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Jump-Starting the Internet Revolution: How Structural Conduciveness and Global Connections Help Diffuse the Internet

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Jump-Starting the Internet Revolution: How Structural Conduciveness and Global Connections Help Diffuse the Internet [1]

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Abstract

The growing perception that the Internet is becoming an engine of global economic and social change has inspired both governments and intergovernmental agencies to accelerate the diffusion of the Internet around the globe via multimillion dollar programs and initiatives. Unfortunately, few empirical studies guide these initiatives. The purpose of this research is to investigate the causes that drive Internet capacity, with special emphasis on diffusion theory. Global diffusion of IT requires some degree of structural conduciveness (similarities between developed and developing countries in economic, political, and social structures) as well as contact with developed countries. In our pooled time-series models of 58 developing nations over the 1995-2000 time period, we find that both structural conduciveness (i.e., teledensity, service economies, political openness, and global urban share) and globalization (i.e., aid share, tourist share, foreign investment share, and trade share) shape the distribution and growth of Internet usage.

Keywords: Digital divide, diffusion, globalization, Internet, structural conduciveness

Introduction

One of the more profound technological revolutions occurring at the beginning of the 21st

[1] Robert Kauffman was the accepting senior editor.

Century is the elegant blending of telecommunications and computer technology known as the Internet. Evolving from humble beginnings as a U.S. Department of Defense project in the 1960s (i.e., the ARPANET) to a mass-production/consumption technology propelled by the World Wide Web, the Internet has outgrown its former role as a specialized tool of governmental and academic elites. Today there is the growing perception that the Internet may become a new, powerful engine of global economic and social change, and as such its spread around the globe requires investigation.

The Internet's economic implications have captured the lion's share of scholarly attention. In a nutshell, advanced telecommunications technology, including the Internet, reduces economic transaction costs and minimizes uncertainty concerning the distribution of goods/services in a high mass consumption society (Rostow, 1991; Hudson, 1997; Hufbauer, 1996; Dewan and Kraemer, 2000). Much like transportation, the Internet's primary economic impact is via fluidity and efficiency in economic matters. The Internet is similar to prior forms of telecommunications, although more extensive and revolutionary in a number of ways (e.g., the richness of data transmission). Indeed, previous research demonstrates a correlation—if not a causal relationship—between telecommunications development, such as the telephone, and economic performance (Saunders et. al., 1994; Dholakia and Harlam, 1994; Cronin et. al., 1993). Other research suggests that IT investment over the past two decades has been important in fueling economic growth in developed nations, which holds important implications for developing nations (Dewan and Kraemer, 2000).

Not surprisingly, many international organizations hail the Internet as a powerful engine of global social and economic transformation. In their "Charter on Global Information Society" issued from Okinawa, Japan in 2000, the G8 (i.e., Group of Eight) asserted that, "Countries that succeed in harnessing (IT) potential can look forward to leapfrogging conventional obstacles of infrastructural development, to meeting more effectively their vital development goals, such as poverty reduction, health, sanitation, and education, and to benefiting from the rapid growth of global e-commerce."

Unfortunately, an abyss yawns between those nations that have high Internet capacity and usage and those that do not. According to the G8, the World Bank, and many other international organizations, this so-called "digital divide" threatens to thwart the transformative power of information technology for the world's poorer nations.

The G8's "Okinawa Charter," while apparently recognizing that the development of IT has prerequisites that are not equally distributed among the nations of the world, nonetheless promotes the idea that the private and public sectors of developed nations can somehow bridge the digital divide and create global, universal connectivity in the very near future. Ultimately, then, these international organizations are relying on *globalization* to accelerate what might normally be the slow diffusion of a complex technological bundle.

In short, both *structural conduciveness* (modernization and post-industrialization) and *globalization* processes are important for the diffusion of the Internet to the developing world. Rogers (1995:5) defines diffusion as a process whereby an innovation is communicated over time to members of a receiving social structure. Although there are several dimensions implicit in this deceptively simple definition, two obvious foci are: (1) the characteristics of the receiving social structure that may aid or impede adoption of the innovation; and (2) the degree, depth, and intensity of the communication between the sender and receiver. Structural conduciveness and contact are therefore important dimensions in any diffusion process.

Figure 1 diagrams our view of international diffusion. When an idea or technology diffuses between two nations, one serves as the sender and the other as the receiver. Both the quality and scope of globalization (between sender and receiver) and the receiver's structural similarities with the sending society (i.e., structural conduciveness) are critical in facilitating the diffusion of ideas and technologies like the Internet. The overall geopolitical context shapes the character and structure of societies and the nature of contact between nations.

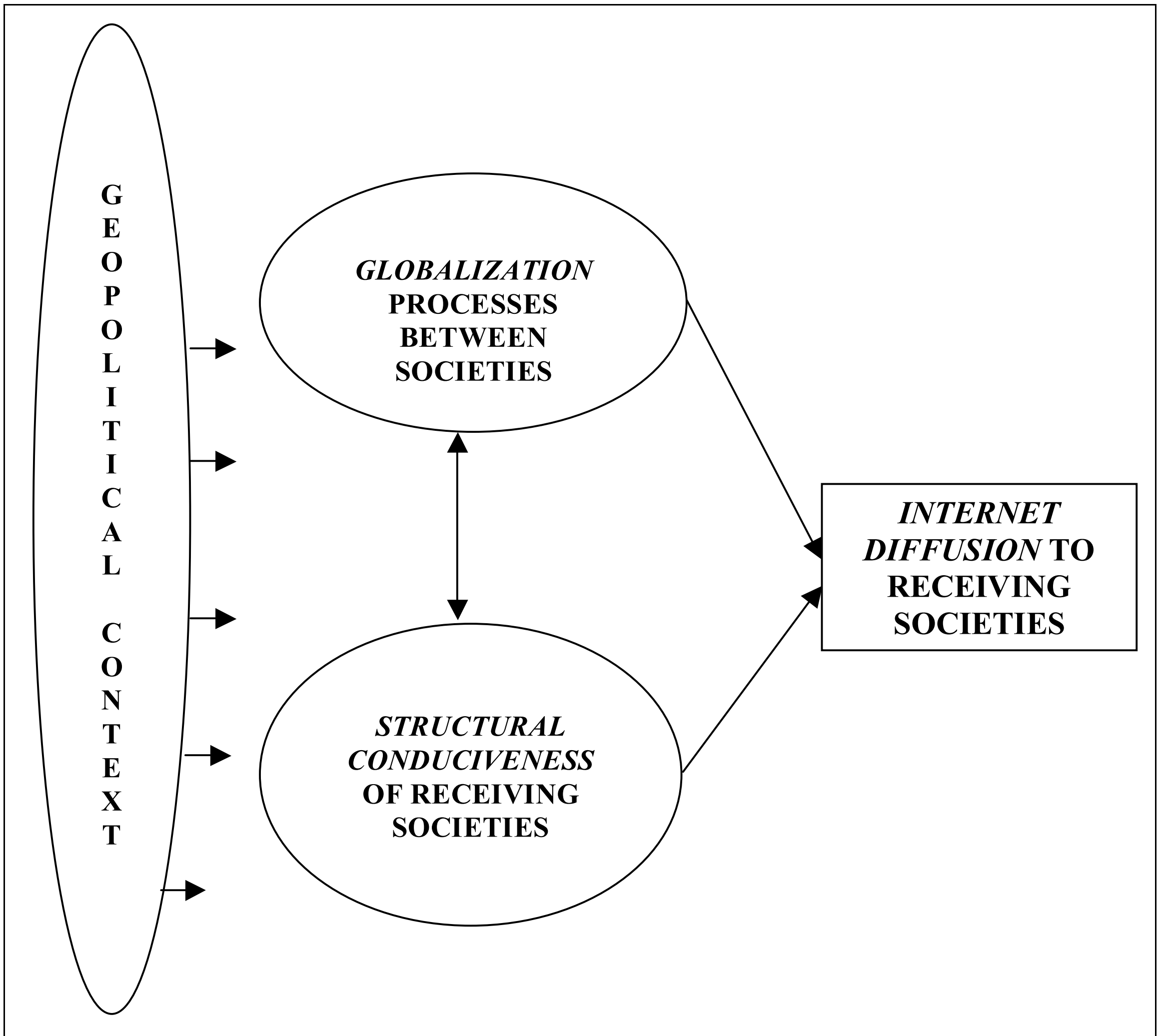

Figure 1. Macro-Social Processes of Internet Diffusion

In terms of structural conduciveness, while it is widely recognized that international social change increasingly relies on cultural diffusion, the important role played by structural compatibility between the sender and receiver has often been underemphasized or even ignored by international policy organizations. This omission is particularly grievous in the case of IT research because the Internet is so obviously a creature of post-industrialism. Foremost, theories of technological and cultural diffusion suggest that diffusion occurs more rapidly between homophilous (i.e., similar) parties in exchange relationships (Rogers

1995:18-19). That is, the greater the similarity between two parties, the faster and more thoroughly they share diffused artifacts (e.g., technology, language, religion). While historical examples of this principle are legion (e.g., the rapid spread of the Industrial Revolution from England to Scotland, New England, and Holland due in part to a common Protestant heritage), application of the principle in development studies has never been common.

Nonetheless, past cross-national research on Internet development has not ignored structural conduciveness. Hargittai (1999) studied 18 OECD nations, finding evidence of the overwhelming importance of the level of affluence (GDP per capita) on Internet development. Norris (2001) used cross-sectional data for 179 countries to demonstrate that economic development and investment in research and development were the overriding factors in the level of Internet adoption. Robison and Crenshaw (2002), using data from more than 70 countries, found strong evidence that the Internet is a post-industrial phenomenon, being more quickly adopted by democratic states that possess advanced service sector economies and highly-educated populations. Kiiski and Pohjola (2002) fit a longitudinal model to predict change in Internet hosts from 1995 to 2000. Using samples of approximately 75 nations, the authors confirmed the strong influence of GDP per capita, human capital formation (schooling), and access costs on Internet adoption. Lucas and Sylla (2003) estimated models based on pooled and partitioned samples of approximately 160 countries. They also found that general affluence is very important, with telephone infrastructure and literacy also playing significant roles in the adoption of Internet technology. Finally, Dewan et. al. (2005) demonstrate the very strong influence of gross domestic product per capita on the development of communications technologies.

These studies suggest a handful of important structural features found in modern and modernizing societies that may be critical to Internet development in the least developed countries (LDCs). Four traits in particular stand out in the empirical literature: (1) the level of economic complexity (i.e., development/infrastructure); (2) political openness (democracy); (3) mass education/literacy; and (4) the economic configuration, with particular emphasis on the service sector. These results suggest that the current optimism about the spread of Internet connectivity should be tempered with a strong dose of realism. If structural conduciveness severely constrains Internet development, then most LDCs will have only a limited presence on the Internet for the foreseeable future.

On the other hand, the constraints of structural conduciveness might be eased by globalization. Globalization commonly refers to a myriad of international networks involving corporations, intergovernmental organizations, governments, and many other actors. Although globalization is not a new phenomenon, what separates today's globalization from earlier forms of international openness is the extent and level of international integration, the absence of overt colonialism, the emergence of international institutions governing international law and commerce, and technological advances that have made communication and transport ever cheaper and faster. As an economic conceptualization, globalization commonly refers to the transfer of capital, technology, people, and goods and services across a globally organized market of buyers and sellers.

How can such global linkages build Internet capacity in societies that might otherwise lack the structural capacity for mass Internet usage? Regardless of the dimensionality of globalization (i.e., whether economic, political or sociocultural), examples abound suggesting that external agencies might "jump-start" IT development in otherwise unlikely locales. For instance, the online magazine eMarketer (www.emarketer.com) has estimated that perhaps as much as 1% of global GDP accrues through business-to-business Internet commerce, suggesting that foreign firms bring with them a sizeable internalized e-market and thereby automatically boost the host country's Internet presence. Non-governmental organizations are also active in propagating Internet development and network-building. For instance, the Association of Progressive Communications (www.apc.org) coordinates a network of websites to bolster various social causes around the globe. Among its members are GreenSpider in Hungary, a cyber-network dedicated to mobilizing people concerning environmental issues in Eastern Europe, and Enda-Tiers Monde in Senegal, an NGO based in Dakar to promote sustainable development. These members have expanded into Internet service providers (ISPs) via the Association's help, and now offer individual Web access and e-mail. International tourism may also boost Internet traffic in the absence of structural compatibility – an estimated 20% to 30% of online revenues to developing countries accrue through travel arrangements made over the Net (ITU, 1999).

The purpose of this research is therefore to provide an empirical examination of the influence of globalization on Internet capacity/development, holding constant structural conduciveness. Ultimately, the broader impact of a study such as this one involves the efficacy and efficiency of international IT initiatives. As noted previously, many OECD governments and intergovernmental organizations (IGOs) are focusing on funding IT programs to bridge the digital divide. If it proves that globalization can promote IT development, but that structural conduciveness plays a strong role in the efficacy of such endeavors, then it allows involved parties to efficiently target those nations/populations where such technological and institutional aid is likely to have the largest effect in the shortest period of time.

Methods

Following more recent conventions in cross-national research, we apply pooled time-series cross-section analysis to an annualized panel of data covering much of the developing world from 1995-2000.

Compared to a typical cross-sectional or time-series OLS design, one of the main advantages of this method is a larger sample size acquired by combining a cross-section and time-series design into a country-year database. Additionally, this methodology allows us to analyze subtle changes over time in the dependent variable, whereas a typical cross-sectional design focuses only on one or two points in time. Finally, a pooled analysis will permit observation of variation over both time and space simultaneously.

The major disadvantage in using pooled time-series is that the error structure is complicated by the inclusion of cases that can have non-random variation over space, time, and various combination-sets of cases. Pooled analysis often violates standard OLS assumptions—that the errors are homoscedastic and uncorrelated. Errors tend to be correlated across both time and space. Furthermore, pooling data with an improper model specification may also lead to the conclusion that the error terms are heteroscedastic and autocorrelated when, in fact, they are not (Podesta, 2002).

To accommodate these potential problems, we follow Beck and Katz (1995, 1998) and use an ordinary least squares model with panel-corrected standard errors. This procedure simultaneously corrects for heteroscedasticity and spatial autocorrelation by using information about the contemporaneous error correlations (between cases) to calculate new standard errors, which are then applied to a regular OLS model. The inclusion of a lagged dependent variable corrects for serial autocorrelation.[2] We do not use fixed effects models (the inclusion of dummies for country and time-specific effects) because of the limited variability in some of our predictors. That is, given the abbreviated time span (1995-2000) of our study, and hence the cross-sectional dependence of some of our variables, using dummies for every case uses an excessive number of degrees of freedom (losing efficiency thereby) and improperly obscures some genuine relationships in the data. As such, our models follow a standard ordinary-least squares design with appropriate modifications.

Our dependent variable is the raw number of Internet hosts annualized for a wide range of developing nations (1995 to 2000) (see appendix A for variables, descriptive statistics, and sources). The term 'host' means any computer or server that has two-way access to other computers and servers on the Internet. Each host has a specific "local or host number that, together with the network number, forms its unique Internet Protocol address," according to a definition provided in whatis.com. A "host" is a unique node in the global Internet. Specifically, these Internet hosts are categorized according to their top level domain name suffixes such as .uk or .ar for the United Kingdom or Argentina. These suffixes are comparable to the commonly found .org, or .edu in the United States (note: most generic ".coms" are U. S. domains). We obtained these data from the Internet Software Consortium (www.isc.org).[3]

The generic model can be specified as follows:

$$Y_{i,t} = \alpha + \beta\, Y_{i,t-1} + \beta_k\, X_{k\,i,t-1} + \varepsilon_{i,t}$$

Where $Y_{i,t}$ is the Internet dependent variable for country i at time t, and $Y_{i,t-1}$ is the same variable lagged one year. $X_{k\,i,t-1}$ is a vector of important covariates each lagged one year. All independent variables are lagged one year to better capture causality. Finally, all variables are logged to correct for skewness.

Structural Conduciveness Covariates

Our first set of models tests the influence of important structural (i.e., modernization and post-industrialization) indicators on Internet capacity. We incorporate a one-year lagged dependent variable for two reasons, one theoretical and the other statistical. First, it is theoretically possible that a nation's level of Internet development one year prior would create multiplier effects, thereby inviting growth in capacity that subsequently ripples through later years. Second, including a lagged dependent variable effectively accommodates serial autocorrelation (Beck and Katz, 1995; Podesta, 2002). The inclusion of the lagged dependent variable renders our tests extremely conservative in that much less variance is left for our theoretical variables to explain. Moreover, because we are focusing

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2 For this analysis we use the panel-corrected standard errors feature in STATA (xtpcse). See (Beck and Katz, 1995) and (Podesta, 2002).
3 The Internet Software Consortium (ISC) collects data through a networking program that "pings" Internet hosts around the globe for numeric responses. The signal returns with the approximated number of hosts per host category (top level domain name).

on the determinants of Internet capacity in developing countries, we exclude OECD nations, further restricting the available variance.[4]

Prior research suggests that infrastructure and institutional environments play essential roles in a nation's structural conduciveness to Internet development. According to the literature, the foremost proxy of infrastructural and institutional readiness should be a robust network of telephone mainlines capable of transmitting electronic data. We include the log of telephone mainlines per 1,000 persons for the period under investigation (1995-2000) (World Bank, 2002). Given that Internet usage in many developing countries is almost entirely dominated by dial-up connectivity via telephone lines, this measure directly taps a nation's technological conduciveness to Internet adoption.

We also include the percentage of the labor force that is employed in the general services sector from the International Labor Organization data (World Bank, 2002). While objections to the use of this variable could be made on the grounds that it includes informal and low-paid services employment such as restaurant work, domestic services, and the like, it should be noted that this measure also incorporates advanced services in the information management and technology sectors. Moreover, a nation with a high level of services employment and lower levels of manufacturing and agricultural employment is typically a more complicated and hence more developed economy. Regardless, differentiating the tertiary sector (i.e., traditional services) from the quaternary sector (i.e., information services) is not possible given missing data for most developing countries.

Previous research also suggests that the political environment plays an important role in Internet deployment (Robison and Crenshaw, 2002; Crenshaw and Robison, 2006). Theoretically, a political institution that is open (or "liberal") to political, economic, and social competition among its citizenry is probably more likely to embrace a diversified, information-diffusing, and empowering communications technology like the Internet. For this study, we make use of the Polity IV's rank measure of political openness (Marshall and Jaggers, 2004).

We adapted our global urbanization variable from the World Development Indicators database. This measure is a nation's percent share of the total world urban population. We calculate our variable by dividing the urban population of a nation in a given year by an estimate of the world's urbanized population for that year. Essentially this indicates a nation's "share" or "rank" in the global network of urban agglomerations, a very rough proxy for the post-industrial islands known as megacities. Such massive urban concentrations provide and fuel the requisite capital, infrastructure, and market demand for significant Internet capacity as well as the prior technological and social connections to the post-industrial world, even in nations that are presently quite backward technologically.

4 The following 58 cases appear in all models in Table 1. Numeric superscripts on the three cases below indicate those nations that are <u>omitted</u> from the respectively numbered equations in Table 2. Omitted cases are due to missing data for tourism share, trade share and foreign investment share. Azerbaijan, Argentina, Bahrain[eq5,6], Bolivia, Brazil, Bulgaria, Belarus, Kampuchea, Sri Lanka, Chile, China, Colombia, Costa Rica, Cyprus, Dominican Republic, Ecuador, El Salvador, Estonia, Fiji, Guatemala, Honduras, Indonesia, Iran, Israel, Jamaica, Kazakhstan[eq1,3], Jordan, Kenya, Latvia, Lithuania, Malaysia, Mauritius, Mongolia, Morocco, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Romania, Russia, Singapore, Vietnam[eq4,6], Slovenia, South Africa, Zimbabwe, Thailand, Trinidad & Tobago, Tunisia, Uganda, Ukraine, Egypt, Uruguay, Uzbekistan, Venezuela.

Certainly, surveys in advanced countries suggest urbanization and Internet usage are strongly correlated (Horrigan et. al., 2005).

Globalization Covariates

In addition to basic internal and institutional variables as measures of structural conduciveness, we include three measures of *economic* globalization: trade as a share of world total, foreign direct investment as a share of world total, and economic aid (official development assistance) as a share of world total (OECD, 2004). These three measures indicate a nation's connectivity with the rest of the world via flows of raw and manufactured goods and capital.

Each indicator is the aggregate aid, trade, and investment within a nation divided by the global total for that particular year. Theoretically, we expect that the higher a nation is in the world's economic hierarchy, the more pressure to augment global connectivity with digital communications and other advanced IT modalities (e.g., email, web hosting, business-to-business communications). In other words, nations that regularly rank high in terms of trade, investment, and aid should have the revenues necessary to make advanced communications outlays as well as the incentive to communicate with, and hence cultivate, stronger relationships with trading, investment, and aid partners via Internet technologies. All three measures are from the World Development Indicators (WDI) database (World Bank, 2002).

Last, we include a social dimension of globalization: tourist arrivals as a share of world total for each year from the World Tourism Organization, adapted from the WDI database (World Bank, 2002). Again, theory would suggest that tourists come with cyber-strings (i.e., their need for global connectivity). A burgeoning tourist mecca would create strong demand for instant and up-to-date information and communications between tourist senders and receivers—a situation readily apparent in the significant numbers of well-financed tourist information/catalogue websites established by national tourism bureaus and travel agencies. And, of course, the bulk of tourists are from post-industrial or otherwise affluent nations, and many such travelers have come to rely on digital communications. In short, their presence in a country should generate demand for computers, ISPs, and other supporting infrastructure.

Analysis

We present the results for the panel-corrected pooled time-series models below. Table 1 provides the standardized estimates for our base model—internal structural and institutional characteristics that shape Internet supply and demand. Table 2 pits our globalization predictors against this base (conduciveness) model.

Table 1 suggests that our five structural indicators strongly predict Internet growth in the developing world—the logs of the lagged dependent variable, telephone mainlines per 1,000 persons (or teledensity), employment in the service sector, political openness, and a nation's global share of urban population are all positive and statistically significant predictors of the log of Internet hosts over time (i.e., from 1995 to 2000). In addition to the very strong effect of the lagged dependent variable (which assumes the lion's share of the available variance), our main measure of infrastructure/affluence (teledensity) is positively and significantly related to Internet deployment over time (Equation 1). The additions of the service sector indicator, political openness, and urban share do not change the impact of teledensity. Referring to the unstandardized coefficients produced by Equation 4 (not shown), a 1% increase in teledensity leads to approximately a twelfth of a percent increase in the log of Internet hosts – a finding that is roughly consistent across equations.

Table 1. Internet Hosts Regressed on Internal Infrastructural and Institutional Characteristics (1995-2000) Standardized Coefficients

	Equation 1		Equation 2		Equation 3		Equation 4	
	B	SE	B	SE	B	SE	B	SE
Intercept	0.710	.094	0.474	.129	0.488	.128	0.298	.108
Log of Internet Hosts t-1	0.910**	.050	0.905**	.050	0.902**	.049	0.867**	.047
Log of Telephone mainlines per K t-1	0.073**	.038	0.056**	.042	0.052**	.044	0.064**	.043
Log of Employment in Services Sector t-1			0.044**	.083	0.040**	.090	0.062**	.090
Log of Political Openness t-1					0.017**	.031	0.044**	.031
Log of Global Urban Share t-1							.104**	1.997
N	319		319		319		319	
Number of Countries	58		58		58		58	
R^2	0.895		0.897		0.897		0.905	
Adjusted R^2	0.895		0.896		0.896		0.904	
Wald Prob > Chisq	0.000		0.000		0.000		0.000	
Note: ** p < .05 * p < .10 (two-tailed tests)								

Similarly, equations 2 through 4 demonstrate that political openness, employment in the services sector and global urban share all positively and significantly contribute to Internet development.

Comparing the standardized coefficients in Equation 4 indicates that global urban share is less influential than the lagged Internet infrastructure variable, yet slightly more important than the other structural variables. The weakest effect in this equation and across the models is our political indicator, while both teledensity and employment in the services sector contribute almost equally to Internet development.

That the five structural conduciveness measures are influential and independent of one another suggests that Internet development in *developing* nations benefits from a modern, post-industrial foundation. Consistent with previous research, our analyses confirm that Internet diffusion is accelerated by robust infrastructure, political democracy, and a growing service sector (Hargittai, 1999; Robison and Crenshaw, 2002; Kiiski and Pohjola, 2002; Lucas and Sylla, 2003; Crenshaw and Robison, 2006). In addition, those developing countries that are integral to the world's urban system have a much easier time embracing Internet development.

Table 2 demonstrates the importance of globalization measures to Internet growth within developing countries. In the first two equations we entered tourism and official development assistance as shares of their respective world totals. While both attain statistical significance when entered independently, tourist share is roughly twice as strong as aid share. Moreover, when both are entered simultaneously (Equation 3), aid share drops out

Table 2. Internet Hosts Regressed on Globalization Indicators (1995-2000) Standardized Coefficients

	Equation 1		Equation 2		Equation 3		Equation 4		Equation 5		Equation 6	
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	0.2663**	0.19	-4.4732**	2.33	-2.9272	3.06	0.3710**	0.10	-1.0463*	0.64	0.3514	1.02
Log of Internet Hosts t-1	0.8468**	0.05	0.8497**	0.05	0.8440**	0.05	0.8233**	0.05	0.8635**	0.04	0.8334**	0.04
Log of Telephone Mainlines per K t-1	0.0488**	0.05	0.0757**	0.05	0.0576*	0.06	0.0530**	0.03	0.0494**	0.04	0.0407**	0.03
Log of Employment in Services Sector t-1	0.0659**	0.05	0.0643**	0.09	0.0666**	0.05	0.0599**	0.08	0.0617**	0.09	0.0598**	0.08
Log of Political Openness t-1	0.0510**	0.03	0.0475**	0.03	0.0530**	0.03	0.0550**	0.04	0.0470**	0.03	0.0585**	0.04
Log of Global Urban Share t-1	0.0458**	1.78	0.0821**	1.54	0.0373**	1.03	0.0289**	1.14	0.0633**	2.68	0.0282	3.09
Log Tourist Arrival Share t-1	0.0769**	1.56			0.0681**	1.77						
Log of Official Development Assistance t-1			0.0396**	7.84	0.0269	10.24						
Log of Trade Share t-1							0.1220**	2.11			0.1186**	2.24
Log FDI share t-1									0.0442**	2.28	0.0006	3.49
N	312		319		312		314		314		309	
Number of Countries	57		58		57		57		57		56	
R^2	0.9113		0.9063		0.9091		0.9064		0.9115		0. 9088	
Adjusted R^2	0. 9070		0. 9045		0. 9070		0. 9046		0. 9098		0.9118	
Wald Prob > Chisq	0.00		0.00		0.00		0.00		0.00		0.00	

* significant at 10%; ** significant at 5%

altogether. Thus, tourism proves to be the more influential global connectivity measure of the two. Curiously, the significance level of teledensity is weakened by the addition of tourism and aid, perhaps suggesting that tourism needs adequate infrastructure to promote Internet development. In other words, a confluence of infrastructure and external inputs is important for technological adoption.

In a similar fashion, our two main economic indicators, trade and foreign investment as shares of their respective global totals, are positive and statistically significant when entered separately. The final model (Equation 6) suggests, however, that only trade affects internet development in a unique way, *ceteris paribus*. This suggests that trade is a more important contributor to Internet development than investment, probably because the importance of foreign investment is in its promotion of trade flows, which in turn place concomitant demands on communications technologies. Interestingly, the simultaneous inclusion of both economic globalization measures washes out the significance of global urban share. This suggests that neither structural conduciveness nor globalization alone promotes Internet development, but rather it is the conjunction of both internal and external factors that proves crucial. For instance, because urbanism encourages trade and attracts foreign investment (Crenshaw, 1991), it is highly likely that the urban-economic globalization matrix proves essential for technological deployment. At the very least, having growing connections with the world in terms of trade and investment may accelerate a nascent process of post-industrialization, in this case, the adoption of a post-industrial technology—the Internet.

Discussion

Our results indicate that both structural conduciveness and globalization are important for Internet development within developing countries. Although conduciveness to digitalized technology may be sufficient to develop it, global contacts with already-digitalized societies apparently boost the adoption rate among developing societies. Precisely, we demonstrate that a strong telephone infrastructure, robust service sector employment, high levels of political openness and large urban agglomerations provide the groundwork for Internet deployment, as measured by Internet hosts over time. Moreover, we also demonstrate that global shares of tourism and trade uniquely contribute to Internet development in less developed countries. Thus, specific internal and external conditions form a confluence of forces that determines the current distribution and growth of Internet usage.

Although wireless technology and other innovations may change our prognosis in the near future, our results lead us to strongly qualify the optimism of some international organizations. "Jump-starting" Internet development sans infrastructure, democracy, and advanced markets (i.e., structures conducive to IT) will be an uphill battle.

Our results suggest that global flows of people, money, and information follow existing channels in the world order, channels solidly anchored in structural conditions that provide the need for communication – democracy encourages trade and tourism, service sectors encourage outsourcing and trade in invisibles, and large urban agglomerations provide the post-industrial islands that concentrate both labor and consumer markets. That these channels or conduits should become digitalized makes sense, and they will in large part determine the immediate distribution and growth of the World Wide Web. Nevertheless, as important as digital development is, our findings suggest that such development should not overshadow the earlier focus on economic growth.

The research presented here has important limitations that should not be ignored, however. First of all, our measure of Internet hosts may not adequately capture the actual global network. The source of information on Internet hosts is from a single organization that uses a single pinging method only twice a year to capture an image of Internet capacity. ISC admits also that one cannot ascertain with exact certainty the precise physical location of the Internet site, since the data is aggregated by the top-level domain name (.ar suffix for Argentina, for instance, can be registered virtually anywhere, including within the U.S.). Finally, the raw number of hosts does not fully measure the depth of Internet use—either in terms of quality of usage (who uses it, why, and to what extent) or the number of users. These figures cannot tell us how many people are online at the moment of the survey or to what extent they were making use of the Internet.

Further research is needed to explore or develop better measures of the global Internet that include, but are not limited to, host-computer data, end-user figures, generic domain-level data, and other information on servers and networks. Moreover, more research is needed on the quality and scope of Internet use at the cross-cultural level of analysis (Hargittai, 2005).

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Appendix A

Variable (logs)	Obs	Mean	Std. Dev.	Min	Max
Internet Hosts	319	3.158632	1.065221	0	5.744041
Internet Hosts t-1	319	2.778976	1.237817	0	5.419316
Telephone Mainlines/K t-1	319	1.912739	0.505272	0.39794	2.800098
Employment in Services Sector t-1	319	1.636354	0.246603	0.612784	1.877947
Political Openness t-1	319	0.697025	0.386457	0	1.041393
Global Urban Share t-1	319	0.003584	0.008449	0.000053	0.057964
Global Tourism Share t-1	312	0.005797	0.008947	0.000173	0.055911
Global ODA Share t-1	319	0.302946	0.002554	0.298913	0.316161
Global Trade Share t-1	317	0.005645	0.009142	0.000147	0.053827
Global FDI Share t-1	314	0.304738	0.010012	0.297252	0.382196

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