIF <2 for each variable in each regression) and the residuals followed the normal distribution. Then, stepwise regression with all variables included was performed for the three groups of countries to eliminate possible multicollinearity problems (Model 6). The results are shown in Table 2.

For developed countries, hypotheses 1, 2, and 3 were supported. However, only one variable was significant when testing hypotheses 4 (PCs) and 5 (expenditure on education). For developing countries Group I, hypotheses 1, 2, and 3 were supported. Hypothesis 4 was supported only for number of PCs. Surprisingly, hypothesis 5 for expenditure on education was significant but in the opposing direction. For developing countries Group II, hypotheses 1, 2, and 3 were supported. Hypothesis 4 was supported only for number of PCs; and hypothesis 5 was not supported.

Model (Adjusted R square)		Model 1 (D: .740) (GI: .137) (GII: .168)	Model 2 (D: .748) (GI: .216) (GII: .268)	Model 3 (D:. 378) (GI: .063) (GII: .146)	Model 4 (D: .710) (GI: .485) (GII: .275)	Model 5 (D: .419) (GI: .095) (GII: 107)	Model 6 (D: .696) (GI: .385) (GII: .286)
GDP Capita	D	.863[.000]**					
	GI	.387[.001]*					
	GII	.427[.001]*					
Telecom Density	D		.867[.000]**				
	GI		.478[.000]**				.637[.000]**
	GII		.530[.000]**				.553[.000]**
School Enrollment Ratio	D			.625[.000]**			.240[.043]*
	GI			.281[.030]*			
	GII			.401[.002]*			
PCs	D				.866[.000]**		.680[.000]**
	GI				.618[.000]**		
	GII				.510[.002]*		
TV Sets	D				-.021[.865]		
	GI				.174[.203]		
	GII				.071[.650]		
Expenditure on Education	D					.579[000]**	
	GI					-.354[.048]*	
	GII					.018[.906]	
Access Price	D					-.238[.064]	
	GI					-.201[.250]	
	GII					-.384[.014]	

| * : significant at .05, **: significant at .01 level |
| D stands for the developed countries, GI for Group I of the developing countries, GII for Group II of the developing countries |

Table 2. Regression results for the Internet diffusion model

FINDINGS AND DISCUSSIONS

The goal of this paper was to investigate the degree to which models and theories of Internet diffusion in developed countries can be applied to developing countries. While economic factors (Model 1), represented by GDP per capita, significantly affect Internet diffusion, the strength of this relationship is approximately six times stronger ($R^2_{adj} = 0.74$) for developed countries than for developing countries (0.14 and 0.17 for Group I and Group II, respectively). This result implies that economic factors alone do not explain Internet diffusion in developing countries and other factors need to be considered.

The next factor investigated was technology infrastructure (Model 2), which is represented by telecom density. While telecom density significantly affects Internet diffusion in developed countries ($R^2_{adj} = .75$), it is three times less effective for developing countries (R^2_{adj} was 0.21 and 0.27). In addition, the importance of economic factors and technology infrastructure are almost equally important for developed countries, while the technology infrastructure is almost twice as important as economic factors for developing countries.

Social and cultural factors (Model 3) were represented by school enrollment in our model. School enrollment ($R^2_{adj} = 0.38$) in developed countries is two to three times as important as school enrollment in developing countries (R^2_{adj} was 0.1 and 0.15). One possible solution to this contra intuitive result may stem from the education itself offered in these two types of countries. While in developing countries the role of education is to make students literate, in developed countries a new type of literacy is introduced, e.g. computer literacy.

User cognition and needs for the Internet (Model 4) was modeled via the number of PCs and TV sets in the regression models. Number of TV sets did not predict the diffusion of Internet neither for developed nor for developing countries. However, as hypothesized, the number of PCs strongly predicted the Internet diffusion in both developed ($R^2_{adj} = 0.71$) and developing countries (R^2_{adj} was 0.49 and 0.28). However, in developed countries the number of PCs was a much stronger predictor of Internet diffusion than in developing countries. One can speculate that while in developed countries the infrastructure for Internet exists and therefore most of the population that owns a PC is connected to the Internet; in developing countries, owning a PC does not necessarily mean that one can also connect to the Internet. This argument can also be supported by the significant difference in R^2_{adj} between Group I and Group II.

The last factor investigated is government policies and regulations (Model 5) represented by public expenditures on education and access price. Access price, interestingly, does not affect the diffusion of Internet in any of the groups. It seems that other factors, like the ones investigated in our study, may decrease the importance of access price. Public expenditure on education as percent of GDP was not significant for developing countries Group II (e.g., lowest GDP per capita) and had a weak effect on Group I ($R^2_{adj} = 0.1$). For developed countries, expenditure on education has a strong effect ($R^2_{adj} = 0.42$). As discussed previously, developed countries focus not only on literacy but also computer literacy that supports Internet usage. This is however not the case for developing countries that focus mainly on literacy of their citizens.

Finally, to explore which explanatory factors had the strongest influence on Internet diffusion a stepwise regression (Model 6) was performed. For developed countries, social and cultural factors and user cognition and needs for the internet were the most important factors. Interestingly, the economic and technological factors were not represented. For developing countries, both Group I and Group II, the technology infrastructure factor is the most important predictor of Internet diffusion. Clearly, there is a significant difference between the models for developed and developing countries that suggests that different factors need to be taken into consideration when trying to predict Internet diffusion in developing countries.

To get a better feel for what the regression analyses tell us, a radar graph was used. A radar graph allows us to plot several properties simultaneously (Figure 1). In our case, five different factors were hypothesized to influence the Internet diffusion and each factor is represented by an axis. The degree to which a factor affects the Internet diffusion is represented by adjusted R squared and a point on each of the axis is assigned to this value. Small values of adjusted R squared are near the center of the radar graph and large values are near the outer circumference. These points are then connected and color coded for different countries. The above findings can also be visualized by comparing the scattered diagrams for the selected variables as shown in Appendix B.
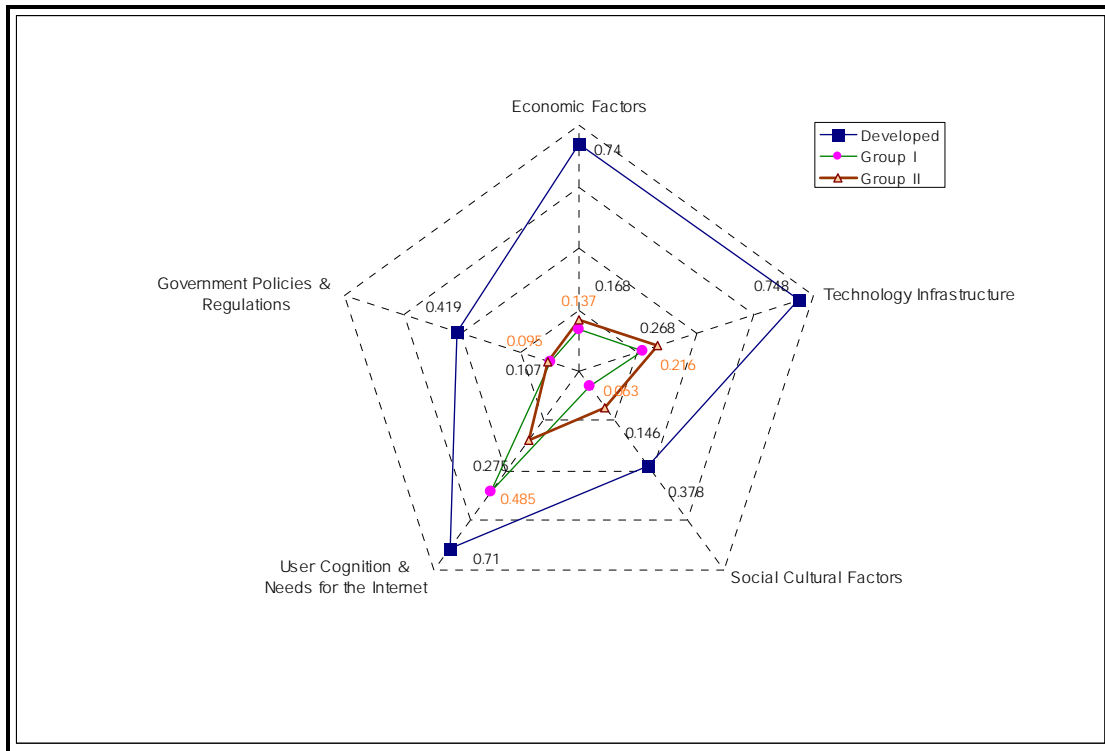
Figure 1. Model Fit Comparison Radar Graph (R^2_{adj})

CONCLUDING REMARKS

The above findings suggest that the factors affecting the Internet diffusion in developed countries do not provide a good fit for modeling Internet diffusion in developing countries. This result implies that Internet diffusion is a complex social phenomenon and more specific qualitative factors in developing countries, which were not captured in the current model, may exist. Therefore, regarding future research on this topic, an important next question includes how to develop a new Internet diffusion model for developing countries that can explain more than the existing models.

As a first step, we may identify other variables that could influence Internet diffusion in developing countries rather than using the indexes that have been used focusing on developed countries. In particular, several variables that indicate the social and cultural environments of developing countries have been suggested (Beilock et al. 2003; Hofstede 2003; Ivanova et al. 1999; Zhu et al. 2002) . An example of these variables is Hofstede's cultural dimensions (Hofstede 2003).

Furthermore, in our future research, we are considering regrouping the developing countries by the regions such as African countries and Asian countries in addition to the grouping based on the GDP. This approach may help us define more appropriate indicators of Internet diffusion for each region, fully explaining the uncovered Internet diffusion phenomenon.

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APPENDIX A: Detalis about the source of the data set

A-1: List of countries

Developing Countries: Group I (64)	Developing Countries: Group II (65)	Developed Countries (52)
Angola, Bangladesh, Benin, Bhutan, Bolivia, Burkina Faso, Burundi, Cote d'Ivoire, Cambodia, Cameroon, Central African, Chad, Comoros, Congo, D.R. Congo, Djibouti, Ecuador, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Kenya, Lao P.D.R., Lesotho, Madagascar, Malawi, Mali, Mauritania, Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palestine, Papua New Guine, Paraguay, Philippines, Rwanda, S. Tom & Princ, Senegal, Sierra Leone, Solomon Islands, Sri Lanka, Sudan, Swaziland, Tanzania, Togo, Uganda, Vanuatu, Viet Nam, Yemen, Zambia, Zimbabwe	Algeria, Antigua & Barbu, Argentina, Bahamas, Bahrain, Barbados, Belize, Botswana, Brazil, Brunei Darussalam, Cape Verde, Chile, Colombia, Costa Rica, Cuba, Cyprus, Dominica, Dominican Rep., Egypt, El Salvador, Equatorial Guin, Fiji, French Polynesia, Gabon, Grenada, Guatemala, Iran (I.R.), Jamaica, Jordan, Korea (Rep.), Kuwait, Lebanon, Libya, Macao, China, Malaysia, Maldives, Marshall Island, Mauritius, Mexico, Morocco, Namibia, New Caledonia, Oman, Panama, Peru, Samoa, Saudi Arabia, Seychelles, Singapore, St. Kitts and N, St. Lucia, St. Vincent, Suriname, Syria, Taiwan, China, TFYR Macedonia, Thailand, Tonga, Trinidad & Toba, Tunisia, Turkey, United Arab Emi, Uruguay, Venezuela	Albania, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia, Bulgaria, Canada, Croatia, Czech, Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Moldova, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Serbia and Montenegro, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Tajikistan, Turkmenistan, Ukraine, United Kingdom, United States, Uzbekistan

A-2: Definition of variables and data sources

Variable	Definition	Measurement	Year	Source
Internet Hosts	Individual computers connected to the Internet	Per 10,000 people	2003	ITU (Internet host data: Network Wizards, RIPE).
GDP	Gross domestic product	Per capita	2002	Worldbank (2004)
Telecom Density	Sum of main telephone subscribers and cellular phone subscribers	Per 100 people	2002-2003	ITU World Telecommunications Indicators Database (2003)
Enrollment Ratio	Combined gross enrollment ratio for primary, secondary and tertiary schools	Ratio	2001-02 School year	UNDP Human Development Report (2003)
PCs	Self-contained computers designed to be used by a single individual	Per 1,000 people	2002	ITU World Telecommunications Indicators Database (2003)
TV Sets	Television sets in use	Per 1,000 people	2002	
Expenditure on Education	Public expenditure on Education	% of GDP /100	2002	UNESCO Institute for Statistics estimates
Access Price	Sum of ISP and telephone usage charges	Per 20 hours	2003	ITU World Telecommunication Development Report (2003)

APPENDIX B: SCATTERED DIAGRAM COMAPARISION

Developing Countries: Group I	Developing Countries: Group II	Developed Countries