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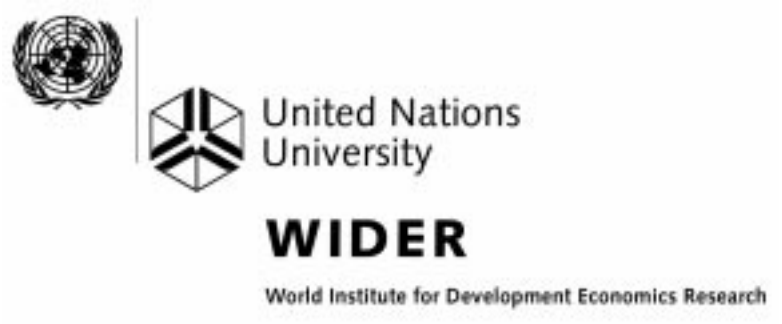

Discussion Paper No. 2002/72

Inter-Country Variations in Digital Technology in Africa

Evidence, Determinants, and Policy Implications

Steve Onyeiwu *

July 2002

Abstract

While much attention has been focused on the so-called 'digital divide' between Africa and the industrialized world, very scant attention has been devoted to the wide variations in the levels of digitalization of African countries. Whereas countries such as South Africa, Mauritius, Namibia, Botswana, Cape Verde and Seychelles have made substantial progress in digitalizing their economies, others are very far behind the international frontiers of information technology (IT). The digital divide within Africa is made even more exasperating when one realizes that countries with the same socioeconomic characteristics have tended to have differential access to IT.

Using five measures of IT, this paper explores and documents the differences in the levels of digitalization of 54 African countries. Based on these indicators, a composite index of digitalization is constructed for each country, and the index is in turn used to

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Keywords: Africa, information technology, digital divide, index of information technology, information policy

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* Department of Economics, Allegheny College, Meadville, Pennsylvania 16335, USA.

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rank the countries according to their levels of access to IT. After identifying a benchmark index of IT access, African countries are classified into six groups that reflect different levels of IT access. A multiple regression analysis of a cross-sectional data set for 51 African countries is used to investigate the extent to which the differences in the levels of digitalization of African countries are correlated with economic indicators such as urbanization, the stock of human capital, the rate of economic growth, the flow of foreign direct investment (FDI), and the openness of the economy. Based on the results of the regression analysis and the experiences of the more digitalized countries, the paper proposes policy measures that would help accelerate the digitalization of the continent.

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UNU World Institute for Development Economics Research (UNU/WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

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1 Introduction

In their preoccupation, and sometimes obsession, with the so-called 'digital divide' between Africa and the developed industrialized world, analysts tend to gloss over the fact that access to information technology varies widely between African countries.[1] That Africa lags behind the industrialized world in digital technology is not disputable, and the digital divide has been well documented by previous studies.[2] For instance, despite being home to more than 10 per cent of the world's population, Africa has fewer than one per cent of the world's Internet users (Dunphy 2000). In the year 2000, there were 2.5 million Internet users in Africa, compared with 136 million in North America, 83 million in Europe and 679 million in Asia.[3] With a population of over 739 million people, there are just about 14 million telephone lines in Africa—which is fewer than the number of telephone lines in Manhattan or Tokyo.

Disturbing as these dramatic descriptions obviously are, they serve very little purpose in helping us understand Africa's lacklustre performance in digital technology. Neither are they helpful in articulating appropriate policies for enhancing the access of African countries to IT. From an epistemological viewpoint, understanding the digital divide within Africa itself may prove to be more instrumental in identifying the appropriate policies for promoting the diffusion of information technology within the continent.

This paper examines inter-country variations in digital technology in Africa, and proposes policy measures for ameliorating the digital divide within the continent, as well as between Africa and the developed world. The paper constructs an index that ranks African countries according to their levels of digitalization, and then explores whether there is a correlation between country rankings and indicators such as the GDP growth rate, openness of the economy, human development, stock of FDI, and the level of urbanization. In addition to these indicators, the paper also investigates whether the differences in digitalization can be explained by factors exogenous to the economies of African countries. The paper is divided into six sections. Section 1 is the paper's introduction, while section 2 discusses the role of IT in productivity and economic growth. In section 3, the evidence of inter-country variations in digital technology in Africa is considered, and section 4 examines the stability and consistency of the IT-rankings of African countries. Section 5 explores the determinants of IT access in Africa, while section 6 is the conclusion of the paper.

2 Information technology, productivity and economic growth

Evidence about the contribution of IT to productivity and growth has been controversial and inconclusive. Among the G-7 countries, for instance, only in the United States has investment in IT translated into an increase in labour productivity growth, while the

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1 The concept of 'digital divide' has been defined as the 'gap between people who have the opportunity for regular access to the Internet and people who have irregular or no opportunity to access the Internet' (Johnston 2001: 194).

2 See Kiiski and Pohjola (2001) for additional evidence of the digital divide between developing countries and the more advanced countries. Rodriguez and Wilson (2000) have also documented the digital divide between the rich OECD countries and the poor developing countries.

3 See the US Internet Council's *State of the Internet Report 2000*.

impact in Japan and Europe has remained ambiguous (IMF 2001: 136).[4] Even in the United States, IT-induced growth in productivity is said to have occurred only 'within the production of computer hardware, peripherals, and telecommunications equipment, with substantial spillover to the 12 per cent of the economy involved in manufacturing durable goods' (Gordon 2000: 50). Productivity growth in the remaining 88 per cent of the US economy has thus not been impacted positively by investment in IT.[5]

In demonstrating the positive impact of IT in the United States, Lehr and Lichtenberg (1999) surveyed 44 federal agencies (where computer usage had increased dramatically) during the period 1987-92, and they found the output elasticity of computers to be 0.06.[6] Supporting the claim of positive impact of IT in the United States, Stiroh (1998) found evidence of total-factor productivity growth in both the computer-producing and computer-using sectors of the economy. Specifically, he found that the contribution of computer capital to aggregate output growth increased from 0.03 percentage points during the 1947-73 period to 0.19 percentage points during 1981-91. By the same token, the contribution of the computer-producing sector to aggregate multi-factor productivity growth increased from 0.01 percentage points to 0.16 percentage points during the same periods. Lastly, using firm-level data and the production function approach, Brynjolfsson and Hitt (1996) reported that the gross marginal product of computer capital ranges from 56-68 per cent, whereas the gross marginal product of non-computer capital falls between 4.14-6.86 per cent.[7]

While evidence points to a positive impact of IT in the United States, the opposite is the case in many other developed countries.[8] In Japan, for instance, labour productivity hardly increased during the 1990s, despite high levels of overall and IT-related capital investment (IMF 2001: 113). Labour productivity has also not accelerated in the United Kingdom, despite a rate of investment in IT capital that is almost as high as in the United States. In France, labour productivity plummeted during the second half of the 1990s, although this may be a result of the overall decline in capital investment in the country (IMF 2001: 113). With regard to the negative impact of IT, Brynjolfsson and Yang (1996) have summarized some of the empirical studies that highlight the negative impact of IT.

Despite the ambivalence over the impact of IT, many African countries, with the assistance of non-governmental organizations (NGOs), foreign corporations and governments, have sought to promote the diffusion of IT in their economies.[9] The

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4 Much of the evidence about the impact of IT on productivity and growth has come from the developed industrialized countries.

5 Gordon (2000: 72) points out that the limited contributions of computers and the Internet to productivity is attributable to the contradiction between 'rapid exponential growth in computer speed and memory on the one hand and the fixed endowment of human time'.

6 This implies that a 1-per cent increase in investment in IT inputs increases output by 6 per cent.

7 Oliner and Sichel (2000: 21) believe that the contribution of IT to growth will 'stay relatively strong for at least the next few years'.

8 Baily and Lawrence (2001) attribute the positive impact of IT in the United States to the fact that the country has internationally competitive service industries that often seek new technologies to improve their productivity.

9 For instance, the United States Agency for International Development (USAID) has been promoting the diffusion of IT in Africa through the Leland project (see section 6 for details). Among the

pursuit of IT capability by African countries has been justified on the expectation that, by enhancing labour and total-factor productivity, IT will accelerate the rate of economic growth (IMF 2001: 134).[10] The acceleration of economic growth, it is also believed, would improve the welfare and living standards of Africans. The pervasive craving for IT in Africa, despite the controversy surrounding its significance, may also be attributed to the bandwagon effect of new technologies. New technologies are often regarded as the key to progress, as well as the solution to many societal problems.[11] In a recent statement, for instance, Kofi Annan, the United Nations Secretary-General, asserted that:

> People in developing countries lack many things: jobs, shelter food, healthcare and drinkable water. Today, being cut off from basic communication services is a hardship almost as acute as these other deprivations, and may indeed reduce the chances of finding remedies to them.

While the impact of IT in developed countries has been mixed, evidence of the effects of IT on developing countries, particularly Africa, has been either conjectural, circumstantial or simplistic (James 2002: 53).[12] One such circumstantial evidence, provided by US Congressman Ed Royce, shows that:

i) Some 120 African newspapers and news magazines are now available on-line;

ii) A major US health insurer is now processing claims in Ghana using telecomputing technology;

iii) A West African women's fishing cooperative has set up a website to enable its 7,000 members to monitor export markets and negotiate prices with overseas buyers;

iv) Medical students in Senegal are being instructed by doctors in Belgium via video link, and

v) The Southern Africa Development Council's Parliamentary Forum is using the Internet to encourage greater government accountability.[13]

Despite the several specific cases of the benefits of IT to African countries, the IMF (2001: 135) contends that the 'aggregate impact' has been abysmal in developing

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prominent corporations that have been helping African countries develop their IT capability are Microsoft and Hewlett-Packard, through the latter's 'technology philanthropy' programme.

10 While the IMF (2001: 134) recognizes the potential contribution of IT to growth in developing countries, it does also believe that the IT revolution will exacerbate the productivity gap between advanced economies and developing countries.

11 This mode of thinking has been referred to as 'technological determinism'—the notion that the acquisition of technological capability will solve virtually all of a country's problems.

12 Pohjola (2001: 2) has expressed surprise by the paucity of research on the impact of IT outside the United States.

13 See the US Department of State International Information Programs (February 2002), for details of Congressman Royce's statement to the House of Representatives Subcommittee on Africa.

countries in general. In a cross-country study, Pohjola (2000) also shows that IT enhances growth in developed economies but not in developing countries. Pointing to the drawbacks of IT, other analysts have suggested that Africa's comparative advantage of surplus labour relative to capital is 'becoming irrelevant' in the new global economy (Adam 1996: 35). In support of this claim, James (2002: 63) argues that Africa and other poor developing countries may 'suffer from the backwash effect of the introduction of information technologies in other, more advanced regions'. Leaving aside the question of the relevance of IT to African countries, an immediate question is why access to IT differs among these countries. To address this question, the evidence of the disparity in IT access is first presented in the following section.

3 Inter-country variations in access to information technology in Africa: The evidence

As pointed out earlier, discussions about differential access to IT have often focused on the so-called digital divide between the developed industrial economies and developing countries. This focus has tended to mask the wide variations in access to IT within Africa itself. The digital divide within Africa becomes even more perplexing when one recognizes that countries with the same socioeconomic conditions tend to have differential access to IT. In the year 2000, for instance, Equatorial Guinea had GDP per capita that was three times that of Senegal, but the latter was four times more IT-advanced than the former. The case of Algeria and Egypt is even more exasperating. While Algeria's GDP per capita in 2000 was higher than that of Egypt, the latter's level of digitalization was about twice Algeria's.[14]

In trying to decipher inter-country variations in access to IT, one is confronted with the problem of the appropriate measures of IT to be used. There not only appears to be lack of universally accepted measures of IT, the concept of IT itself is both amorphous and nebulous.[15] Given the lack of standardization, analysts have used various measures of IT to determine the levels of digitalization of different countries. For instance, the International Institute for Management Development (IMD) has developed the *World Competitiveness Index* (WCI), which uses IT and other indicators to ascertain the extent to which countries have provided firms with 'an environment that sustains the domestic and global competitiveness of the firms operating in their borders' (Rosselet 2001: 50). Rouvinen (2002) has also constructed a comprehensive *E-competitiveness Index* that uses the following four categories of IT indicators: diffusion and use of information and communication technology (ICT), provision of ICT, human capabilities, and

14 These comparisons are based on the indexes of IT shown in Table 2, and which are explained later in the paper.

15 There are as many definitions of IT as there are analysts. One analyst perceives IT as 'the preparation, collection, transportation, retrieval, storage, access, presentation, and transformation of information in all its forms—voice, graphics, text, video and image (Boar 1995: 12). Yet, another analyst regards IT as 'hardware, software, telecommunications, database management, and other information processing technologies used in computer-based information systems (O'Brian 1996: G-10).

organizational capabilities. He used this index to rank 47 developed and developing according to their levels of achievement with regard to each of the four categories.[16]

A major problem with some of the existing IT indexes is that they include indicators that cannot be measured objectively.[17] What is more, data on many of the indicators used for computing the existing indexes are often not available for African countries, making it impossible to determine the levels of digitalization of many African countries.[18] There is thus need for a simple, but robust index that sheds light on the access of African countries to IT.[19] This paper proposes the following index for computing the levels of digitalization of African countries:[20]

$$\text{IT Index} = [1/10(A + B) + 10 (C + D + E)]/50$$

Where:

A = number of internet hosts per 10,000 of the population

B = Internet users per 10,000 of the population

C = number of personal computers per 100 of the population

D = telephone lines per 100 of the population

E = cellular phones per 100 of the population.

The index has an upper bound of 100 and a lower bound of zero. A completely digitalized economy would have an IT index of 100, implying that there is an Internet host for every person in the country and also that everyone in the country uses the Internet. A completely digitalized economy means that everyone in the economy owns a personal computer; that there is a telephone line for every person, and also that everyone in the country owns a cellular telephone. This is obviously a highly idealized and utopian scenario, but it does provide a useful benchmark for assessing the level of digitalization of African countries.

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16 The World Economic Forum has also introduced two indexes (*Current Competitiveness Index* (CCI) and *Growth Competitiveness Index* (GCI)) that incorporate several IT indicators. For a summary of these and other indexes, see Rouvinen (2002)

17 For instance, the E-competitiveness index includes subjective and nebulous variables such as 'suitability of the political system', overall flexibility and adaptability', 'willingness to delegate authority', etc.

18 Only one African country (South Africa) was included among the 47 countries ranked by Rouvinen (2002: 11) on the basis of the E-competitiveness index.

19 Kenny (2001) has undertaken country-rankings that used three indicators: Internet users per capita, telephones per capita, and mobile telephones per capita.

20 One difference between the IT index proposed in this paper and those introduced by other authors is that the former index is used as a dependent variable in this paper to identify the determinants of IT access in Africa. In other words, they are not simply used as ranking measures (as the other studies have done), but also for conducting an empirical analysis of why IT access differs among African countries.

Table 1
IT indexes of African countries

	No. per 10,000 people		No. per 100 people				
Country	Hosts	Users	PCs	Telephone lines	Cell phones	Weighted sum	IT index
Algeria	0.01	16.19	0.65	5.7	0.28	67.92	1.3584
Angola	0.01	22.84	0.11	0.53	0.2	10.685	0.2137
Benin	0	24.6	0.16	0.85	0.91	21.66	0.4332
Botswana	14.53	92.48	3.7	9.27	12.33	263.701	5.27402
Burkina Faso	0.32	8.38	0.13	0.45	0.21	8.738	0.17476
Burundi	0	4.48	0	0.3	0.24	5.848	0.11696
Cameroon	0.21	26.52	0.33	0.64	0.98	22.173	0.44346
Cape Verde	0.62	183.99	0	12.62	4.54	190.061	3.80122
CAR	0.02	4.15	0.17	0.26	0.14	6.117	0.12234
Chad	0.01	3.92	0.13	0.13	0.07	3.693	0.07386
Comoros	0.58	21.61	0.43	1	0	16.519	0.33038
Congo	0.02	1.75	0.35	0.75	2.38	34.977	0.69954
Côte d'Ivoire	0.41	27.05	0.61	1.78	3.04	57.046	1.14092
D. R. Congo	0.02	0.1	0	0.04	0.03	0.712	0.01424
Djibouti	0.02	21.94	1.02	1.52	0.04	27.996	0.55992
Egypt	0.35	70.89	2.21	8.64	2.14	137.024	2.74048
E. Guinea	0	11.32	0.23	1.35	0.07	17.632	0.35264
Eritrea	0.05	13.05	0.16	0.8	0	10.91	0.2182
Ethiopia	0.01	1.58	0.09	0.37	0.03	5.059	0.10118
Gabon	0.28	122.35	0.98	3.18	9.79	151.763	3.03526
Gambia	0.12	30.7	1.15	2.56	0.43	44.482	0.88964
Ghana	0.01	14.84	0.3	1.17	0.64	22.585	0.4517
Guinea	0.25	10.12	0.37	0.79	0.53	17.937	0.35874
G. Bissau	0.17	24.97	0	0.93	0	11.814	0.23628
Kenya	0.53	65.21	0.49	1.05	0.42	26.174	0.52348
Lesotho	0.47	18.58	0	1.03	1	22.205	0.4441
Liberia	0	1.59	0	0.21	0	2.259	0.04518
Libya	0.05	17.84	0	10.79	0.71	116.789	2.33578
Madagascar	0.34	18.82	0.22	0.34	0.4	11.516	0.23032
Malawi	0.01	14.51	0.12	0.44	0.47	11.752	0.23504
Mali	0.08	16.74	0.12	0.35	0.09	7.282	0.14564
Mauritania	0.45	18.87	0.94	0.72	0.27	21.232	0.42464
Mauritius	27.44	728.91	10.05	23.53	15.08	562.235	11.2447
Morocco	0.66	70.54	1.23	5.03	8.26	152.32	3.0464
Mozambique	0.06	15.24	0.3	0.44	0.26	11.53	0.2306
Namibia	18.51	170.78	3.42	6.27	4.67	162.529	3.25058
Niger	0.16	4.66	0.05	0.19	0.02	3.082	0.06164
Nigeria	0.07	17.57	0.66	0.43	0.03	12.964	0.25928
Reunion	0.01	1859.8	4.63	38.86	39.5	1015.881	20.31762
Rwanda	0.47	6.47	0	0.23	0.5	7.994	0.15988
Sao Tome	52.65	436.48	0	3.1	0	79.913	1.59826
Senegal	1.93	42	1.68	2.16	2.63	69.093	1.38186
Seychelles	1.11	739.54	13.56	23.45	32	764.165	15.2833
S. Leone	0.18	10.3	0	0.39	0.25	7.448	0.14896
Somalia	0	0.21	0	0.15	0	1.521	0.03042

Table 1 continues

Table 1 (con't)
IT indexes of African countries

	No. per 10,000 people		No. per 100 people				
Country	Hosts	Users	PCs	Telephone lines	Cell phones	Weighted sum	IT index
S. Africa	42.95	549.38	6.18	11.36	19.02	424.833	8.49666
Sudan	0	9.65	0.32	1.24	0.07	17.265	0.3453
Swaziland	9.73	99.21	0	3.19	3.27	75.494	1.50988
Tanzania	0.23	32.75	0.28	0.49	0.51	16.098	0.32196
Togo	0.34	216.03	2.16	0.92	1.08	63.237	1.26474
Tunisia	0.03	104.32	2.29	8.99	0.58	129.035	2.5807
Uganda	0.08	18.01	0.27	0.28	0.85	15.809	0.31618
Zambia	0.86	19.19	0.67	0.8	0.95	26.205	0.5241
Zimbabwe	2.16	37.08	1.19	1.85	2.29	57.224	1.14448

Source: ITU database (2002). Weighted sum and IT index computed by author.

Table 2
The IT ranking of African countries, 2000

Rank	Country	IT index	GDPCAP	Rank	Country	IT index	GDPCAP
1	Reunion	20.32	N/A	28	Benin	0.43	380
2	Seychelles	15.28	7,349	29	Mauritania	0.42	368
3	Mauritius	11.25	3,676	30	Guinea	0.36	677
4	S. Africa	8.50	3,024	31	Eq Guinea	0.352	1,290
5	Botswana	5.27	2,892	32	Sudan	0.350	364
6	Cape Verde	3.80	1,356	33	Comoros	0.33	382
7	Namibia	3.25	1,834	34	Tanzania	0.322	263
8	Morocco	3.04	1,256	35	Uganda	0.316	265
9	Gabon	3.03	3,999	36	Nigeria	0.26	336
10	Egypt	2.74	1,424	37	G. Bissau	0.236	238
11	Tunisia	2.58	2,216	38	Malawi	0.235	176
12	Libya	2.34	5,944	39	Mozambique	0.231	209
13	Sao Tome	1.60	236	40	Madagascar	0.230	240
14	Swaziland	1.51	1,353	41	Eritrea	0.22	191
15	Senegal	1.38	512	42	Angola	0.21	685
16	Algeria	1.36	1,613	43	Burkina Faso	0.18	220
17	Togo	1.27	313	44	Rwanda	0.16	263
18	Zimbabwe	1.45	487	45	S. Leone	0.148	142
19	Côte d'Ivoire	1.14	818	46	Mali	0.145	248
20	Gambia	0.89	284	47	CAR	0.122	312
21	Congo	0.70	774	48	Burundi	0.120	110
22	Djibouti	0.56	846	49	Ethiopia	0.10	106
23	Zambia	0.524	463	50	Chad	0.07	180
24	Kenya	0.523	360	51	Niger	0.06	171
25	Ghana	0.45	372	52	Liberia	0.05	N/A
26	Lesotho	0.444	432	53	Somalia	0.03	N/A
27	Cameroon	0.443	664	54	D. R. Congo	0.01	90

Source: IT index computed from the ITU database on the Internet 2002.

Table 1 shows the numerical values of each of the IT indicators and the corresponding indexes for 54 African countries.[21] Using the computed IT indexes, these countries were ranked from the highest index to the lowest (see Table 2). It can be seen from the table that, in terms of access to IT, the top ten countries are Reunion, Seychelles, Mauritius, South Africa, Botswana, Cape Verde, Namibia, Morocco, Gabon, and Egypt. The bottom ten countries are Democratic Republic of Congo, Somalia, Liberia, Niger, Chad, Ethiopia, Burundi, Central African Republic, Mali, and Sierra Leone.

While the IT index may be useful for ranking African countries according to their levels of digitalization, the index *per se* is not entirely helpful for an intuitive perception of how digitalized African countries are. To be useful as a perceptive and cognitive instrument, a country-benchmark has to be established for deciphering the differential access of African countries to digital technology. For the purpose of comparing the IT access of African countries, such a benchmark can be established by identifying an African country that is widely regarded by the international community as sufficiently digitalized. After identifying such a country—the 'frontier country'—the next step is to ascertain the extent to which other countries' IT indexes have deviated from the IT index of the frontier country.

South Africa has been selected as the frontier country in this paper because of its worldwide recognition as a country advanced in IT. South Africa has been rated as among the top 20 most digitalized countries in the world (Ajayi 2001: 1). Table 3 shows that South Africa has not only outperformed many developing countries in digital technology, but has indeed done better than some developed countries in certain areas of IT. In 1999, for instance, South Africa recorded the highest IT expenditure as a percentage of GDP in the whole world. South Africa has also recorded one of the fastest growth rates in IT expenditure per capita (49.5 per cent) in the world, exceeding those of Canada, Denmark, France and Germany during the 1992-99 period. Although South Africa is still behind the developed countries in terms of personal computers per 100 people, its average of 6.2 in the year 2000 exceeded those of the more digitalized developing countries such as Argentina, Brazil, China, India, Indonesia, Mexico and the Philippines. There is thus a sufficient basis for using South Africa as a benchmark for determining the levels of digitalization of African countries.

Countries that have an IT index equal or greater than that of South Africa (8.497, as shown in Table 2) could be regarded as 'very advanced' in IT; those with indexes of between 3.0 and 7.99 are regarded as 'advanced'; those within 1.0 and 2.99 are, and those with indexes of 0.2 and 0.39 are perceived as having 'weak' perceived as 'semi-advanced'; countries with indexes of between 0.40 and 0.99 are seen as 'catching up access' and indexes below 0.2 reflect 'very weak access'.[22] Based on this taxonomy, African countries are classified according to their levels of access to IT (see Table 4). It can be seen from the table that only nine of the 54 African countries can be regarded as either advanced or very advanced in access to IT, although their IT indexes are far below those of developed countries (see Table 5) Ten countries are classified as semi-

[21] There was no complete data set for Mayotte, the only African country excluded from the list.

[22] In the absence of universally accepted methods of ranking, this classification should be perceived as an ad hoc method of gaining some insight into the digital divide within Africa. Some may even view it as too arbitrary and subjective. Unless standard and universally accepted measures of IT are developed in the literature, classifications of this nature will necessarily be ad hoc.

advanced, while the same number of countries fall under the category of catching-up. A total of 25 countries have either weak or very weak access to IT. This classification provides overwhelming support for the notion that a preponderance of African countries still have very weak access to IT.[23]

Another way of making intuitive sense of the levels of digitalization of African countries is to compare their IT indexes to those of a selected number of developed countries, as shown in Table 5. It can be seen that South Africa's IT index (see Table 1) is only about one-sixth of the IT indexes of the United States and Sweden, and about one-fifth of that of Switzerland (Table 5). The most digitalized African country, Reunion, has an IT index that is less than half the IT indexes of the United States, Sweden and Switzerland. A comparison of Table 1 and Table 5 shows that the digital divide between Africa and the developed industrialized world is indeed very wide. A pertinent question, however, is whether this gap would close in the future or continue to widen? This question is addressed in the next section.

Table 3
Indicators of information technology (IT) use in selected economies

	IT/GDP (in %)		IT per capita (nominal US$)		PCs per 100 people	
	Change 1992-99	1999	Growth 1992-99 (%)	1999	Change 1990-2000	2000
Developing						
Argentina	1.0	3.4	78.0	294.3	4.4	5.1
Brazil	2.3	5.8	199.4	267.4	4.1	4.4
Chile	1.1	5.7	121.8	321.0	7.5	8.6
China	3.0	4.9	465.7	37.9	1.6	1.6
India	1.8	3.5	220.8	15.4	0.5	0.5
Indonesia	-0.3	1.4	7.0	13.7	0.9	1
Korea	-0.5	4.4	53.8	521.5	15.3	19
Malaysia	2.1	5.5	61.8	168.4	9.7	10.5
Mexico	5.2	1	30.6	231.8	4.3	5.1
Philippines	0.9	2.7	82.6	33.6	1.6	1.9
South Africa	1.8	7.2	49.5	240.6	5.5	6.2
Advanced						
Canada	1.6	5.3	31.6	1,808.7	28.3	39
Denmark	1.0	4.5	45.3	2,540.3	31.6	43.1
France	0.8	3.8	27.5	1,706.6	23.4	30.5
Germany	0.9	4.1	29.4	1,699.9	23.4	33.6
United Kingdom	0.7	4.7	52.0	1,979.5	23.0	33.8
United States	0.9	5.2	57.9	2,792.1	36.8	58.5

Source: IMF (2001: 134).

[23] In a statement to the United Nations Economic and Social Council in July 2000, the Executive Secretary of the Economic Commission for Africa (ECA), K. Y. Amoaka, said that 'a few years ago only a handful of countries in Africa had been connected to the Internet' (Economic and Social Council 2000).

Table 4
Classification of African countries according to their levels of digitalization

IT index of:					
8.50 & above	3.0–7.99	1.0–2.99	0.40–0.99	0.2–0.39	below 0.2
Very advanced	Advanced	Semi-advanced	Catching-up	Weak access	Very weak access
Reunion	Botswana	Egypt	Gambia	Guinea	Burkina Faso
Seychelles	Cape Verde	Tunisia	Congo	Eq. Guinea	Rwanda
Mauritius	Namibia	Libya	Djibouti	Sudan	Sierra Leone
South Africa	Morocco	Sao Tome	Zambia	Comoros	Mali
	Gabon	Swaziland	Kenya	Tanzania	Central African Rep.
		Senegal	Ghana	Uganda	Burundi
		Algeria	Lesotho	Nigeria	Ethiopia
		Togo	Cameroon	Guinea Bissau	Chad
		Zimbabwe	Benin	Malawi	Niger
		Côte d'Ivoire	Mauritania	Mozambique	Liberia
				Madagascar	Somalia
				Eritrea	D. R. Congo
				Angola	

Table 5
IT indexes of a selected number of developed countries, 2000

	No. per 10,000 people		No. per 100 people				
Country	Hosts	Users	PCs	Telephone lines	Cell phones	Weighted sum	IT index
United Kingdom	280.75	3,011.75	33.78	58.86	72.7	1,982.65	39.653
Switzerland	364.39	2,962.22	49.97	72.67	64.39	2,202.961	44.05922
Sweden	670.79	4,558.29	50.67	74.56	71.72	2,492.408	49.84816
Finland	1,022.53	3,722.95	39.61	55.02	72.04	2,141.248	42.82496
France	190.59	1,443.32	30.43	57.71	49.33	1,538.091	30.76182
Germany	248.05	2,917.6	33.60	61.05	58.60	1,849.065	36.9813
Japan	365.66	2,931	31.52	58.58	52.62	1,756.866	35.13732
United States	2,928.32	4,506.96	58.52	69.97	39.79	2,426.328	48.52656
Canada	768.78	4,130.07	39.02	67.65	28.46	1,841.185	36.8237

Source: Computed from ITU Database (2002).

4 Stability and consistency of country rankings

Access to IT is a dynamic process in which less IT-advanced countries tend to catch-up rapidly with the more advanced countries. This dynamism implies that country rankings in IT will change from year to year, depending on how fast less advanced countries are catching up with the advanced ones. This convergence in IT access is said to occur because of the existence of the so-called 'latent' demand for IT in countries with weak access to IT. As this latent demand gets satisfied in the long run, the growth of IT becomes very rapid in these countries, while the growth of IT slows down in IT-advanced countries as a result of the exhaustion of demand for IT.

Table 6
IT indexes of African countries, 1998

Country	No. per 10,000 people		No. per 100 people			Weighted sum	IT index
	Hosts	Users	PCs	Telephone lines	Cell phones		
Algeria	0.03	0.68	0.54	4.99	0.06	55.971	1.11942
Angola	0	2.07	0.08	0.54	0.08	7.207	0.14414
Benin	0.02	5.18	0.12	0.66	0.11	9.42	0.1884
Botswana	4.19	63.69	2.55	6.5	1.46	111.888	2.23776
Burkina Faso	0.16	4.42	0.09	0.36	0.02	5.158	0.10316
Burundi	0	1.55	0	0.28	0.01	3.055	0.0611
Cameroon	0	1.4	0.24	0.66	0.03	9.44	0.1888
Cape Verde	0.02	47.94	0	9.58	0.24	102.996	2.05992
CAR	0.02	0.57	0.1	0.27	0.05	4.259	0.08518
Chad	0	0.46	0.11	0.12	0	2.346	0.04692
Comoros	0.14	3.04	0.23	0.95	0	12.118	0.24236
Congo	0	0.36	0.32	0.79	0.12	12.336	0.24672
Côte d'Ivoire	0.17	7	0.45	1.19	0.64	23.517	0.47034
D. R. Congo	0	0.04	0	0.04	0.02	0.604	0.01208
Djibouti	0.06	10.43	0.88	1.27	0.04	22.949	0.45898
Egypt	0.39	16.29	0.98	6.47	0.15	77.668	1.55336
E. Guinea	0	10.9	0.23	1.29	0.07	16.99	0.3398
Eritrea	0	0.84	0	0.68	0	6.884	0.13768
Ethiopia	0.01	1.01	0.06	0.28	0	3.502	0.07004
Gabon	0.09	17.14	0.86	3.32	0.83	51.823	1.03646
Gambia	0.08	20.34	0.33	2.08	0.41	30.242	0.60484
Ghana	0.1	3.13	0.21	0.75	0.22	12.123	0.24246
Guinea	0	0.65	0.32	0.48	0.28	10.865	0.2173
G. Bissau	0.13	2.61	0	0.7	0	7.274	0.14548
Kenya	0.24	5.17	0.34	0.99	0.04	14.241	0.28482
Lesotho	0.09	0.97	0	1.02	0.48	15.106	0.30212
Liberia	0	0.38	0	0.24	0	2.438	0.04876
Libya	0.01	0	0	9.07	0.36	94.301	1.88602
Madagascar	0.04	5.83	0.16	0.31	0.08	6.087	0.12174
Malawi	0	2.01	0.08	0.38	0.11	5.901	0.11802
Mali	0	1.87	0.08	0.25	0.04	3.887	0.07774
Mauritania	0.06	4.01	0.6	0.6	0	12.407	0.24814
Mauritius	4.96	258.69	8.62	21.16	5.21	376.265	7.5253
Mayotte	0	0	0	9.53	0	95.3	1.906
Morocco	0.74	14.44	0.72	5.03	0.42	63.218	1.26436
Mozambique	0.07	1.85	0.21	0.4	0.04	6.692	0.13384
Namibia	15.99	30.12	2.41	6.38	1.17	104.211	2.08422
Niger	0.02	0.3	0.03	0.18	0.01	2.232	0.04464
Nigeria	0.04	2.82	0.61	0.38	0.02	10.386	0.20772
Reunion	0.06	131.96	4.4	35.58	7.38	486.802	9.73604
Rwanda	0	1.21	0	0.16	0.08	2.521	0.05042
Sao Tome	8.16	28.37	0	3.05	0	34.153	0.68306
Senegal	0.22	8.33	1.33	1.55	0.31	32.755	0.6551
Seychelles	0.89	253.66	12.05	23.78	6.58	449.555	8.9911
S. Leone	0.03	1.31	0	0.38	0	3.934	0.07868

Table 6 continues

Table 6 (con't)
IT indexes of African countries, 1998

	No. per 10,000 people		No. per 100 people				
Country	Hosts	Users	PCs	Telephone lines	Cell phones	Weighted sum	IT index
Somalia	0	0.1	0	0.15	0	1.51	0.0302
South Africa	34.29	300.49	4.98	12.05	6.17	265.478	5.30956
Sudan	0.09	0.71	0.19	0.57	0.03	7.98	0.1596
Swaziland	2.92	10.5	0	3.05	0.49	36.742	0.73484
Tanzania	0.04	0.93	0.17	0.38	0.12	6.797	0.13594
Togo	0.25	17.06	0.68	0.71	0.17	17.331	0.34662
Tunisia	0.02	10.71	1.48	8.06	0.42	100.673	2.01346
Uganda	0.05	7.13	0.19	0.27	0.14	6.718	0.13436
Zambia	0.35	3.42	0.68	0.88	0.09	16.877	0.33754
Zimbabwe	0.91	8.8	1.14	2.08	0.17	34.871	0.69742

Source: ITU database (2002). Weighted sum and IT index computed by author.

To test the 'convergence hypothesis', as well as determine the stability and consistency of the 2000 rankings, IT indexes for 1998 were computed for all the African countries (see Table 6).[24] Based on these indexes, the countries were again ranked according to their levels of digitalization (Table 7). Table 7 shows that there is a high degree of consistency between the 1998 and 2000 rankings of African countries. With the exception of Gabon and Morocco, all the top ten countries in 2000 were also among the top ten in 1998 Interestingly, all the bottom eleven countries in 2000 also were among the bottom eleven countries in 1998. Generally, most of the countries maintained their relative rankings in 1998 and 2000. It is also instructive to note that the Democratic Republic of Congo ranked last in both the 1998 and 2000 rankings, a result that may be attributed to the country's landlocked status and several years of civil war.

What is, perhaps, striking about the 1998 and 2000 IT indexes is that, while there was a general improvement in the IT access of most African countries, the disparity in access to IT grew among these countries between 1998 and 2000.[25] Table 8 shows that the mean IT index of all African countries almost doubled from 1.06 in 1998 to 1.94 in 2000. This rapid growth in IT access supports the widely held notion that the fastest rate of IT use can be found in developing countries.[26] Likewise, the median IT index rose from 0.25 in 1998 to 0.44 in 2000. However, the digital divide between these countries increased during 1998-2000, as indicated by the standard deviation, variance and skewness indexes in Table 8. For instance, the standard deviation and variance of the IT indexes of all the African countries rose from 2.08 and 4.33 respectively in 1998 to 3.80 and 14.42 in 2000. The skewness index also increased from 3.16 in 1998 to 3.48 in

24 Rodriguez and Wilson (2000: 2) address the issue of convergence and divergence in their paper, and conclude that, while the access of developing countries to IT has improved, the 'gap between the rich OECD countries and the poor developing countries is growing'.

25 The increase in IT access may be attributed to the rapid decline in prices of information technology products (IMF 2001: 134).

26 As the developed countries reach the peak of their demand for IT, new sources of global demand for IT are expected to come from developing countries. Thus, while the growth in IT use has slowed in developed countries, it is expected to accelerate in developing countries. The acceleration in the demand for IT in developing countries has been characterized as the 'latent demand effect' of IT use.

2000, suggesting that, rather than converging in their access to IT, the gap between African countries in their IT access actually increased between 1998 and 2000. How might the differential access of African countries to IT be explained? What accounts for the increasing digital gap between these countries, and how might the gap be closed? What should be the optimal policy response to the digital divide in Africa? To address these questions, there is need for an understanding of the determinants of IT access in Africa.

Table 7
The IT ranking of African countries, 1998

Rank	Country	Index	Rank	Country	Index
1	Reunion	9.74	28	Ghana	0.243
2	Seychelles	8.99	29	Comoros	0.242
3	Mauritius	7.53	30	Guinea	0.22
4	South Africa	5.31	31	Nigeria	0.21
5	Botswana	2.24	32	Cameroon	0.1888
6	Namibia	2.08	33	Benin	0.1884
7	Cape Verde	2.06	34	Sudan	0.16
8	Tunisia	2.01	35	G. Bissau	0.15
9	Libya	1.89	36	Angola	0.144
10	Egypt	1.55	37	Eritrea	0.138
11	Morocco	1.26	38	Tanzania	0.136
12	Algeria	1.12	39	Uganda	0.135
13	Gabon	1.04	40	Mozambique	0.134
14	Swaziland	0.74	41	Madagascar	0.121
15	Zimbabwe	0.70	42	Malawi	0.118
16	Sao Tome	0.68	43	Burkina Faso	0.10
17	Senegal	0.66	44	CAR	0.09
18	Gambia	0.61	45	S. Leone	0.08
19	Côte d'Ivoire	0.47	46	Mali	0.077
20	Djibouti	0.46	47	Ethiopia	0.070
21	Togo	0.35	48	Burundi	0.06
22	E. Guinea	0.339	49	Rwanda	0.050
23	Zambia	0.337	50	Liberia	0.048
24	Lesotho	0.30	51	Chad	0.046
25	Kenya	0.29	52	Niger	0.045
26	Mauritania	0.248	53	Somalia	0.03
27	Congo	0.247	54	D. R. Congo	0.012

Table 8
Measures of dispersion of IT access in Africa

	1998	2000
Mean IT index	1.06	1.94
Median IT index	0.25	0.44
Standard deviation	2.08	3.80
Variance	4.33	14.42
Skewness index	3.16	3.48

Source: Computed from Tables 2 and 6

5 Determinants of IT access in Africa

Studies based on the experiences of developed countries have shown that the following factors are important determinants of access to IT: urbanization, the stock of human capital, growth rates, openness of the economy, and the stock of FDI (IMF 2001: 135).

5.1 Urbanization

Communication and telecommunication facilities such as telephone lines, cellular phones, telefax, and television transmitters are concentrated in the urban areas of African countries (Boafo 1991: 108; UNESCO 1989). Table 9 shows the percentage of total telephone lines in the urban areas of selected African countries. The table shows that the percentage exceeds 60 per cent for many African countries. Thus, the more urbanized an African country is, the more communication and telecommunication facilities the country tends to have. Countries with high levels of urbanization are also more likely to have business organizations, government and non-governmental agencies, and white-collar workers that use computers and the Internet. For instance, Internet cafes are typically found in urban areas than in rural communities. Network externalities from IT are also usually large in urban areas, which further encourages more people to use the Internet.[27]

Table 9
Percentage of total telephone lines in urban areas in selected African countries, 1998

Country	% Urban lines
Angola	95.00
Djibouti	100.00
Eritrea	100.00
Ethiopia	99.00
Guinea	98.00
Libya	60.00
Mauritania	100.00
Sudan	92.00
Sierra Leone	87.00
Chad	81.31
Togo	97.00
Uganda	97.57

Source: ITU (1999).

5.2 Stock of human capital

The amount of human capital accumulated by a country can also be instrumental in the country's access to IT. A large stock of human capital implies a high literacy rate,

[27] Network externalities arise when the benefits of access to IT increase as more people use the Internet. Conversely, very little externalities will be realized in a society or community in which few people use the Internet. Lack of substantial network externalities may, therefore, discourage people from striving to gain access to the web.

which in turn means that a preponderance of the population will be prone, at the very least, to using the Internet. The effective acquisition and assimilation of new technologies in Africa have also been shown to be a function of the stock of human capital (Lall 1991).

5.3 Economic growth and foreign investment

A higher rate of economic growth, other things being equal, raises living standards and demand for normal goods such as computers, telephones, and cable/satellite televisions. High-growth economies are also typically more attractive to Internet-providing companies. Because growth rates are affected by the rate of investment (both domestic and foreign), a high rate of investment or flow of FDI is also likely to facilitate access to IT. Countries with high rates of investment typically import capital goods such as computers and other communication equipment. It should be pointed out, however, that there may be a complex, two-way causation between economic growth, investment, and IT. The availability of a well-developed IT network may attract foreign investors into a country. Likewise, a well-developed IT network may, as evidence from the United States has shown, boost total factor productivity and the rate of growth of the GDP.

5.4 Openness of the economy

The extent to which a country is integrated into the global economy can play a role in its access to IT. Countries with greater contact, either via trade, tourism, or geographical location, with the outside world, are more likely to be advanced in digital technology than other countries.

5.5 The model and data collection

To explore the determinants of IT access in Africa, the following simple equation is used:

IT Index = *f* (Urbanization, human capital, growth rate, openness of the economy, flow of FDI).[28]

The variables in the equation are operationalized as follows:

IT index = The index of digitalization as defined earlier in the paper, and as shown in Table 2;[29]

Urbanization = Urban population as a percentage of total population;

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28 This list of factors that influence the diffusion of IT is by no means exhaustive. Kirkland (2001) has identified other factors such as the availability of information infrastructure, skill levels, telecommunications policy framework (including taxes, tariffs and cyberlaws), business and political climate.

29 The use of IT index as dependent variable is a departure from earlier studies that used IT investment as a percentage of GDP (see, for instance, Shih *et al.* 2002: 13). This latter approach is suspect because expenditures on IT *per se* does not always translate to IT access.

Human capital	=	The percentage of the population aged 15 and above who are illiterate;
Growth rate	=	Average annual growth rate of GDP per capita;
Openness of the economy	=	Import of goods and services as a percentage of the GDP; and
Flow of FDI	=	The annual flow of FDI measured in billions of US dollars.

Cross-sectional data on the above variables were collected for 51 African countries for the year 2000. Data on IT index (see Table 1) were computed from the International Communication Union's database on the Internet. The data on urbanization, human capital, growth rate and openness of the economy were collected from the World Bank's *Data and Statistics* (Internet version), while data on the flow of FDI was from UNCTAD's *World Investment Report*. The ordinary least squares (OLS) method of regression was used to estimate the model and the results are reported below:

Model 1
Dependent variable: Index of IT access

Independent variables	Coefficients	Standard error	T Stat.	P-value
Intercept	-29.5116	95.16466	-0.31011	0.757908
Urbanization	1.577154	1.42701	1.1052216	0.27494
Human capital	-1.65118	1.143322	-1.44419	0.155611
Growth of GDP per capita	0.015838	6.647655	0.002382	0.99811
Openness	3.025142	1.102136	2.744799	0.008669
FDI	-0.09901	14.02065	-0.00706	0.994397
$R^2 = 0.22$	Adj. $R^2 = 0.13$	F = 2.541579	Obs. = 51	

With the exception of the flow of FDI, all the independent variables came out with the expected signs.[30] However, of all the variables with the correct signs, only the openness variable is significant at the 5 per cent level. The openness variable is not only significant, it also has the largest coefficient of each of the other variables. This result supports an earlier finding by Shih *et al.* (2002: 20), who concluded, on the basis of data on IT investments in 43 countries between 1985 and 1998, that 'the openness of a country's economy is positively related to IT investments'. The insignificance of the growth of GDP per capita is somewhat surprising, though, especially in view of the fact that per capita GDP and Internet access cost have been identified by Kiiski and Pohjola (2001) to be the 'best' explanatory variables for the growth in computer hosts per capita in OECD countries. They also found that investment in education is not an important explanatory variable for the growth in IT use in OECD countries – a conclusion that supports the insignificance of the human capital variable in the regression results of this paper.

[30] It is instructive to note that Baliamoune (2002: 16) found no support for a positive relationship between FDI and IT diffusion.

Given the possible multicollinearity between FDI and the growth of GDP, the former was dropped from the equation, and the model was re-estimated. The result shows no change in both the signs and magnitude of the coefficients of the independent variables. The openness variable continues to be the only significant variable in the re-estimated model (see Model 2).

The overarching significance of the openness variable for access to IT in Africa is underscored further by Table 2, which shows the ranking of countries according to their IT indexes. The table shows that, with the exception of Botswana, all the top ten countries on the list (Reunion, Seychelles, Mauritius, South Africa, Cape Verde, Namibia, Morocco, Gabon and Egypt) are located along ocean or sea outlets that give them unfettered access to the global economy. Countries such as Seychelles, Mauritius, South Africa, Morocco and Egypt have vibrant tourist industries that attract visitors from all over the world. By contrast, six of the bottom ten countries are landlocked. The salience of openness is further illustrated by the case of Senegal, which had a meagre GDP per capita of US$360 in 2000, but ranked number 15 in the level of digitalization.

Senegal is arguably one of the most open African countries, attracting hundreds of thousands of tourists annually, as well as being home to numerous foreign NGOs and multilateral institutions.

Even countries with favourable economic conditions have performed below expectations with regard to IT access, probably because of the non-openness of their economies. One such example is Libya, which had the second highest GDP per capita in Africa in the year 2000, but ranked twelfth in IT access. Libya's relatively low IT ranking may be attributed to its lack of openness, following the travel ban and economic sanctions imposed on the country by the United Nations in the 1990s. Its adherence to a more conservative and fundamentalist variant of Islam may have also undermined its access to IT by discouraging tourists from patronizing the country.[31] It does also seem that an overwhelming favourable socioeconomic conditions may help offset a country's lack of openness. Botswana is a very good example of this latter scenario; despite the fact

Model 2
Dependent variable: Index of IT access

Variable	Coefficient	Standard error	T-Stat	P-Value
Intercept	-0.18769	1.408772	-0.13323	0.894591
Urbanization	0.040311	0.020604	1.956416	0.056503
Human capital	-0.03298	0.017004	-1.9393	0.058613
Growth of GDP per capita	0.021361	0.098989	0.215796	0.830101
Openness	0.034991	0.016406	2.132797	0.03831
R^2 = 0.26	Adj. R^2 = 0.20	F = 4.099461	Obs: 51	

[31] Further research is needed to ascertain the relationship between access to IT and socio-cultural variables. It is noteworthy, though, that Tunisia, Morocco and Egypt that practice more moderate versions of Islam are ranked as either 'advanced' or 'semi-advanced' in their IT access, even though their GDP per capita levels are far lower than Libya's. Their moderation may also have boosted their openness to the outside world, which in turn may have facilitated IT access.

that the country is landlocked, it ranks number 10 in IT access. This impressive ranking may be due to the country's high GDP per capita (relative to most African countries), as well as the large number of literate people in the country; only 25 per cent of Botswana's population is illiterate.

Although the growth of GDP per capita is not significant, a cursory look at Table 2 shows that there is some correlation between the IT index and the GDP per capita of many of the countries. Notice, for instance, that, with the exception of Madagascar, all the countries classified as having either weak or very weak access to IT (Table 4) have per capita GDP of less than US$1,000. The Democratic Republic of Congo has the lowest IT index, and it also happens to have the least GDP per capita in the region. It should be pointed out, though, that six of the bottom ten countries have been involved in civil wars and violent ethnic conflicts in the recent past. This problem obviously has contributed to their abysmal GDP per capita and very weak access to IT. By contrast, most of the countries classified as either very advanced, advanced or semi-advanced have per capita GDP of over US$1,000.

Model 3
Dependent variable: Index of IT access

Variable	Coefficient	Standard error	T-Stat	P-Value
Intercept	-0.56101	1.477568	-0.37969	0.706005
Urbanization	0.043295	0.02181	1.985082	0.053391
Human capital	-0.02765	0.017883	-1.54596	0.129277
Growth of GDP per capita	0.029955	0.100058	0.299375	0.766064
Openness	0.029014	0.017352	1.672101	0.101602
FDI	0.073992	0.210486	0.351528	0.72687
Regional dummy	1.036672	0.93579	1.107804	0.273966
$R^2 = 0.28$	Adj. $R^2 = 0.19$	F = 2.913487	Obs: 51	

The geographical location of some of the top ten countries also points to a possible 'cluster' or 'contagion' effect in the diffusion of IT. It certainly cannot be fortuitous that four of the IT-advanced countries (South Africa, Botswana, Namibia, and Mauritius) are located in the same geographical area. The first three of these countries are even located contiguously next to each other. Notice also that none of the bottom ten countries are in southern Africa; all are located in west, central and east Africa. While risking being labelled a geographical determinist, it is difficult, given the geographical clustering of some of the countries with advanced access to IT to avoid the suggestion that IT tends to diffuse more rapidly within regions in which an IT-advanced country exists. It is possible that the spillover effects from an advanced country such as South Africa may have induced the neighbouring countries to adopt the technology more rapidly than countries that are located in regions where there are no IT-advanced countries. The existence of a number of IT-advanced countries in southern Africa may also be explained in terms of network externalities—as more people in the region began gaining access to IT, the payoff from adopting the technology became increasingly large. To determine the effect of geographical location on IT access in Africa, a regional dummy variable was included in the model estimated earlier. This variable assigns the value one to each country located in southern Africa, and zero to other countries. The result from the re-estimated model, however, indicates that location in southern Africa is not

significant in explaining differences in IT access in Africa (see Model 3). Indeed, the inclusion of a regional dummy renders all the independent variables insignificant (including the openness variable that has been consistently significant in two of the previous models). However, the signs of the independent variables continue to be in the appropriate directions.

6 Conclusion and policy implications

Despite their expression of interest in IT, many African countries still do not have explicit and well-articulated policies for promoting the acquisition and diffusion of IT.[32] The conventional wisdom in Africa has been that privatization and deregulation of telecommunication markets would lead to more investment, new services, lower prices, and higher usage. Consequently, some African countries have been deregulating and privatizing their telecommunications sector, with the hope that this would promote the diffusion of IT in their economies.

High user-cost has been identified as a major constraint in the diffusion of Internet technology in developing countries. Given abysmal levels of per capita income in African countries, the prices of hardware, software and of connectivity remain so prohibitive that only affluent urban dwellers can afford the high cost of Internet access (Kirkman 2001: 4). It is widely believed, therefore, that the competitive market pressure that privatization unleashes would drive Internet cost down, and thus promote the diffusion of the technology. For instance, Schneider (2002) found that the deregulation of the Brazilian telecommunications sector resulted decreased the access cost for 20 hours of dial-up in Brazil from US$33.21 in 1998 to US$14.73 in 2000.

While privatization and deregulation can reduce Internet access cost, they may also exacerbate the digital divide within individual African countries. This is more so because Internet service providers (IPS) and telecommunications operators would prefer areas where basic telecommunications infrastructures already exist. As Kirkman (2001) points out, market failure is a major reason for the slow diffusion of digital technology to developing countries. He argues that digital technology firms have no incentive to develop digital technologies that are appropriate for developing countries. Thus, in addition to privatization and deregulation, there is the need for state support, particularly in the provision of basic communications infrastructures in areas where private operators are reluctant to invest.

The active role played by the government in Seychelles has shown that state support can be very effective in tandem with privatization. Seychelles is one of the few African countries that have established a ministry of information technology and communication. The mission of this ministry is to ‘provide reliable, good quality, cost-effective and timely information technology services within flexible and affordable frameworks’. The ministry also monitors and controls the implementation of the government’s information systems policy. In addition to privatizing their telecommunications sector, African countries should emulate Seychelles by setting a

[32] Only a few African countries have agencies, ministries or departments devoted solely to the development of IT.

national policy on information technology. Such a policy should incorporate measures that promote the diffusion of IT in rural communities of Africa.

Beyond privatization and deregulation, however, there appears to be no explicit and systematic policies for promoting the diffusion of IT in many African countries. In fact, most of the efforts and initiatives toward the digitalization of Africa have come from foreign governments, multilateral institutions, NGOs, aid agencies, foundations, and educational institutions abroad. One of these foreign initiatives, the Leland Initiative, deserves some scrutiny, in view of the scope of its activities and the publicity it has generated.

The Leland Initiative is a five-year US$15 million US government effort to promote 'full Internet connectivity' to twenty or more African countries. The project seeks to facilitate Internet access in Africa by supporting policy reform, facilitating low-cost, high-speed access to the Internet, and introducing mechanisms to build networks of active users. Administered by the United States Agency for International Development (USAID), the ultimate aims of the project are (i) affordable prices that promote a broad expansion of the user base; (ii) delivery of Internet services by private sector providers; and (iii) free and open access to information available through the Internet, in accordance with host-country laws.

After a long process of screening, 21 African countries have been selected to participate in the project.[33] While projects like this are laudable and commendable, they often seem to be too ad hoc to make lasting impacts on the diffusion of IT in Africa. Some of these external initiatives are also not well-targeted on countries that need them the most, or areas of IT that are more relevant to Africa. For instance, three of the countries (South Africa, Botswana, and Namibia) selected to participate in the Leland project are already either very advanced or advanced in IT (see Table 4), while nine of the 25 countries with weak or very weak access to IT are among the participants. Most of the participants in the project, however, are made up of countries with weak access to IT. While external support is helpful, a more successful IT policy would require Africans themselves to take the initiative in promoting the digitalization of the continent. As the Executive Secretary of the Economic Community of Africa (ECA), K. Y. Amoako, points out, 'no one can do this for us. Africa must have its own answers, its own policy dynamics just as is the case of every other region'(Amoako 1999: 3).

Having their own answers, however, requires that African countries understand why there are differential access to IT in the region. This paper has shown that openness of the economy is the most important factor that explains variations in IT access in Africa. This implies that African countries that are aspiring to promote the diffusion of IT should remove trade barriers, encourage tourism, and relax the laws and regulations that compromise the openness of their economies.

The paper also shows that four of the IT advanced countries (South Africa, Mauritius, Botswana, and Namibia) are located in the same geographical area, suggesting that there could be substantial network externalities effect in the diffusion of IT in Africa. It may well be that the presence of South Africa in the region has facilitated the access of

[33] The participating countries are Benin, Botswana, Cote d'Ivoire, Eritrea, Ethiopia, Ghana, Guinea, Guinea Bissau, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Rwanda, Senegal, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe.

neighbouring countries to IT. For instance, Namibia imports cheap computer hardware and software from the South Africa. These imports are cheap because of the low transportation cost between the two countries. It means, therefore, that multilateral and other agencies that seek to promote access to IT in Africa should focus on one country in each subregion. Rather than spreading scarce resources thinly among several countries, it may be more appropriate and effective to develop one IT growth-centre in each subregion, with the expectation that the positive externalities generated by this country would spur other countries in the subregion to enhance their access to IT.

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