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GLOBAL DIFFUSION OF THE INTERNET II: NATIONAL DIFFERENCES IN WEB SITE CONNECTIVITY

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ABSTRACT

Conventional wisdom argues that low- and middle-income countries can use Information and Communication Technologies (ICT) in general, and the Internet and the World-Wide Web in particular, to bridge the income gap with high-income countries. The so-called "digital divide" between the rich and the poor is well documented: inhabitants of rich countries have far greater access to the Internet and other forms of ICT than inhabitants of low-income countries. However, access to technology is only one factor affecting the ability to increase income by using the Web. An equally important factor is the ability to attract traffic to a web site. If the Web is to help economic development, then it is crucial that web sites publicizing investment opportunities, goods, or services attract investors and customers.

This paper sets out to determine whether there is a digital divide in web site traffic as well as in access to ICT. The answer, it turns out, is unequivocally "yes", suggesting that the argument that the Web can be used to bridge the income gap between rich and poor countries needs considerable refinement.

Keywords: internet, web, economic development, digital divide

I. INTRODUCTION

Conventional wisdom argues that Information and Communication Technologies (ICT) provide important economic opportunities for low-income countries by helping them overcome low educational attainment levels, governmental inefficiencies, environmental degradation, and by assisting small and medium size enterprises [Talero and Gaudette, 1996]. In addition, the export of ICT services can provide low-income countries with an opportunity to diversify their economies, as demonstrated by India and China.

The argument that ICT can be used to help low-income countries overcome many of the challenges that they face and develop economically recently focused on the World-Wide Web and e-commerce [e.g., Heeks and Dumcombe, 2001; UNCTAD, 2003]. Although significant

hurdles need to be overcome, the Web is claimed to "level the playing field" and allow developing countries to increase their participation in the global economy. However, many of the analyses of the obstacles that developing countries must overcome to take full advantage of e-commerce opportunities seem to overlook one, rather obvious, fact--an organization that wishes to use the Web to its advantage must ensure that its Web site attracts traffic. Being available on the Web is not enough; the site must be seen to be there. Unfortunately, as we will show in Section V of this paper, web sites in low-income countries have not yet attracted high volumes of traffic. In Section VI, we use our results to conclude that the argument that the Web opens up enormous economic opportunities for low-income countries needs to be significantly refined, and in Section VII we make some preliminary suggestions about what such refinements should look like.

II. REVIEW OF THE LITERATURE

A large number of commentators argue that ICTs offer significant opportunities for economic development.

1. Talero and Gaudette [1996] argue ICTs can help low-income countries overcome many traditional challenges, such as low educational attainment, governmental inefficiencies, and governmental lack of transparency and accountability. One example of the use of ICT to increase governmental efficiency and transparency can be found in Warschauer [2003, p. 173-185]. Warschauer reports that the state government of Karnataka, India, implemented an automated land record system. As a result, owners of large or small plots of land can obtain records of their properties efficiently, without bribing government officials.

2. Heeks and Duncombe [2001] argue that ICTs can significantly assist small- and medium sized enterprises in developing countries. In general, information infrastructures in low-income countries are poorly designed. Entrepreneurs in such countries often work with inadequate information about supply and demand, the regulatory environment in which they conduct their business, and even their internal business processes. As a result, they often make ill-informed, and potentially wrong, decisions. ICTs can help make relevant information available to those who run businesses in developing countries.

3. Since the main recurrent cost in providing many ICT services is salaries, the provision of ICT services for export provides low-income, low-salary countries with a significant opportunity to diversify their economies [Talero and Gaudette, 1996] [Schware and Hume, 1996]. Many countries, including India and China, seem to demonstrate the validity of this argument. Reichgelt [2000], however, argues that the opportunities for small developing countries are significantly lower, especially in the higher value-added ICT services, such as software engineering. Reichgelt's argument is based on the observation that higher valued-added ICT services require a critical mass of individuals with skills that are typically acquired after some tertiary education. Since the proportion of the population in tertiary education is small in developing countries (on the order of 5% of the eligible age cohort, compared with 25-50% in high-income countries), the percentage of the population with the required ICT skills is low. While a low percentage still results in large absolute numbers in countries with large populations, the arithmetic works against countries with small populations. Small developing countries are unlikely to have the critical mass of skilled ICT personnel required to offer successfully higher value-added ICT services to the world.

More recently, the argument that ICTs afford developing countries an important opportunity for economic development was applied to the Web and to e-commerce [Townsend, 1999], [Goldstein and O'Connor, 2000], [UNDP, 2001], [UNCTAD, 2001, 2002], [Sarkar and El Sawy, 2003]. At the same time, it is generally accepted that developing countries face significant obstacles, such as poor and expensive telecommunication services, lack of sufficient number of skilled personnel, and a regulatory environment and managerial practices not conducive to e-commerce.

The argument that the Web offers significant opportunities for economic development in low-income countries attracted criticism [Odedra-Straub, 2003], [Gurstein, 2003], [Jennex, 2003], [Jennex, Amoroso, Olayele, 2003], [Young and Ridley, 2003]. Jennex *et al* base their criticism on the claim that the successful establishment of e-commerce operations depends on five critical factors, each consisting of a number of related items. The factors include

- people factors (e.g., availability of project management and language skills),
- technical infrastructure (e.g., availability of a reliable telecommunications infrastructure, up-to-date hardware and technical skills relevant to setting up and maintaining web sites),
- client interface (e.g., the establishment and maintenance of trust between clients and providers, the ability for the client and provider to communicate in a common language),
- business infrastructure and
- regulatory environment.

There is debate on how environmental and policy factors influence the adoption of e-commerce, and significant research efforts are underway to address this question [Kraemer et al, 2003]; but most researchers agree that the factors that Jennex *et al* list are important for establishing successful e-commerce operations.

While individual small enterprises in low-income countries may be able to attain most of the items included in the Jennex *et al* list, most enterprises experience difficulty doing so. For example, most low-income countries suffer from lower literacy levels and computer literacy levels than high-income countries. As a result, only a small fraction of their inhabitants possess the skills necessary to access e-commerce sites. Low-income countries typically are short of individuals able to provide technical support, financial and marketing services, or translation services. Therefore, enterprises within developing countries find it difficult to establish and maintain their own e-commerce sites.

Jennex *et al* also argue that the business infrastructure and regulatory environment are less conducive to e-commerce in low-income countries than in high- and middle-income countries. For example, underdeveloped trade support services, such as finance, insurance, and logistics, do not allow low-income countries to take full advantage of the opportunities that e-commerce offers. UNCTAD [2001] argues that e-commerce is only possible after significant changes in managerial style and that such changes are less likely in developing countries.

If low-income countries are to take advantage of the opportunities offered by e-commerce, the biggest problem to overcome is perhaps the “digital divide”-- the glaring discrepancy in the availability of ICTs between the rich and the poor-- within countries and between countries. For example, in 1998, the number of fixed and wireless telephone lines was 72.1 per 100 inhabitants in member countries of the Organization for Economic Cooperation and Development (OECD), but only 7.8 per 100 inhabitants in non-OECD countries. Similarly, in October, 2000, the number of Internet hosts per 1,000 inhabitants in OECD countries, was 82, compared to only 0.85 in non-OECD countries [OECD, 2001].

Many measures of the digital divide between countries focus on quantities such as the number of telephone lines per 100 inhabitants, the number of Internet hosts or Internet users per 10,000 inhabitants, and the number of personal computers in use. Wolcott et al., [2001] present a more sophisticated framework for assessing a country’s use of the Internet, which combines six factors:

1. pervasiveness (number of Internet users per capita),
2. geographic dispersion (how many of the political sub-divisions of a country have Internet access),
3. sectoral absorption (the extent to which different sectors in the country’s economy – Government, Education, Private Sector, and Health Care – made a commitment to Internet use),

4. connectivity infrastructure (extent and robustness of the physical structure of the network),
5. organizational infrastructure (number of Internet Service Providers and their competitive environment), and
6. sophistication of use (the level of innovation in Internet use by leading edge groups in a country).

Clear frameworks for measuring e-commerce and the state of the Internet in a country, and a clear understanding of the factors that affect their diffusion are extremely important because they can help policy makers formulate appropriate economic and social policies [Wolcott and Goodman, 2003].

Originally referring to levels of access to computers, the concept of the digital divide is being rethought [Norris, 2001], [Servon, 2002], [Warschauer, 2003]. Some authors argue that defining the digital divide as a difference in access to ICT quite naturally leads to the corollary that the social problems that result from the digital divide can be addressed by providing those on the "wrong side" of the digital divide with computers and Internet access. Both Servon and Warschauer reject this definition as too simplistic. They argue that access to relevant content and language (the overwhelming majority of web material is in English, even though less than one quarter of the world's population is familiar with the language), literacy and access to education, and the presence of supporting social structures are equally important in framing the problem and suggesting potential solutions.

The analyses of the digital divide discussed in this section concentrate almost exclusively on access: to ICTs, to the Internet, and, in particular, to the Web. They seem to downplay the importance of an obvious fact: any organization that wants to use the Web to increase its income must not only be present on the Web, it must also have visitors to its web site. This paper focuses on countries' abilities to attract traffic to web sites administered in that country.

III. RESEARCH QUESTION

While the measures of Internet diffusion and the attempts to refine the concept of a digital divide discussed in the previous section are informative, they tend to concentrate what we shall call "Active Web Participation". They measure how many people in a country (can) access the Web, or suggest public policies and other measures that can increase access, or both. However, the percentage of a country's population with access to the Web or the number of Internet hosts that a country supports is of little relevance to the current discussion. If a country is to use the Web to attract new clients for the goods and services it provides or to increase foreign direct investment, then it needs to make information available and make sure that this information is accessed by potential customers or investors. Although they had sophisticated web sites and the right technical infrastructure in place, many dot.com firms collapsed because they failed to attract customers to their Web sites. We coin the term "Passive Web Participation"[1] for the ability to attract traffic to web sites. Clearly, to use the Web to sell its products and services, or to attract investors, a county must establish good Passive Web Participation.

Although Active Web Participation may seem a good approximation for Passive Web Participation, at least at the country level, counterexamples suggest that a distinction between the two is useful. One example is Antigua and Barbuda. Although an increasing percentage of the GDP of this small island nation in the Caribbean comes from Internet gaming services, the

[1] We use the terms "Active" and "Passive" in a grammatical sense and analogous to active voice and passive voice. Thus, Active Web Participation concerns the ability to visit other Web sites; Passive Web Participation concerns the ability of being visited. We do not mean to imply that Passive Web Participation is something that does not need any activity on the part of the person participating passively.

International Telecommunications Union (www.itu.int) reports 79.74 Internet hosts and 904.09 Internet users per 10,000 inhabitants in 2002 in Antigua and Barbuda, compared with a global average of 258.38 and 994.01 respectively. In other words, while Antigua and Barbuda's Active Web Participation is below the global average, its Passive Web Participation is substantial.

Given the importance of Passive Web Participation for economic development, a significant question is whether the digital divide documented by measures of Active Web Participation persists when measures of Passive Web Participation are employed. In other words, are there significant differences in the amount of traffic attracted to web sites hosted in high- and low-income countries?

IV. METHODOLOGY

COUNTRY SAMPLE SELECTION

To answer our question, we selected 18 countries. Apart from pragmatic reasons, which will become clear later on, countries were selected based on population and income. We used income because we are interested in determining whether the same digital divide exists between low- and high-income countries for both Active and Passive Web Participation. Just as absolute measures of Active Web Participation are relatively useless for comparative purposes, absolute measures of Passive Web Participation are of limited value for our purposes. Turning absolute numbers of Active Web Participation into figures more meaningful for inter-country comparisons is straightforward: divide the absolute measures by the population size of a country. Turning absolute measures of Passive Web Participation into useful figures is more difficult. In our sample of countries, we therefore carefully controlled for population. For each high-income country of a given population, our sample included a medium-income country and a low-income country of approximately the same population.

Using data from the Human Development Report prepared by the United Nations Development Program [UNDP, 2001], we selected six low-income countries (a per capita GDP of less than $1,900), six medium-income countries (per capita GDP of between $3,200 and $6,500) and six high-income countries (per capita GDP of more than $20,000). In each group, we selected two countries with a large population (>59 million), two with a medium population (17.9 to 30.5 million), and two with a small population (<6.1 million). The desire to match countries on population meant that some countries whose IT policies and activities attract interest, such as India and China, were excluded from the sample because there were no medium- or high-income countries with matching population sizes. Table 1 lists the population and the purchasing power adjusted per capita GDP of the 18 countries selected.

The countries selected are geographically well dispersed: six of the 18 countries are in Africa (all but 1 of the poorest); six, in Asia; three, in Europe; and one each, in Oceania, North America and South America.

MEASURING PASSIVE WEB PARTICIPATION

Having selected the countries, we sought to develop a good measure of passive Web participation. We first selected web sites for each country in our sample, and then used the web sites to arrive at a measure of Passive Web Participation for each country.

Table 1. Countries Selected

		Population		
		Small	Medium	Large
Income Level	Low	Central African Republic Pop: 3.6M Income: $1,166	Mozambique Pop: 17.9M Income: $861	Ethiopia Pop: 61.4M Income: $628
		Benin Pop: 6.1M Income: $933	Sudan Pop: 30.4M Income: $664	Vietnam Pop: 77.1M Income: $1,860
	Med	Lebanon Pop: 3.4M Income: $4,705	Sri Lanka Pop: 18.7M Income: $3,279	Turkey Pop: 65.7M Income: $6,380
		Paraguay Pop: 5.4M Income: $4,484	Algeria Pop: 29.8M Income: $5,064	Philippines Pop: 74.2M Income: $3,805
	High	Singapore Pop: 3.9M Income: $20,767	Australia Pop: 18.9M Income: $24,574	France Pop: 59M Income: $22,897
		Finland Pop: 5.2M Income: $23,096	Canada Pop: 30.5M Income: $26,251	Germany Pop: 82M Income: $23,742

To select web sites for each country, we first searched for web sites located in these countries. We typed the name of the country, both in English and in the language of the country in question, into the Google search engine (www.google.com). For example, for Germany, we searched both on "Germany" and "Deutschland"; for Finland we used both "Finland" and "Suomi". We assumed that web sites returned would contain contact information, or information about the person or organization for which the web site was developed, or information about the web site developer. We further assumed that this information would allow us to ascertain the country of origin. We realized that this assumption was not warranted for sites located in the United States. This was one of the pragmatic reasons for excluding the United States from our country selection. The exclusion of the United States meant that we also had to exclude other countries with comparable population, such as Russia.

Of the first 50 search results returned by Google, we eliminated personal Web pages, different Web pages within the same top-level domain, and Web pages that were created and managed in a country other than the country in question. For example, we found a large number of Web sites mentioning "Vietnam" that were created and managed by individuals or organizations in the United States. Many of the web sites that mentioned Benin or the Central African Republic were the work of geography departments elsewhere. At this stage, we did not attempt to classify the sites (e.g., a portal, an e-commerce site, a newspaper). We return to this point in Section VI.

To determine whether a site was administered from somewhere other than the country in question, we used a combination of factors. We assumed that URLs that had the country's national domain name (e.g., .dz for Algeria or .bj for Benin) were managed within the country. However, we could not assume that URLs that did not have the country's national domain name were not managed from within the country. Many web sites managed within one country, especially a smaller, low-income country, are hosted on servers located in another. For example, we found pages for both Benin and the Central African Republic managed by individuals in these countries but hosted by servers in France. We also found that many commercial sites use a .com domain name rather than their country's top-level domain name. In those cases, we looked at the page itself for contact information or an indication of who was responsible for the page. Whenever we eliminated a web site from our list, we added the next search result returned by Google.

For most countries we were able to find 50 Web sites hosted in the country or administered by organizations within the country. There were exceptions. For Algeria we found only 44 web sites; for Sudan, 43; for Ethiopia, 34; for Benin, 15; and for the Central African Republic, 14. For all five countries, we tried to find additional web sites, primarily by using alternative search engines, but without success. In all, we examined 800 web sites.

Using the Alexa toolbar (http://info.alexa.org), we analyzed each of the web sites identified in the first step. Alexa collects statistical information about web sites, including the number of links into the site and the date at which the site was first registered, and calculates a traffic rank. Alexa's traffic ranks are based on the number of Alexa toolbar users who visit a site on a given day ("reach") and the number of different URLs requested from a site on a given day by a given user ("pageviews"). A web site's traffic rank indicates how often the web site was visited compared with other web sites Alexa is aware of. The most frequently visited web site is assigned a traffic rank of one; the second most frequently visited, a traffic rank of two; and so on. Though the Alexa data possesses limitations (Section VII), we used the Alexa traffic ranks on May 22 and 23, 2002 to select the 12 most frequently visited sites for each of the 18 countries, for a total of 216 web sites.

As traffic ranks change frequently, we repeated the data collection exercise for the 216 sites on June 10, 2002. Although we found minor changes in the absolute traffic ranks between the first and the second data collection efforts, the ranks of the web sites relative to each other changed little. Based on the second set of data collected, we recorded the ranks and links for the ten most frequently visited sites for each country. Alexa traffic ranks were available only for seven sites in the Central African Republic and nine in Benin.

Having selected a set of web sites, we used the Alexa toolbar to calculate the Passive Web Participation of each country by averaging the Alexa traffic ranks of that country's web sites. We then ranked the countries based on this measure.

To validate our figures further, we repeated the data collection exercise three times: over a two-day period on September 3 and 4, 2002; on November 11 and 12, 2002; and on January 3, 2003. Table 2 gives the average traffic rank for the 18 countries at each data collection point. The final rank for each country was calculated by adding the ranks at the different data collection points and ranking the countries based on this sum.

Table 2. Average Traffic Ranks at Different Times

(Under each date, first column is average traffic rank, second column is rank order)

Country	June 2002		Sep 2002		Nov 2002		Jan 2003		**Final**
Algeria	79,378	9	103,413	9	84,066	8	73,289	8	**8**
Australia	7,113	3	7,722	2	7,082	2	6,622	2	**2**
Benin	1,123,981	17	914,735	17	1,344,058	17	1,693,310	18	**17**
CAR	1,129,299	18	1,765,609	18	1,558,197	18	1,506,923	17	**18**
Canada	4,082	1	4,844	1	4,748	1	4,940	1	**1**
Ethiopia	356,242	13	400,112	14	654,964	14	192,769	12	**13**
Finland	15,671	5	18,685	6	14,597	4	8,900	4	**4.5**
France	5,404	2	7,832	3	8,019	3	7,047	3	**3**
Germany	15,588	4	15,627	4	17,036	5	21,526	6	**4.5**
Lebanon	859,219	16	628,845	16	898,158	15	425,280	13	**15**
Mozambique	634,963	15	507,497	15	943,741	16	1,030,128	16	**16**
Paraguay	243,054	12	246,778	13	336,122	12	655,084	15	**12**
Philippines	92,942	11	132,296	10	149,261	11	129,465	9	**10.5**
Singapore	18,942	6	17,291	5	20,469	7	23,898	7	**6.5**
Sri Lanka	78,871	8	98,984	8	133,157	9	155,627	11	**9**
Sudan	399,948	14	329,557	13	336,699	13	657,721	15	**14**
Turkey	19,391	7	19,639	7	20,293	6	16,860	5	**6.5**
Vietnam	86,428	10	132,665	11	125,483	10	132,918	10	**10.5**

To verify the reliability of the data, we calculated a Spearman rank order correlation between the rank orders of the countries at the different data collection points. The lowest rank order correlation was .946, which is highly significant. We further verified the reliability of our data by repeating the exercise for the individual web sites. Using Alexa traffic ranks, we rank-ordered the web sites for each data collection session and calculated Spearman rank order correlations. The lowest Spearman rank order correlation we obtained was .896, also highly significant. In other words, despite the large fluctuations in actual Alexa traffic ranks, the rank orders for the individual web sites and for the countries that formed part of our study were stable.

Did we exclude web sites using a language not based on the Phoenician script, thereby biasing our results? The Phoenician script is the mother of all European and many Middle Eastern alphabets. The Google search algorithm relies on an analysis of web page content. Although many languages are written in a script other than the Phoenician, the content of pages in these languages is typically coded in the Phoenician alphabet with some instruction to the Web browser to render the Web page in a different script. Of the 40 web sites in countries with an official language using a non-Phoenician script -- Sri Lanka, Sudan, Turkey, and Vietnam -- we found 16 using a non-Phoenician script (one in Sri Lanka, five in Sudan, five in Turkey and five in Vietnam). We believe that our results were not biased through the exclusion of web sites using a non-Phoenician script.

MEASURING ACTIVE WEB PARTICIPATION

To measure Active Web Participation, we collected data from the International Telecommunications Union (www.itu.int) about Internet use and the number of PCs. Where possible, we cross-tabulated the information obtained from the ITU with that obtained from other sources, such as the Internet Software Consortium (www.isc.org). Although some minor differences were observed, we found the numbers to be in broad agreement.

V. RESULTS

Table 3 summarizes the data we gathered. We ordered the country data by their average traffic rank, our measure of Passive Web Participation. Notice that the top six countries are high-income countries, that the second group of six contains five of the six medium-income countries, and that the bottom group of six contains five of the six low-income countries.

Table 4 reports the correlations between the factors on which we gathered data. Factor 9 is the total number of PCs in the population, and factor 10 is the number of PCs per 100 inhabitants. Numbers in italic are significant at p = .01, while numbers in bold are significant at p = .005.

VI. DISCUSSION

The results paint an interesting picture. First, strong correlations were found between income, measured in GDP per capita in purchasing power parity, and the indicators of Active Web Participation: the number of Internet users and Internet hosts per 10,000 population and PCs per 100 inhabitants. We also found strong correlations between income and absolute numbers of Internet hosts, Internet users, and PCs. Given that the population of some of the high-income countries included in our study are quite low compared with some of the low- and middle-income countries, we found this result interesting and somewhat surprising.

The raw data show that more Internet hosts are in the high-income countries, no matter what their population, than all other countries in the survey. Moreover, the smallest of our high-income countries, Finland and Singapore, have nearly as many Internet users as Turkey, a country with a

Table 3: Factors Considered in this Study.
(Countries Are Ordered Based On Average Alexa Traffic Rank)

Country	GDP/ Capita	Pop Size (M)	Internet Users		Internet Hosts		PCs	
			Total (K)	Per 10,000	Total	Per 10,000	Total (K)	Per 10,000
Canada	26251	30.5	13,500	4352.73	2,890,273	931.90	12,000	39.02
Australia	24574	18.9	7,200	3723.05	2,288,840	1183.40	10,000	51.71
France	22897	59.0	15,653	2637.72	788,897	132.94	20,000	33.70
Finland	23096	5.2	2,235	4302.83	886,916	1707.25	2,200	42.35
Germany	23742	82.0	30,000	3642.54	2,426,202	294.58	27,640	33.60
Singapore	20767	3.9	1,500	3630.91	197,959	479.18	2,100	50.83
Turkey	6380	65.7	2,500	377.22	106,556	16.08	2,700	4.07
Algeria	5063	29.8	60	19.27	665	0.21	220	0.71
Sri Lanka	3279	18.7	150	78.52	2,286	1.20	150	0.79
Philippines	3805	74.2	2,000	259.30	30,851	4.00	1,700	2.20
Vietnam	1860	77.1	400	49.31	487	0.06	800	0.99
Paraguay	4384	5.4	60	106.44	2,704	4.80	80	1.42
Ethiopia	628	61.4	25	3.88	43	0.01	75	0.12
Sudan	664	30.4	56.0	17.61	0	0.00	115	0.36
Lebanon	4705	3.4	300.0	858.00	7,101	19.97	200	5.62
Mozambique	861	17.9	15.0	7.43	16	0.01	70	0.35
Benin	933	6.1	25.0	38.78	500	0.78	11	0.17
CAR	1166	3.6	2.0	5.29	7	0.02	7	0.19

Table 4: Spearman Rank Order Correlations Between Factors

Factors	2	3	4	5	6	7	8	9
1. Average Rating	**.88**	.37	**.88**	**.82**	**.87**	**.78**	**.93**	**.82**
2. Income		.07	**.84**	**.93**	**.95**	**.93**	**.87**	**.91**
3. Population Size			.45	.04	.17	-.10	*.47*	-.01
4. Total Internet Users				**.86**	**.89**	**.79**	**.97**	**.83**
5. Internet Users Per 10,000					**.96**	**.97**	**.85**	**.95**
6. Total Internet Hosts						**.95**	**.88**	**.89**
7. Internet Hosts Per 10,000							*.77*	**.93**

Factor 8 is the total number of PCs in the population, and factor 9 is the number of PCs per 100 inhabitants.
Numbers in italic are significant at p = .01, whereas numbers in bold are significant at p = .005.

population at least 13 times as large and the richest of our middle-income countries[2]. The data show that population size is correlated only with number of PCs in a country, and very weakly so. We expected to find evidence for the existence of a digital divide in Active Web Participation between high-income and other countries; we did not expect the evidence to be so compelling.

One of the aims of our study was to investigate the importance of Passive Web Participation. Our survey shows an extremely strong correlation between income and Passive Web Participation. Web sites hosted by poor countries do not have high average traffic rankings. The digital divide appears to be just as wide for Passive Web Participation as for Active Web Participation.

[2] This comparison uses the estimates of the ITU; other estimates put Turkey just behind Finland and Singapore.

LIMITATIONS

Although we believe that our study shows convincingly that web sites in low-income countries attract significantly less traffic than those in medium- and high-income countries, it is worthwhile to point to some limitations.

1. Alexa itself admits to biases in the data that it collects. For example, the current Alexa toolbar only works with the Internet Explorer browser and the Windows operating system. It therefore underreports traffic to sites that are frequently accessed using other browsers, such as AOL, or to sites that are more likely to be accessed from browsers running under Unix or Linux (as one would expect Linux help sites to be).

2. Alexa reports geographical differences in the rate of adoption of the Alexa toolbar. For example, the rate of adoption in South Korea is higher than in many other parts of the world. A relatively high traffic rank for Korean sites might be a consequence of the higher number of Korean Alexa users. Conversely, a low traffic rank can mean that a web site attracts little traffic, or only that it attracts little traffic from Alexa users. Unfortunately, the Alexa toolbar does not present figures on the number of Alexa users per country; we therefore cannot determine how this factor influenced our data.

3. For statistical reasons, Alexa states that its traffic ranks are less accurate for sites with low numbers of visitors, and it cautions against using rankings of 100,000+. However, our data indicate that the traffic ranks are more reliable than Alexa suggests. We rank-ordered both the countries and the web sites based on their traffic ranks for each of the four data collection periods and found highly significant correlations among these rank-orders.

4. We were not able to determine where visitors to a particular site came from. Were high traffic ranks the result of domestic users visiting sites, or were they the result of users from abroad? There are reasons to believe that in many cases most visitors were domestic visitors. Our data show very strong correlations between different measures for what one might call “technological uptake.” As Table 4 shows, correlation between the number of Internet hosts per 10,000 population and both the number of Internet users per 10,000 population and the number of PCs per 100 population is quite high (over 0.9). One explanation may be that Internet hosts in a given country primarily host information for Internet users in that country. The language used in web sites seems to confirm this hypothesis. For example, all of the Finnish web sites in our sample were in Finnish, although most of them allowed the users to switch to Swedish or English. Since Finnish is not widely spoken outside Finland, we infer that the primary audience for these sites was domestic. Similar considerations applied to web sites in other countries in our sample that do not have English as an official language(s).

Further evidence for the proposition that most visitors to web sites are domestic comes from an inspection of the types of sites in our sample. We ignored site type in the selection of our sample. However, when we inspected the sites, we saw that about 80% (~640) of them are probably not intended to attract business or investment. For example, about 40% (~ 320) of the web sites in our sample were newspapers In countries with large numbers of nationals living abroad, e.g., Ethiopia, the Philippines, Sri Lanka, Turkey, and Vietnam, newspapers may view these individuals as a key audience. Even so, we believe that such web sites are aimed at individuals with close ties to the country from which the newspaper’s web site is managed. Another 35% (~280) of the web sites did not seem to be directly commercial (e.g., non-commercial portals and entertainment sites, including web sites for television stations).

Only about a quarter of the web sites in our sample (~200) contained commercial intent. About 20 sites offered general information about a country, often including information about investment policies. Government web sites were equally distributed over the country categories: a third were in high-income countries, a third in medium-income countries, and a third in low-income countries. Similarly, about a third were in large countries, a third in mid-size countries and a third in small countries.

The commercial web sites were either company web sites, sites attempting to sell goods and services, or both. About half were in high-income countries, and the other half were distributed about equally between medium and low-income countries. Interestingly, about a quarter of the commercial sites were commercial portals, and all of these were in low- or medium-income countries. Only some of these, such as tourism portals for Algeria and Vietnam, were aimed primarily at foreign audiences.

If domestic users generated most of the traffic measured in our study, what are the reasons? Is this a consequence of the way we selected the web sites? Would we have found different access patterns if we had only selected commercial sites? Are web surfers interested primarily in information provided by domestic web sites and unlikely to visit foreign web sites?

The possibility that web surfers are interested primarily in domestic web sites raises further issues. If web users primarily visit domestic sites, then the high correlation between Active and Passive Web Participation that we observed would be expected. One might argue that although high-income countries have high numbers of Internet users, their traffic would be spread across a high number of Internet hosts, lowering the average traffic rank of individual web sites. However, the data shows the ratio of the number of Internet users to the number of Internet hosts to be considerably higher in high-income countries than in the others. The high number of Internet hosts in high-income countries is more than offset by the vastly larger number of Internet users in these countries.

Another issue that is relevant in this context is a more general one, namely what drives people to visit particular web sites in the first place? Understanding this issue may help organizations develop strategies to increase traffic to their web sites and increase a country's Passive Web Participation. We leave these questions to future research.

VII. CONCLUSION

Our survey strongly suggests that the proposition that low-income countries can use the Internet and the Web to help them develop economically needs critical examination. A *sine qua non* for using the Web to support e-commerce operations or attract foreign direct investment is that web sites in low-income countries attract traffic. Our data suggests that they do not. Just as the differences between high-income and lower-countries in the use of ICTs, the Internet, and the Web are large, so are the differences in their ability to attract visitors to their web sites.

Although the reasons for the difference in web site traffic in high-, medium- and low-income countries can be debated, the effect is strong. Web sites administered in low-income countries do not attract significant amounts of traffic. If low-income countries are to use the Web to develop economically, they need to devise strategies to attract traffic to their sites. This problem is difficult; many well-funded dot.com start-ups failed miserably to do so. Without such strategies, however, economic development policies based on the assumption that the Web will provide an economic boost are in jeopardy of failure, particularly for low-income countries.

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REFERENCES

Goldstein, A. and D. O'Connor. (2000) *E-commerce for Development: Prospects and Policy Issues*, Paris, France: OECD Development Centre, Paper 164.

Gurstein, M. (2003) "Default 'Check This Box If You Don't Want This Message to Appear Again'". *Electronic Journal on Information Systems in Developing Countries*, (11)12, pp. 1-5.

Heeks, R. and R. Duncombe. (2001) *Information and Communication Technologies (ICTs) and Small Enterprise: A Handbook for Enterprise Support Agencies in Developing Countries*. Manchester, UK: Institute for Development Policy and Management, University of Manchester.

Jennex, M. (2003) "UNCTAD and E-commerce Success." *Electronic Journal on Information Systems in Developing Countries*, (11)11, pp. 1-7.

Jennex, M., D. Amoroso, and A. Olayele. (2003) "E-commerce Infrastructure Success Factors for Small Companies in Developing Countries." *Journal of E-Commerce Research*, 4 (3).

Kraemer, K., J. Dedrick, and J. Gibbs. (2002) "Introduction to the Special Volume on Globalization and E-commerce". *Communications of the Association for Information Systems*, (11), pp. 1-3.

Norris, P. (2001) *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide.* Cambridge, UK: Cambridge University Press.

Odedra-Straub, M. (2003) "'E-commerce and Development' Whose Development?" *Electronic Journal on Information Systems in Developing Countries*, (11)2, pp. 1-5.

OECD (2001) *Understanding the Digital Divide,* Paris, France, OECD Publications.

Reichgelt, H. (2000) "Software Engineering Services for Export and Small Developing Countries". *Information Technology for Development*, (9)2, pp. 77-91.

Sankar, M. and O. El Sawy (2003) "The Four Tigers of Global E-business Infrastructure: Strategies and Implications for Emerging Economies", *Communications of the Association for Information Systems*, (12), pp. 1-22.

Schware, R. and S. Hume. (1996) *Prospects for Information Service Exports from the English-Speaking Caribbean*, Washington, DC: The World Bank.

Servon, L. (2002) *Bridging the Digital Divide: Technology, Community, and Public Policy.* Oxford, UK: Blackwell Publishing.

Talero, E. and Ph. Gaudette. (1996) *Harnessing Information Technology for Development: A Proposal for a World Bank Group Strategy,* Washington, DC: The World Bank.

Townsend, D. (1999) *Regulatory Issues for Electronic Commerce: Briefing Report for the 8th ITU Regulatory Colloquium, to address the topic of Regulatory Issues for Electronic Commerce, InfoDev Project #341-990103*. Washington, DC: The World Bank.

UNCTAD (2001) *E-commerce and Development Report 2001.* New York, NY: United Nations.

UNCTAD (2002) *E-Commerce and Development Report 2002*. New York, NY: United Nations.

UNCTAD (2003) *E-Commerce and Development Report 2003*. New York, NY: United Nations.

UNDP (2001) *Human Development Report 2001: Making New Technologies Work for Human Development,* New York, NY: United Nations.

Warschauer, M. (2003) *Technology and Social Inclusion: Rethinking the Digital Divide*. Cambridge, Mass.: The MIT Press.

Wolcott, P. and S. Goodman. (2003) "Introducing the Global Diffusion of the Internet Series". *Communications of the Association of Information Systems*, (11), pp. 555-559.

Wolcott, P. *et al.* (2001) "A Framework for Assessing the Global Diffusion of the Internet," *Journal of the Association for Information Systems*, (2), Article 6.

Young, J. and G. Ridley (2003) "E-commerce in Developing Countries". *Electronic Journal on Information Systems in Developing Countries*, (11)1, pp. 1-6.

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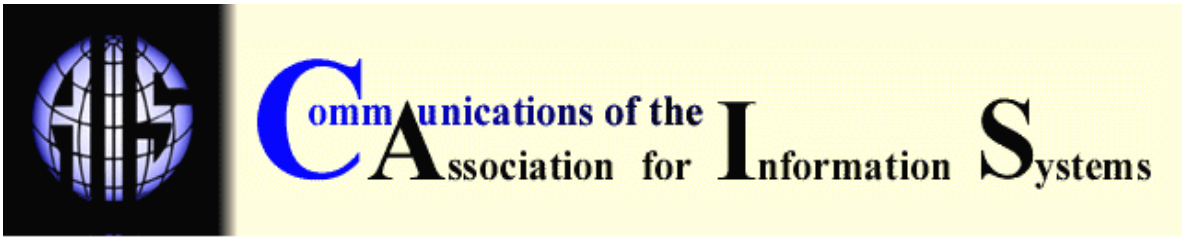

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