Regulation and Internet Use in Developing Countries

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December 2002
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Abstract

Policy makers are simultaneously concerned about the consequences of a worsening "digital divide" between rich and poor countries and hopeful that information and computing technologies (ICTs) could increase economic growth in developing countries. Very little research, however, has explored the reasons for the digital divide beyond noting that it is strongly correlated with standard development indicators, and no empirical research has explored the role of regulation. In this paper I use data from a unique new survey of telecommunications regulators and other sources to measure the effects of regulation on Internet development. I find regulation strongly correlated with lower Internet penetration and higher Internet access charges. More specifically, controlling for factors such as income, development of the telecommunications infrastructure, ubiquity of personal computers, and time trends, countries that require formal regulatory approval for Internet Service Providers (ISPs) to begin operations have fewer Internet users and Internet hosts than countries that do not require such approval. Moreover, countries that regulate ISP final-user prices have higher Internet access prices than countries that do not have such regulations. These results suggest that developing countries' own regulatory policies can have large impacts on the digital divide.

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* I am grateful for helpful comments from George Clarke and Greg Rosston. I am of course responsible for all errors.

I. Introduction

As information and communication technologies (ICTs) became ever more ubiquitous in the late 1990s, many began to worry about an increasing "digital divide" between rich nations and poor.[1] That is, those in rich nations had increasingly better access to ICTs and were using them more intensively while poor nations continued to fall further behind. At the same time, many believed that the Internet and ICTs potentially offered developing countries an opportunity to increase productivity and economic growth. These two beliefs have led to many initiatives by industrialized countries, NGOs, and international organizations such as the World Bank and the UN intended to increase Internet usage and, presumably, bridge the digital divide in developing countries.

While many of these initiatives mention the importance of competition and regulatory structure, few have given it much attention, and almost no research has explored the effects of regulation on Internet development. In this paper I combine data from a new survey of regulators, the International Telecommunications Union (ITU), and World Bank statistics to estimate the effects of regulation on the Internet in developing countries. Controlling for factors including income, development of the telecommunications network, and number of computers in the country, regulations targeted at the Internet were correlated with lower Internet usage, fewer Internet hosts, and higher prices for Internet access. More specifically, countries that require formal approval for Internet Service Providers (ISPs) to begin operations had fewer Internet users and Internet hosts, while countries that regulate ISP prices have higher prices for Internet access.

II. The Digital Divide

People in richer countries have better access to ICTs and use them more intensively than do people in poorer countries. Figure 1 shows Internet use over time by countries' average income. It is clear that Internet usage is far more common in richer countries than in poorer countries, and also that the number of users has grown more quickly in richer countries. The torrid pace of technological change—and the ensuing technology bubble—in industrialized

[1] There is also concern about so-called "digital divides" within countries, but this paper is concerned with the gap between countries.

countries led to the simultaneous concerns that this divide would continue to grow with grave consequences, and also that the Internet and new technologies could help stimulate economic development (see, for example, Hammond 2001; Ishaq 2001; Norris 2001; Steinmueller 2001).

Concerns about consequences of the widening digital divide permeated discussions of economic development. Kofi Anan, for example, said that "People lack many things: jobs, shelter, food, health care, and drinkable water. Today, being cut off from telecommunications services is a hardship almost as acute as these other deprivations, and may indeed reduce the chances of finding remedies to them" (as quoted in Norris 2001). The concerns about the digital divide have probably been overstated and the potential benefits from ICTs over-hyped. Kenny (2002), for example, notes that the likely impact of any particular technology is likely to be small,[2] and Pohjola (2002) finds little correlation between ICT investments and economic growth in 42 developing countries from 1985-1999.

Nonetheless, there is evidence that ICTs can improve productivity and economic growth in developing countries. Clarke (2002), for example, using enterprise-level data in Eastern European transition economies, finds that even controlling for endogeneity, firms that have Internet access are more likely to export than firms that do not.[3] Bhavani (2002) finds that use of technology is beneficial for firms in the Indian auto components industry. Moreover, ICTs—or, more accurately, involvement in ICT industries—have also been important in spurring regional economic growth in places such as Taiwan and Bangalore (Arora, et al. 2001; Athreye 2002; Saxenian and Hsu 2000).

In response to the concerns and hopes, a wide range of organizations established initiatives to "bridge the digital divide." As Heeks (2002) put it, "donors, attracted by a combination of the hype and hope generated by ICTs have altered their funding priorities and pushed ICTs up the development agenda."[4] These initiatives include, but are not limited to, the United Nations Information and Communication Technologies Task Force, the Digital

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[2] While any *given* technology is unlikely to have a major impact on economic growth, some innovations become "general purpose technologies" that do generate a burst of productivity and economic growth (e.g., Bresnahan and Trajtenberg 1992; Helpman 1998; Rosenberg and Trajtenberg 2001). Whether certain ICTs are general purpose technologies is still a matter of debate.

[3] In a complementary paper, Clarke (2001) finds that foreign-owned firms are more likely to have Internet access. Moreover, he found evidence of spillovers from this access, with FDI increasing Internet access among domestic firms other than firm receiving the FDI.

[4] Heeks (2002) also notes that this is not necessarily good: "Like sharks drawn to blood in the ocean, a whole host of consultants, academics, vendors, and development organization staff have been drawn into the e-development arena by the scent of money."

Opportunities Task Force created by the G8 and administered by the World Bank and UNDP, the World Economic Forum Global Digital Divide Initiative, and agreements between the ITU and vendors such as Cisco and Oracle to bring training centers to poor countries (Campbell 2001).

These initiatives typically share common goals and methods, consistent with the view that the key to building ICT use in developing countries was some kind of direct provision, investment, or demand-push from governments (see, for example, Kapur 2002). InfoDev at the World Bank, for example, describes itself as "a multi-donor program supporting, through a competitive grant mechanism, innovative activities demonstrating the opportunities offered by new technologies in information and communications. Its mission is to utilize these technologies for economic and social development, with a special emphasis on the needs of the poor in developing economies" (InfoDev 2002). Funded projects and programs generally focus on directly providing the technology or training necessary to bring ICTs to the poor.[5]

Even if targeted projects achieve their goals, truly addressing the problem requires understanding factors underlying the divide. Given the potential of ICTs in developing countries to improve growth and the resources already committed to addressing the issue, it is important to investigate whether certain obstacles make the divide worse than one would expect even given a country's general economic situation. A few papers have empirically explored ICT use in developing countries. This work is generally based on data collected by the International Telecommunications Union (ITU), and tends to find digital technologies correlated with the general level of development such as trade openness and income (Baliamoune 2002; Onyeiwu 2002).

The results from this literature are perhaps not surprising, but suggest that technology diffusion in developing countries may not be so different from other goods and services. These papers do suffer from some shortcomings, however. First, they include Internet users, Internet hosts, number of computers, telephone lines, and mobile telephone customers all as dependent variables.[6] While this choice is not necessarily incorrect, the resulting empirical specifications cannot control for many relevant necessary factors. For example, as discussed below, the number of Internet users is likely to be (partly) a function of the development of the telecommunications infrastructure and the number of computers in the country. Also, the

[5] See http://www.infodev.org/index.html for lists of proposals and funded projects.
[6] Indeed, Onyeiwu (2002) combines these four variables into a single, "digitalization" index.

analyses typically do not incorporate or acknowledge the collected knowledge of telecommunications reforms, which suggests that some measure of market structure and liberalization should be taken into account.

One notable exception is a study by Dasgupta, et al. (2001), who find that the digital divide is better characterized as a lack of telecommunications access than a lack of access to ICTs, per se. As a result, competition policy proves to be important—countries with higher general scores on competition policy have higher Internet intensity (Internet subscriptions per telephone mainline). Their conclusions are sensible given other work on telecommunications reforms in developing countries. By now a great deal of research has demonstrated the benefits of competition in telecommunications (e.g., Ambrose, et al. 1990; Fink, et al. 2002; Li and Xu 2001; Ros 1999; Wallsten 2001). Nonetheless, their analysis uses a very general measure of overall "competitiveness" within a country—an index constructed in 1995 that measures on a scale of 1 to 6 whether "the state inhibits a competitive private sector, either through direct regulation or by reserving significant economic activities for state-controlled entities."

In this paper I use data from a new survey of telecommunications regulators to assess the effects of targeted regulations on the development of the Internet. Specifically, the data allows me to explore the effect of ISP regulations on Internet usage and access pricing, while controlling for other factors that one would expect to affect these variables. In the sections below I discuss regulation and the Internet and then proceed to explain the data, empirical methods, and results.

III. Regulation and the Internet

Regulation is an important component of competition policy in the context of telecommunications. A key problem in telecommunications reforms is that while competition is technically possible, new entrants require the cooperation of the incumbent firm, which often has nearly a complete monopoly. In particular, a new entrant's customers must be able to reach the incumbent's customers if the entrant's network is to have any value. In order to be viable, therefore, the entrant must be able to interconnect with the incumbent's network. Because a monopolist has no incentive to interconnect, and every incentive to exercise its market power at the expense of new entrants and consumers, most countries established regulatory agencies as

part of their telecommunications reform process in large part to curb the incumbent's market power and promote competition in the industry. But the definition of "telecommunications" is not clear-cut, and regulatory discretion is rarely limited to interconnection issues. In particular, in addition to telephony, some countries regulate aspects of the Internet, especially Internet Service Providers (ISPs).

Regulatory discretion is not the only ambiguous feature of these agencies. Whether regulatory agencies effectively correct market failures has been a hotly debated issue for several decades, as discussed below.

Helping Hand, Capture, and the Grabbing Hand

In an ideal world, economic regulation is intended to correct market failures (Pigou's (1938) "helping hand" theory). For example, in industries considered to be natural monopolies—where increasing returns to scale mean that one firm can supply the market at lowest cost—a *laissez-faire* approach would ultimately result in a single firm dominating the market free to charge monopoly prices and providing lower quantities of the service. The regulator was supposed to ensure that the firm kept costs down while continuing to innovate and improve service as if it operated in a competitive industry.

Regulations, however, can end up primarily benefit the regulated firm. As Stigler (1971) pointed out, it is easy for the regulated firm to "capture" the regulator. In this case, regulations can become a vehicle not for maximizing total or consumer welfare, but for protecting the firm's monopoly and profits. It is easy to understand how such regulatory failure can happen, even assuming a benevolent regulator. The firm always has more information about its cost structure than does the regulator, making it difficult for the regulator to independently evaluate the firm and the industry. The firm can strategically control the information available to the regulator to increase the probability that decisions are in the firm's favor. Likewise, the regulator may impose entry barriers to the industry, either out of a belief that entry would be harmful or, if truly captured, simply to protect the incumbent. In either case, the incumbent firms benefits from the regulation.

Developing countries face an additional regulatory pitfall. Regulatory agencies create more opportunities for governments to extend a "grabbing hand"—that is, they increase the

number of interaction points between government and industry where bribes may be required for firms to begin or continue operations. This pattern of administrative barriers imposed on firms in developing countries is becoming well-documented (e.g., de Soto 1989; Djankov, et al. 2002; Emery, et al. 2000; Friedman, et al. 2000). These barriers impose real costs on developing economies. Emery, et al. (2000) discovered that "when added together, this whole maze of often duplicative, complex, and non-transparent procedures can mean delays of up to two years to get investments approved and operational." Moreover, Djankov, et al. (2002) finds entry regulation in developing countries to be associated with lower quality public and private goods.

The net effect of telecommunications regulation in developing countries is unclear. On the one hand, regulatory agencies may be crucial in encouraging entry and investment in the face of a dominant incumbent. On the other hand, the track record is not good. Developing country regulators face the dual problems of avoiding capture and becoming another grabbing hand.

Regulation and the Internet

The effects of regulation on telecommunications reforms in general have only begun to be extensively investigated.[7] Research, however, has almost completely ignored the effects of regulation on Internet development. Many of the "digital divide" reports note that promoting competition and Internet-friendly regulatory policies are an important component of addressing the issue (e.g., International Labour Office 2001). Nonetheless, to my knowledge no empirical study has explored the effects of regulation on the Internet in developing countries. This omission is especially unfortunate given that regulatory agencies are likely to be the primary way public policy affects Internet development.

One case study on the subject highlights the potential importance of regulation on Internet development. Petrazzini and Guerrero (2000) investigate development of the Internet in Argentina. In particular, they try to explain Argentina's progression from having among the lowest Internet penetration in Latin America in 1993 to among the highest in 1999. Essentially, they find that regulatory intervention was key in that non-competitive market, with the government mandating large reductions in prices of leased lines and the creation of a special

[7] Many researchers have discussed telecommunications regulation (e.g., Galal and Nauriyal 1995; Gasmi, et al. 2000; Guasch and Hahn 1997; Hill and Abdala 1996; Noll 2000; Stiglitz 1999; Wallsten 2001; Wellenius and Stern 1994). To date, however, most analysis consists of case studies; there is very little empirical work on the issue.

local dialing scheme for calls to connect to the Internet. Even with those mandated reductions, however, the authors note that high prices still seemed to be a major obstacle to higher Internet penetration.

While the Argentina case study highlights the potential influence regulatory policy can have on Internet development, this paper aims to address this question empirically by exploiting a new, detailed dataset based on a survey of telecommunications regulators in 44 developing countries. As discussed below, the survey contained several questions on regulation of ISPs, which, combined with standard data from other sources allow me to test the effects of regulation on Internet development. The following sections describe the data, empirical methods, and results.

IV. Data and Empirical Analysis

The point of this paper is to measure the effects of regulation on the Internet in developing countries. I do the analysis in the context of a simple regression framework, estimating several versions of equation (1).

$$(1) \qquad y = \beta_0 + \beta_1 * (regulation) + \beta_2 \boldsymbol{Z} + \varepsilon$$

In this equation, the dependent variable y is the relevant Internet measure, *regulation* is the relevant regulation variable, and $\boldsymbol{Z}$ is a vector of control variables. These are described in more detail below.

The regulation variables—the heart of this paper—are derived from a survey of regulators in developing countries conducted from March 2001 to August 2001. We contacted 60 regulatory agencies in developing countries around the world and received responses from 45 (see Wallsten, et al. 2002 for a complete description of the data).[8] The survey asked detailed questions about the agency's independence, composition, appointment and removal processes, transparency, accountability, and discretion. Several questions about the regulator's discretion focused on ISPs, resulting in two useful regulation variables for this analysis. First, the survey asked "What approval do Internet Service Providers have to get before they can start operating,"

[8] We actually received 46 responses, but one returned the survey unanswered.

where possible answers were "none", "notification", and "formal approval." For the analysis I coded regulatory approval as a dummy variable that equals one if the operator requires formal approval to start operating, and zero otherwise. Second, the survey asked whether "final-user prices [are] regulated" for ISPs. Again, price regulation becomes a dummy variable that equals one if ISP prices are regulated. Table 1 shows the results of these questions by country. The table shows that of 38 countries that answered the question, 23 require formal approval for ISPs to start operation. Of 41 countries that responded to the second question, six regulate final-user ISP prices.

The two Internet measures come from the ITU. The two measures of Internet penetration include the number of Internet users and the number of Internet hosts (Table 2). The number of Internet users is "based on reported estimates, derivations based on reported Internet Access Provider subscriber counts, or calculated by multiplying the number of hosts by an estimated multiplier" (International Telecommunications Union 2002c). While imperfect, this estimate seems to be the best estimate of Internet use available. The second variable, the number of Internet hosts, "refers to the number of computers in an economy that are directly linked to the worldwide Internet network. This statistic is based on the country code in the host address and thus may not correspond with the actual physical location" (International Telecommunications Union 2002b). The qualifier on the definition is likely the explanation for large variation in the number of hosts per country. The problem is essentially that while each country is assigned an Internet identifier (e.g., .uk for Britain), there is no obligation for everyone in the country to use it, resulting in ambiguity regarding the physical location of a given host.[9] These issues result in strange anomalies in the data. For example, while it is conceivable that Brazil had nearly 663,000 Internet hosts in the year 2000, it is strains credulity to believe that Malawi—despite being one of the poorest countries in the world—had only one.[10]

Data on Internet pricing also comes from the ITU. The pricing information is the ISP charge, and is defined as "the costs associated with 30 off-peak hours of dial-up Internet time per month. It is the monthly Internet subscription rate plus extra charges once free hours have been used up" (International Telecommunications Union 2002a). While the measures of Internet use

[9] Any internet address registered as .com or .org, for example, is counted as being located in the United States.
[10] The reason for Malawi's poor showing appears to be a dispute over Malawi's Internet identifier, .mw. Until recently Malawi was unable to use it, because it was being held by a "British-South African entrepreneur" (Blantyre 2000).

are available from the early 1990s for many countries, the price data are available only for 2001. The last column of Table 2 shows ISP charges that year for the countries in the sample, revealing large variation across countries.

The vector $\boldsymbol{Z}$ attempts to control for other factors affecting Internet usage and pricing. In particular, it includes per capita income, development of the telecommunications industry (number of telephone mainlines), number of personal computers, whether the incumbent telecommunications provider has been privatized, and the share of trade in the economy. The combination of income, telecommunications development, and ubiquity of personal computers is likely to be a good indicator of potential demand for Internet services—or at least the number of users as measured here. The privatization variable provides some measure of whether the industry has been liberalized or is still run by the state. Trade is included as a measure of international integration, under the assumption that countries that are more connected to the rest of the world are more likely to tolerate or promote Internet access. Moreover, such openness measures are the one factor consistently significant in econometric analyses discussed above.

One potential problem here is the likely correlation between the control variables. That is, the number of personal computers per capita in a country is likely to be determined in large part by a country's per capita income. Likewise, an enormous literature has explored the relationship between trade and income. However, Internet use is likely to be a function of all these variables, meaning it would be a mistake to exclude them, and they are unlikely to be correlated with the regulatory variable of interest. The implication of this collinearity is that interpreting the coefficients on the control variables may not be easy, but it should not affect the variables of interest and excluding them is likely to bias the coefficient on the regulation variable. Nonetheless, I add control variables to each regression slowly both to see how including one variable affects the others, and to test the robustness of the results on the policy variables.

Internet users and hosts

The first part of the analysis explores the relationship between regulations and Internet penetration by estimating equation (2), which is similar to equation (1) except that the data exist over time and across countries.

(2) $y = \beta_0 + \beta_1 *(\text{formal approval required for ISP to operate?})_i + \beta_2 \mathbf{Z}_{it} + \gamma_t + \varepsilon_{it}$

The first set of regressions uses the number of Internet users per capita as the dependent variable, and the second set of regressions uses the number of Internet hosts per capita as the dependent variable. The control variables are the ones described above, though the panel nature of the data means that I can also control for year fixed effects. This time trend is an especially important control with a new technology such as the Internet, which is growing rapidly over time.

Note that the regulation variable does not vary over time. The survey was conducted in 2001, and I assume that this regulatory function was in place from the time the regulatory agency was founded. In one sense this is a bad assumption. The Chilean regulatory agency, for example, was founded in 1977 and is unlikely to have considered regulations regarding a technology that, from the point of view of a telecommunications authority, did not yet exist. In a practical sense, however, this assumption is reasonable for two reasons. First, the first year any country in the sample reports Internet users is 1991 (in Brazil, which had 5,000), and more commonly not until 1995 or 1996, meaning that the analysis never includes an observation that assumes Internet regulation to exist absurdly early. Second, most regulatory agencies were formed around the same time the Internet was becoming popular and countries were already considering its implications, making it likely that these regulations were part of the regulatory agency's purview from its inception. The implication of this discussion is that the dataset becomes an unbalanced panel, where an observation is a country-year, and the first year a country appears in the regression is the first year the regulatory agency was operating.

Table 3 reports the results of estimating equation (2) with the number of Internet users per capita as the dependent variable. Interpreting the coefficients on the control variables is not easy, as discussed above, though broadly speaking the results are consistent with expectations. The number of telephone mainlines per capita is positively and significantly associated with Internet users, though it becomes insignificant as other variables are added. The coefficient on per capita income is negative, though significant only in some specifications. It is well-known that the most important determinant of telecommunications development, however, is income, so it is not surprising that including both of those variables together makes interpreting them difficult. The number of personal computers per capita is robustly positively correlated with

Internet use, and having a privatized telecommunications incumbent is also positively and significantly associated with Internet use.

The regulatory variable is negatively and significantly associated with per capita Internet use across all specifications. That is, countries that require ISPs to get formal regulatory approval to start operations have fewer Internet users per capita than countries that allow ISPs to begin operations without such formal approval. Moreover, the coefficient is not only negative, but also fairly large in magnitude at just about half the mean of the dependent variable.

Table 4 shows the results of estimating equation (2) when the dependent variable is Internet hosts per capita. The results on the control variables are basically the same as described above. The coefficient on the regulation variable, however, while always negative, ranges from being significant at the one percent level when in the regression by itself and also controlling for income (and year dummies), to not significant at all when including mainlines per capita, privatized incumbent, and personal computers per capita.

A slightly different specification, however, yields more robust results. Table 5 shows the results of estimating equation (2) using log-levels. In this specification, the regulation variable is robustly negative across specifications. Even including any combination of income, GDP, population, number of telephone lines, privatized incumbent, number of personal computers, and trade variables, requiring formal approval for ISPs to start operations is correlated with fewer Internet hosts per capita.[11] Using logs is arguably more sensible in this case given the very large variation in reported number of Internet hosts. Nonetheless, the large error inherent in the measurement of this indicator discussed above suggests that the results in general may be less reliable than for other variables.

ISP Final-User Prices

Equation (3) presents the equation to be estimated using the price of monthly ISP access as the dependent variable, and whether or not ISP final-user prices are regulated as the policy variable of interest.

(3) $y = \beta_0 + \beta_1 * (\text{ISP final-user prices regulated?})_i + \beta_2 \mathbf{Z}_i + \varepsilon_i$

[11] The results are, not surprisingly, equally robust when using log-levels without normalizing by population (that is, not in per capita terms).

While the Internet penetration variables used above are available for several years, ISP prices are reported only for the year 2001. Unfortunately, not all of the control variables are yet available for that year for all countries, so I use year 2000 figures for those variables. The result is a cross-section of 29 countries using variables from 2000 and 2001.

Table 6 shows the results of this estimation. None of the control variables are significant across specifications. There is some evidence that a larger number of personal computers is correlated with lower ISP prices, but the coefficient is barely significant, at best. The regulatory variable, however, is positive and statistically significant across specifications. In other words, Internet access is more expensive in countries that regulate final-user ISP prices.

V. Discussion and Conclusion

The prospect of a growing "digital divide" between poor and rich countries and hope that ICTs may present an opportunity to improve productivity and economic growth has led to a number of initiatives designed to stimulate ICT use in developing countries. While many organizations note that competition and a friendly regulatory environment may be important to ICT development, few of these initiatives and very little research has actually focused on the role of regulation in promoting Internet use. This paper is an attempt to fill that gap. Using data from a new survey of telecommunications regulators in developing countries combined with publicly-available information from the ITU and the World Bank, I find regulation of Internet Service Providers to be correlated with worse outcomes. In particular, countries that require ISPs to get formal approval before beginning operations have fewer Internet users and Internet hosts, while ISP price regulation is correlated with higher ISP final-user prices.

One potential concern with the analysis is whether the regulatory variables are endogenously correlated with the dependent variables. While this is a concern in a great deal of similar work on telecommunications reforms, reverse causality is unlikely to be the case here. First, these regulations were set largely in the early days of the technology's introduction into the country. In other words, the regulations probably came before the Internet was so ubiquitous, not the other way around. Second, the empirical results are consistent with many governments' initial reaction to the Internet, which was apprehension. More repressive governments worried

about the effects of free access to information, and nearly all governments worried about the effects of Internet telephony on their incumbent telecommunications provider.[12] In this light, ISP regulations were likely promulgated precisely in order to suppress Internet access, and in that light, seems to have been successful.

These results suggest that regulations on the Internet are not intended to correct market failures, and are more consistent with a capture or "grabbing hand" view of regulation. Price regulation correlated with higher prices is consistent with capture, and requiring formal approval for ISP operations consistent with both capture and grabbing hands. Requiring formal regulatory approval presents a barrier to entry to new ISPs. The finding that this entry barrier is correlated with lower development of the industry is also consistent with Djankov's (2002) finding that countries with heavier entry regulations have lower quality public and private goods.

The results also suggest that a country's regulatory approach to the Internet and ICTs can have a large impact on its ubiquity throughout the country. While the sample contains a relatively small number of countries, the results suggest that reducing entry barriers and promoting competition is likely to yield large increases in the share of developing countries' populations with access to the Internet and any potential benefits that flow from such access. In other words, removing entry barriers and promoting ISP competition may present a low-cost and non-distortionary way to boost Internet use in developing countries.

[12] I tried including various measures of civil liberties (e.g., from Freedom House) and corruption in the empirical analyses, but they were generally not significant. Moreover, because such indicators are not available for all countries over all years their inclusion caused the sample size to shrink substantially.

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Figure 1
Internet Users per 10,000 People

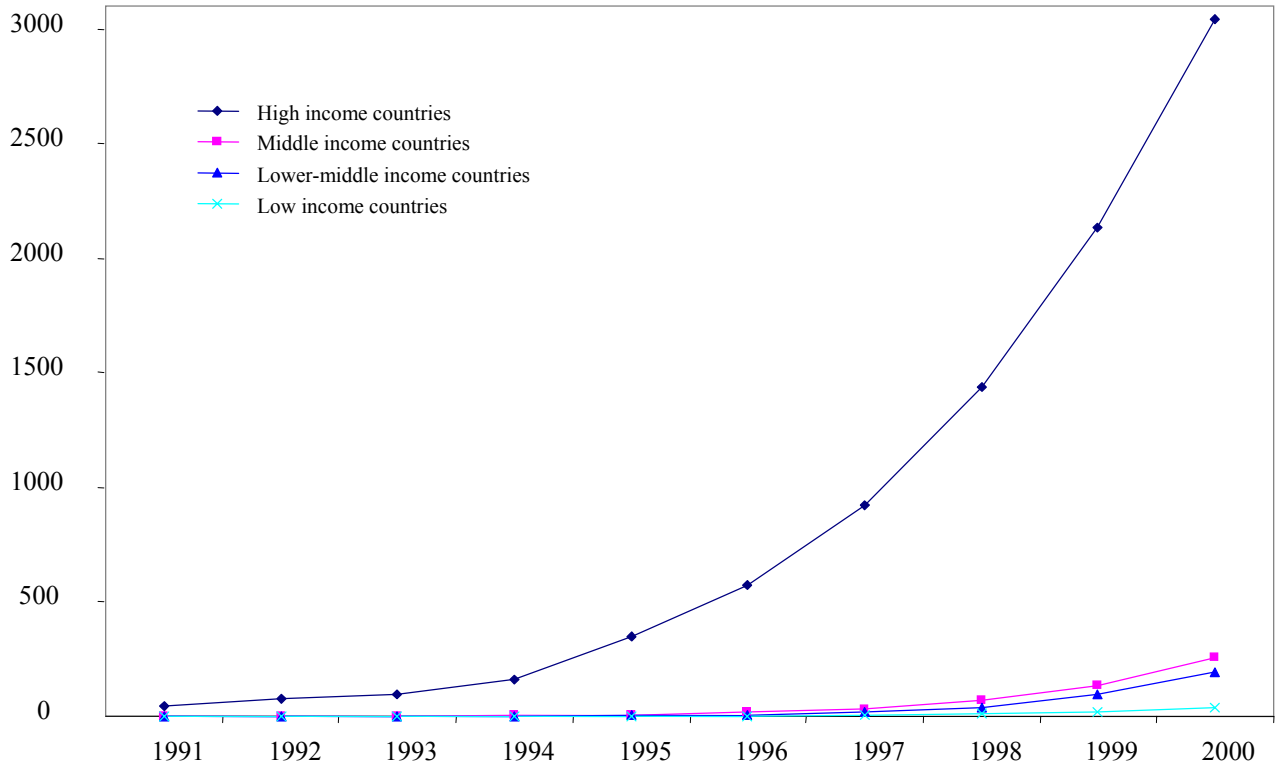

Table 1
Regulators and Internet Regulations

Country	Year regulator established	Approval required for ISP to start opertions	ISP prices regulation?
Argentina	1990	Formal	No
Barbados	2001	Formal	No
Belize	1987	n/a	Yes
Bolivia	1995	Notification	No
Bosnia and Herzegovina	2001	Notification	n/a
Brazil	1997	None	No
Bulgaria	1998	None	No
Chile	1977	None	No
Colombia	1994	Formal	No
Costa Rica	1996	Formal	n/a
Cote d'Ivoire	1995	Formal	Yes
Czech Republic	2000	Notification	No
Dominican Republic	1998	Formal	No
Ecuador	1995	Formal	No
El Salvador	1996	None	No
Estonia	1998	Notification	No
Ghana	1996	Formal	No
Guatemala	1996	Formal	No
Honduras	1995	Formal	No
Hungary	1990	Formal	No
India	1997	Formal	No
Jamaica	1997	Formal	No
Jordan	1995	Formal	Yes
Kenya	1999	Formal	No
Latvia	1992	n/a	No
Malawi	1998	Formal	Yes
Malaysia	1998	None	No
Mexico	1996	Notification	No
Moldova	0	None	No
Mongolia	1995	Formal	No
Morocco	1998	n/a	No
Pakistan	1996	Notification	No
Panama	1996	Formal	No
Peru	1991	Formal	No
Poland	2000	Notification	No
Romania	2001	Formal	No
Slovakia	1993	Notification	No
South Africa	2000	Formal	No
Sri Lanka	1991	Formal	Yes
Tanzania	1993	None	Yes
Thailand	2001	n/a	n/a
Turkey	2000	n/a	No
Uganda	1997	n/a	No
Venezuela	1991	Formal	No

Table 2
Internet Users, Hosts, and Access Prices
(users and hosts in 2000, prices in 2001)

Country	Internet users		Internet Hosts		Internet access charge*
	number	Per 1000 people	Number	Per 1000 people	
Argentina	2,500,000	67.51	175,303	4.73	77.90
Barbados	10,000	37.45	79	0.30	n/a
Belize	15,000	62.50	291	1.21	n/a
Bolivia	120,000	14.41	1,438	0.17	n/a
Bosnia and Herzegovina	40,000	10.06	722	0.18	19.34
Brazil	5,000,000	29.34	662,910	3.89	n/a
Bulgaria	430,000	52.65	15,353	1.88	7.75
Chile	2,537,308	166.80	51,380	3.38	n/a
Colombia	878,000	20.76	42,927	1.01	0.01
Costa Rica	228,000	59.83	8,882	2.33	16.00
Cote d'Ivoire	40,000	2.50	594	0.04	183.29
Czech Republic	1,000,000	97.34	138,060	13.44	0.00
Dominican Republic	159,000	18.99	7,841	0.94	17.97
Ecuador	180,000	14.23	2,106	0.17	n/a
El Salvador	50,000	7.97	1,018	0.16	25.96
Estonia	391,600	286.05	35,773	26.13	n/a
Ghana	30,000	1.55	119	0.01	36.00
Guatemala	80,000	7.03	2,894	0.25	n/a
Honduras	40,000	6.23	123	0.02	15.00
Hungary	715,000	70.04	129,587	12.69	12.74
India	5,500,000	5.41	32,991	0.03	10.01
Jamaica	80,000	30.38	592	0.22	49.25
Jordan	127,317	26.05	709	0.15	23.94
Kenya	200,000	6.65	949	0.03	65.56
Latvia	150,000	63.24	15,773	6.65	28.52
Malawi	15,000	1.45	1	0.00	n/a
Malaysia	3,700,000	159.00	64,081	2.75	5.26
Mexico	2,712,375	27.69	495,747	5.06	10.69
Moldova	52,600	12.28	1,713	0.40	33.31
Mongolia	30,000	12.51	168	0.07	51.50
Morocco	200,000	6.97	951	0.03	26.34
Pakistan	133,875	0.97	5,487	0.04	12.61
Panama	90,000	31.51	2,915	1.02	n/a
Peru	2,500,000	97.42	9,967	0.39	n/a
Poland	2,800,000	72.45	259,511	6.71	0.00
Romania	800,000	35.66	29,662	1.32	15.00
Slovakia	650,000	120.33	31,753	5.88	8.51
South Africa	2,400,000	56.07	184,547	4.31	8.50
Sri Lanka	121,500	6.28	1,754	0.09	6.49
Tanzania	115,000	3.41	536	0.02	69.00
Thailand	2,300,000	37.87	53,683	0.88	8.98
Turkey	2,000,000	30.63	108,410	1.66	1.35
Uganda	40,000	1.80	159	0.01	30.00
Venezuela	950,000	39.30	15,658	0.65	n/a

* Access charge is number of US dollars for 30 off-peak hours of Internet time per month
Source: International Telecommunications Union

Table 3
Regulation and Internet Users

Dependent Variable: Internet Users per million people					
Mean of dependent variable:	17857			19232	
Formal approval required by ISP?	-8,261.859	-8,737.642	-6,961.854	-6,608.000	-6,611.632
	(1.99)*	(2.07)*	(1.98)*	(1.90)+	(1.95)+
Telephone mainlines per 100 people	2,065.406	1,920.932	-188.177	-14.794	-376.557
	(9.45)**	(6.34)**	(0.60)	(0.05)	(1.12)
GDP per capita		0.980	-2.448	-3.706	-1.254
		(0.69)	(2.06)*	(2.87)**	(0.83)
Personal computers per million people			1.013	1.015	0.932
			(10.64)**	(10.82)**	(9.73)**
Incumbent privatized?				8,827.408	6,775.936
				(2.33)*	(1.81)+
Trade as share of GDP					145.625
					(2.94)**
Constant	-14,196.594	-16,347.968	7,795.502	2,094.340	-11,140.177
	(0.54)	(0.61)	(0.37)	(0.10)	(0.53)
Observations	181	181	165	165	165
R-squared	0.52	0.52	0.73	0.74	0.75

Absolute value of t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
year dummies included

Table 4
Regulation and Internet Hosts Per Capita

Dependent variable: Internet hosts per million people						
Mean of dependent variable:	1190.56			1295.427		
Formal approval required by ISP?	-1,386.972	-1,222.210	-404.048	-196.327	-361.857	-129.819
	(2.90)**	(2.80)**	(1.04)	(0.50)	(0.95)	(0.35)
gdpcap		0.648	-0.076	-0.290	-0.259	-0.506
		(5.90)**	(0.57)	(2.18)*	(1.78)+	(3.58)**
lines			214.209	84.213	240.092	112.005
			(7.61)**	(2.44)*	(8.30)**	(3.29)**
Private?					1,193.846	1,443.576
					(2.89)**	(3.59)**
computercap				0.064		0.065
				(6.16)**		(6.51)**
Constant	956.625	-1,020.359	-1,530.912	-950.265	-1,881.465	-1,374.777
	(0.96)	(1.06)	(1.84)+	(0.98)	(2.28)*	(1.47)
Observations	172	172	172	155	172	155
R-squared	0.14	0.29	0.48	0.59	0.50	0.62

Absolute value of t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
Year dummies Included

Table 5
Regulation and log of Internet hosts per capita

Dependent variable: log(hosts per capita + 1)					
Mean of dep var	4.95				4.99
Formal approval required by ISP?	-0.941	-0.686	-0.460	-0.475	-0.630
	(2.47)*	(4.08)**	(2.82)**	(2.88)**	(4.05)**
lngdpcap		2.171	1.494	1.574	0.968
		(25.57)**	(9.40)**	(8.45)**	(4.32)**
lnlinecap			0.852	0.780	0.233
			(4.92)**	(4.03)**	(1.14)
Private?				-0.157	-0.010
				(0.83)	(0.06)
lncomputercap					0.840
					(4.39)**
Constant	3.861	-12.819	-9.638	-9.992	-11.807
	(5.48)**	(17.75)**	(10.32)**	(9.72)**	(11.25)**
Observations	165	165	165	165	152
R-squared	0.14	0.83	0.86	0.86	0.88

Absolute value of t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
Year dummies included

Table 6
Price Regulation and Internet Access Prices in 2000

Dependent variable: 30 off-peak hours of dial-up Internet time per month									
Mean of dependent variable	28.7055							29.08	
ISP prices regulated?	48.690	46.448	40.453	42.992	42.336	40.003	39.954	36.385	37.166
	(2.74)*	(2.46)*	(2.14)*	(2.24)*	(2.15)*	(2.03)+	(2.02)+	(1.88)+	(1.79)+
GDP per capita		-0.001	0.003	-0.001	-0.001	-0.000	-0.002	-0.002	0.001
		(0.41)	(0.67)	(0.27)	(0.34)	(0.07)	(0.49)	(0.55)	(0.18)
Telephone mainlines per 100 people			-1.065						
			(1.44)						
Number telephone mainlines (millions)				-.9409402	-.8668842	-1.337605	-3.238662	-3.488897	-2.737031
				(0.99)	(0.86)	(1.24)	(1.33)	(1.47)	(1.05)
Incumbent privatized					3.778	3.197	0.001	2.849	0.983
					(0.26)	(0.22)	(0.00)	(0.19)	(0.06)
Trade as a share of GDP						-0.175	-0.123	0.000	-0.077
						(1.16)	(0.75)	(0.00)	(0.41)
GDP (milions USD)							134.3397	438.5419	93.95396
							(0.87)	(1.93)+	(0.56)
Number personal computers per thousand people									-.2069728
									(0.72)
Number personal computers (millions)								-24.59824	
								(1.82)+	
Constant	21.990	25.413	31.846	28.891	26.981	42.710	42.107	33.964	40.407
	(3.33)**	(2.38)*	(2.80)**	(2.57)*	(1.97)+	(2.22)*	(2.18)*	(1.73)+	(1.97)+
Observations	29	29	29	29	29	29	29	28	28
R-squared	0.22	0.22	0.28	0.25	0.25	0.30	0.32	0.42	0.34

Absolute value of t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%