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Information and Communication Technology (ICT) Investment in Economically Developing Countries

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ABSTRACT

This study looked at two research questions: Are economically developing countries spending a comparable percentage of their budgets, compared to industrialized nations, on ICT investment? What ICT investment framework should economically developing countries use to spur economic activities? We used annual telecommunication investment (ATI) as percentage of Gross Domestic Product (GDP) as a surrogate for telecommunication investment budget allocation in a country. Ten year data from the 2005 World Telecommunication Indicator Database by International Telecommunication Union (ITU) were used for analysis. Our findings indicate that the percentage of GDP allocation by economically developing countries is comparable to, and in many cases higher than, that of industrialized nations. This paper argues that even after spending a higher proportion of their GDP on ICT investments, economically developing countries are not investing enough money to realize economic benefits that derive from those investments. We propose a new framework, community focused ICT investment instead of individual focused ICT investment, to spur economic activities in economically developing countries.

Keywords

Information and communication technology, ICT, annual telecommunication investment, economically developing countries, developing countries, telecommunication

INTRODUCTION

Can telecommunication investment help economically developing countries (EDCs) to advance? Prior research indicates that telecommunication investment increases growth dividend (Roller and Waverman, 2001), facilitates economic growth (Waverman, Meschi, and Fuss, 2005), combats poverty (Calderon and Serven, 2004), and promotes expansion in economic activities (World Bank, 1991). Other researchers have also found relationship between development and telecommunication investments in economically developing countries (Alleman et al., 1994). Roller and Waverman (2001) found that telecommunication investments spur economic benefits in EDCs.

A high correlation between telecommunication investment and Gross Domestic Products (GDP) was found (Saunders, 1982; Saunders et al., 1983, 1994; Gille, 1986). Furthermore, a positive relationship between teledensity (number of main telephone lines for every one hundred inhabitants) and GDP per capita was established (Mbarika et al., 2003).

Many researchers have shown that a country can achieve economic development as a result of telecommunication investment. ICT has been shown as a driver for economic growth in several OECD (Organization for Economic Cooperation and Development) countries (Colecchia and Schreyer, 2002). Armed with this wealth of information EDCs should be able to use ICT to leap-frog to a developed economy. However, a decade after the Internet revolution, EDCs have not leaped out of economic stagnation. Are EDCs spending enough money on telecommunications? Prior studies have suggested that EDCs may not be putting enough financial investment in telecommunications (Alleman et al., 1994). Some of the reasons cited are that telecommunication authorities are state enterprises in most EDCs and hence subject to standard governmental budget practices. Telecommunications must compete for budget allocations from the state along with all other bureaucracies, and government authorities do not understand the economic benefits (Alleman et al., 1994).

These findings imply that EDCs are not committing to an adequate level of investment in telecommunications. Are EDCs allocating adequate budget for telecommunications? What proportion of their budgets are EDCs allocating for telecommunication investments? Are the proportions of EDCs' telecommunication investments comparable to those in industrialized nations? If they are not, how much more should they invest? If EDCs are already allocating a comparable amount, compared to industrialized countries, are the investment frameworks appropriate for EDCs? What type of ICT investment framework should EDCs follow?

To address these questions, this paper focuses on two research questions: First, are EDCs spending a comparable percentage of their budgets, compared to industrialized nations, on ICT investments? Second, what ICT investment framework should EDCs use to spur economic development?

METHODOLOGY

We used Annual Telecommunication Investment (ATI) as a percentage of GDP to be a surrogate for telecommunication investment budget allocation in a country. ATI is the annual expenditure associated with acquiring ownership of property and plants used for telecommunication services (ITU, 2003). We used ICT investment levels to study the contribution of ICT to economic growth (Colecchia and Schreyer, 2002). GDP reflects the economic strength of a nation. To compare investment across countries, we used ATI as a percentage of GDP (ATI/GDP).

	Country	Ec	Avg. ATI		Country	Ec	Avg. ATI		Country	Ec	Avg. ATI
1	Azerbaijan	B	0.439	31	Togo	A	0.011	61	United Arab Emirates	D	0.007
2	Gabon	C	0.234	32	Nicaragua	A	0.011	62	Japan	D*	0.006
3	Honduras	B	0.024	33	Bahrain	D	0.010	63	Austria	D*	0.006
4	Cape Verde	B	0.023	34	Morocco	B	0.010	64	Ukraine	B	0.006
5	Jamaica	B	0.021	35	Brazil	B	0.010	65	Pakistan	A	0.006
6	Costa Rica	C	0.020	36	Swaziland	B	0.010	66	Uganda	A	0.006
7	Gambia	A	0.020	37	Mozambique	A	0.010	67	Canada	D*	0.006
8	China	B	0.018	38	Armenia	B	0.010	68	Finland	D*	0.006
9	Latvia	C	0.017	39	Nigeria	A	0.010	69	Macau	Y	0.006
10	Czech Republic	C	0.017	40	Thailand	B	0.009	70	Italy	D*	0.006
11	Belize	C	0.017	41	Cyprus	D	0.009	71	New Zealand	D*	0.006
12	Malaysia	C	0.016	42	Mongolia	A	0.009	72	Singapore	D	0.005
13	Kenya	A	0.016	43	Namibia	B	0.009	73	Denmark	D*	0.005
14	Zimbabwe	A	0.015	44	Bulgaria	B	0.009	74	Germany	D*	0.005
15	Bolivia	B	0.015	45	Tunisia	B	0.009	75	Belgium	D*	0.005
16	Philippines	B	0.014	46	Venezuela	C	0.009	76	Belarus	B	0.005
17	Senegal	A	0.014	47	Taiwan, China	Y	0.009	77	Luxembourg	D	0.005
18	Jordan	B	0.014	48	Greece	Z	0.009	78	United States	D*	0.005
19	Barbados	C	0.013	49	Sri Lanka	B	0.008	79	France	D*	0.004
20	Portugal	D*	0.013	50	United Kingdom	D*	0.008	80	Nepal	A	0.004
21	Hungary	C	0.013	51	Israel	D	0.008	81	Kazakhstan	B	0.004
22	Mauritius	C	0.013	52	Hong Kong	D	0.008	82	Turkey	C	0.003
23	Eritrea	A	0.013	53	Burkina Faso	A	0.008	83	Russia	C	0.003
24	Korea (Rep. of)	D*	0.013	54	Cote d'Ivoire	A	0.007	84	Kyrgyzstan	A	0.003
25	Fiji	B	0.012	55	Malta	D	0.007	85	Bangladesh	A	0.002
26	Chile	C	0.012	56	Spain	D*	0.007	86	Central African Rep.	A	0.002
27	Estonia	C	0.012	57	Botswana	C	0.007	87	Myanmar	A	0.002
28	Slovak Republic	C	0.011	58	Mexico	C	0.007				
29	South Africa	C	0.011	59	Switzerland	D*	0.007				
30	Slovenia	D	0.011	60	Syria	B	0.007				

Table 1: List of Countries included in the study

Further statistical scrutiny is needed to validate if ATI/GDP is a good measure for ICT investment. ATI and GDP data from the 2005 World Telecommunication Indicator Database are used for this study (ITU, 2005). ITU (International

Telecommunication Union), a department of the United Nation, tracks global data for telecommunication indicators through annual surveys of over 200 countries and territories. The ITU data are collected from telecommunication ministries, regulators, and operators.

We looked at 10 year data, 1993 to 2002, from 204 countries: 109 EDCs and 95 industrialized countries. Classification for EDCs was taken from the 2005 World Bank classification (World Bank, 2005a). Based on the World Bank classification, 109 countries (53%), 59 low income countries and 54 lower-middle-income countries, were grouped as EDCs for this study. Ninety-five countries (47%), 40 upper-middle-income countries and 55 high-income countries, were grouped as industrialized countries.

The 2005 World Telecommunication Indicator Database (ITU, 2005) had ATI data through 2003. However, only 29% of the countries reported ATI data for 2003; about half of these countries did not have complete 10 year data. Therefore, we took the 10 year data from 1993 to 2002 for this study. From the 204 countries, we found 87 countries with data for all 10 years under consideration. The remaining 127 countries were missing data for multiple years and hence excluded from this study.

Table 1 shows the names, economic groups, and average ATIs/GDPs, for the countries included in this study. The four economic classifications include A = Low-income economies; B = Lower-middle-income economies; C = Upper-middle-income economies; D = High-income economies. High income economies that are also members of OECD are indicated with asterisks (D*). The 87 countries considered in this study consisted of 41 EDCs (47%) and 46 industrialized countries (53%). The representation of EDCs in our sample study is lower than the World Bank classification for EDCs, 53%. This reflects the challenges of data collection.

We calculated the average investment over 10 years using the ATI/GDP ratio. We ranked countries based on their average 10 year investment.

RESULTS

The 10 year average ATI/GDP ratio was used to rank the 87 countries in our study. Thirty-nine countries invested more than 1% of their GDP on telecommunication. The majority of these countries, 56%, were EDCs. This showed that on the average, EDCs' investment in telecommunications was proportional to, or higher than, that of industrialized countries.

Rank[1]	**Country**	Economy[2]	2002 ATI ($millions)	2002 GDP ($millions)	10 year Average ATI/GDP
1	Azerbaijan	B	8	6,194	0.439
2	Gabon	C	11	4	0.234
3	Honduras	B	52	6,565	0.024
4	Cape Verde	B	14	633	0.023
5	Jamaica	B	136	8,419	0.021
6	Costa Rica	C	249	16,836	0.020
7	Gambia	A	3	358	0.020
8	China	B	25,039	1,236,690	0.018
9	Latvia	C	91	8,378	0.017
10	Czech Republic	C	810	69,505	0.017
78	United States	D	34,818	10,445,600	0.005

Table 2: Average ATI/GDP for TOP 10 countries

[1] Rank based on 10 year average telecommunication investment as a percentage of GDP
[2] Economic classification: A = Low-income economy; B = Lower-middle-income economy; C = Upper-middle-income economy; D = high-income economy

The top 10 countries, based on a 10-year average annual telecommunication investment, are shown in Table 2. The table includes the 2002 ATI and GDP data along with the economic classification. EDCs are labeled as A or B in the "Economy" column. Sixty percent of the top 10 countries in average telecommunication investment were EDCs. The United States, the country with the largest dollar amount in annual telecommunication investment, is used as a benchmark.

As shown in Table 2, the United States, the largest ATI spender, ranked 78th out of the 87 countries studied here. The combined spending of the top 10 countries is only 12% of what the United States alone spends. However, the ranking in this study is based on the percentage of GDP allocated to telecommunication. The United States, with a large ATI and large GDP, spends only one half of one percent of its GDP on ATI.

The 10-year trend for ATI/GDP spending for the top 10 countries and the United States is shown in Table 3. During the 10 years, the top 10 countries spent a consistently higher percentage of their GDP year after year, except two. The two exceptions were Azerbaijan and Gabon. During the year 2000, Azerbaijan reportedly spent 436% of its GDP on telecommunication. Gabon also spent a higher amount, 229% of its GDP in 2002. The data for the other nine years for Azerbaijan and Gabon, however, show that they spent less than 1% of their GDP annually. Further study is needed to investigate if a reporting error had occurred or if these two countries invested amounts significantly higher than their GDP. If Azerbaijan and Gabon's investment is in fact higher than their GDP, then further study is needed to understand the impact of these investments.

	Econ	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**	**Avg.**
Azerbaijan	B	0.001	0.005	4.366	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.439
Gabon	C	2.291	0.001	0.009	0.005	0.002	0.007	0.005	0.008	0.008	0.008	0.234
Honduras	B	0.008	0.004	0.008	0.020	0.012	0.038	0.028	0.054	0.024	0.040	0.024
Cape Verde	B	0.023	0.021	0.024	0.027	0.021	0.032	0.031	0.010	0.016	0.023	0.023
Jamaica	B	0.016	0.017	0.019	0.018	0.018	0.018	0.023	0.026	0.027	0.024	0.021
Costa Rica	C	0.015	0.014	0.026	0.029	0.032	0.029	0.022	0.017	0.011	0.009	0.020
Gambia	A	0.010	0.017	0.015	0.034	0.030	0.010	0.007	0.025	0.009	0.040	0.020
China	B	0.020	0.026	0.025	0.019	0.019	0.014	0.013	0.017	0.014	0.012	0.018
Latvia	C	0.011	0.011	0.010	0.012	0.020	0.014	0.011	0.027	0.029	0.029	0.017
Czech Republic	C	0.012	0.021	0.023	0.015	0.021	0.027	0.018	0.014	0.010	0.009	0.017
United States	D	0.003	0.007	0.008	0.006	0.006	0.003	0.003	0.003	0.003	0.004	0.005

Table 3: Ten year ATI/GDP trend

IMPLICATIONS

Based on the results shown above, many EDCs are spending a higher percentage of their GDP when compared to industrialized nations. Two of the reasons why industrialized nations are spending less than EDCs may be, first, industrialized nations have already established the basic infrastructure for telecommunication and hence require a smaller amount for ongoing maintenance. Second, industrialized nations have significantly larger economies and hence the smaller percentage of GDP may still be larger than what EDCs are allocating. This paper does not try to imply that EDCs are spending higher amounts than industrialized nations. In fact, telecommunication investments need significant financial input, and the small investments made by EDCs may not be enough to spur economic development.

This paper, however, looked at annual telecommunication investment as a percentage of GDP to measure budget allocations. Based on our results, we conclude that EDCs are allocating a percentage of their GDP on telecommunication investments equivalent to that of industrialized nations. In fact, our preliminary results show that many EDCs, on the average, spend proportionally higher amounts of their GDP on telecommunication.

PROPOSED ICT INVESTMENT FRAMEWORK

If EDCs are already allocating a proportional amount of their budgets for telecommunication investments but are not benefiting from related economic activities, what investment framework should they follow to spur economic development? The current approach for assessing ICT progress is focused on how much access individuals receive, i.e., the number of main telephone lines per 100 inhabitants or percentage of households with personal computers. These measures imply that ICT investment should focus on individual access. Current assessments are that EDCs need to invest at least $8 billion to increase

the teledensity from 0.29 to 1.0, from the current 1 telephone per 300 inhabitants to 1 telephone per 100 inhabitants (Mbarika et al., 2003; Hudson, 1997), still a meager amount compared to industrialized nations.

Many households in industrialized nations have personal computers. The percentage of households with personal computers in 2003 for Japan, Korea, Canada, and the United States was 78.2%, 77.9%, 66.8%, and 61.8%, respectively. In contrast, many of the EDCs are hovering below 10%. For example, Honduras, the 3rd country in our ATI/GDP ranking and the only EDC in the top 10 that reported personal computers per household data, had only 5.2% penetration.

With the current individual access focus, significant ICT investment is needed to benefit from a related economic development. Research has indicated that EDCs will have a 30% shortfall ($2.4 billion) in allocations required to achieve a teledensity of 1 telephone per 100 inhabitants (Hudson, 1997). One option is to look for funding sources that will augment this shortfall. Even if this approach works, the level of penetration will still be dismal. We argue that changing the current approach for telecommunication investment in EDCs from individual access to community access may provide better results (Negash, 2005).

EDCs, as shown above, are already spending a higher percentage, compared to industrialized nations, of their GDP on ICT investments. With the many competing basic needs EDCs face, it is unlikely and may not be practical to expect further increase in their ICT budget allocation. It has been shown that a critical mass in telecommunication investments is needed before related economic development is achieved (Roller and Waverman, 2001). Reaching this critical mass is financially daunting for EDCs. Should EDCs delay ICT related economic benefits until their ICT investment reaches critical mass? We argue that instead of delaying economic benefits until ICT access at the individual level becomes financially feasible, EDCs can spur economic benefit by re-directing their ICT investment to community access investments.

EDCs should continue to aspire to deliver network access at the individual level. However, re-directing investments to community access may spur economic development more quickly. To spur economic development despite financial and infrastructure challenges, we propose an ICT Investment Framework for Economically Developing Countries (see Table 4).

The level of access in the framework is defined as community or individual. Community refers to shared access from a common resource such as libraries or community centers. Individual refers to dedicated access to the individual at her/his residence. The type of connection, local versus network dimension, looks at the reach of access to information. Local refers to access to information within the local server. Network refers to access to information from a wide area network including Internet access. Access in many industrialized nations has reached quadrant IV, network access for individuals. But EDCs need to start at quadrant I, local access at the community level.

Type of Access

Level of Access		**Local**	**Network**
	Community	I	II
	Individual	III	IV

Table 4: ICT Investment Framework for Economically Developing Countries

We propose to begin by disseminating general purpose technologies like computers and computer applications. “As [general purpose technologies] diffuse, it fosters complementary investments and technical change in the user sectors, thereby bringing about sustained and pervasive productivity gains” (Helpman and Trajtenberg, 1998, p. 85). A communication network (or the Internet) can be used to facilitate trade among regions in business services (Harris, 1996). A communication network, however, needs skilled labor to facilitate the business services (Harris, 1996). We believe that by introducing ICT at the local level, a skilled labor force that facilitates business services will be created.

Our framework has four quadrants. To realize economic development from ICT investment, we propose that EDCs follow the four quadrants sequentially.

First quadrant: The first quadrant in the framework is local access at the community level. As described above, financial challenges limit individuals in EDCs from getting access to the vast array of digital information. Instead of waiting for additional financial infusion, this framework proposes to re-direct the limited resources to community access investment. Community centers can reach a large number of people, making the cost per person nominal, spreading the limited funds to reach more residents. A local server and a set of computers at the community center would be used for access. Digital resources, including books, journals, multimedia lessons, edutainment, and training programs, can be stored and delivered from the local server. Community access increases ICT awareness. For example, teachers can get reference material for their

classes, students can extend their research, and entrepreneurs can benefit from new training services. "Children and youths are a very appropriate target group for ICT initiatives" (Fillip, 2002, p. 4). Community access would accommodate the children and youth. The community centers can be expanded to reach schools, community organizations, and other public institutions.

Second quadrant: The second quadrant in the framework is network access at the community level. This is an extension of the first quadrant. Local area networks and computers, components of the first quadrant, would to be installed to make the second quadrant feasible. As financial availability increases, EDCs should strengthen their infrastructure to provide broadband access. By connecting the community centers to broadband services, EDCs can increase digital information access to their citizens. The community centers established in the first quadrant can provide support services during the second quadrant. Once the computers and ICT services are provided, there is a bigger challenge: training the users such as teachers on how to use the technology effectively (Fillip, 2002). The community centers can serve as resources for maintaining the network, providing training, and developing local content.

Third and Fourth quadrants: The third and fourth quadrants in the framework require a higher level of infrastructure and economic affluence. The third quadrant is a case where individuals have the infrastructure, wired or wireless infrastructure, to access information but are not able to pay for Internet connections. In this case they can link their home to the community centers and access local information. The fourth quadrant is the case where individuals are able to afford Internet services from home and hence directly connect to the Internet. This is similar to today's case in many industrialized nations.

The trend of Internet access to individuals in EDCs is at least 10 years behind that of the United States (Negash, 2006). Continuing the focus on individual access may mean a delay of a decade or more before realizing ICT related economic benefits. This challenge is compounded in EDCs because of their large rural communities. Even industrialized nations are "works in progress" when it comes to closing the Internet access gap between rural and urban households. In the United States, for example, rural residents in 2003 lagged by half in broadband access, compared to their urban counterparts: 9% of households in rural community had broadband access compared to 22% for urban residents. By 2005, the gap had narrowed to 24% and 39%, respectively (Associated Press, 2005).

EDCs have large proportions of rural community, as high as 85% in some EDCs. If telecommunication infrastructure is to accelerate economic activities in EDCs, it should reach the vast rural communities. Individual-based ICT access may not reach EDCs' households beyond the urban areas.

We anticipate that many residents in EDCs, especially those in rural communities, will not go beyond the second quadrant. However, access to ICT infrastructure through intermediaries has been shown to generate economic benefits (James, 2004). Therefore we posit that the large rural communities will be able to spur economic activities from ICT through community access.

When considering the many challenges faced by EDCs, investing in ICT may be considered a luxury. Maslow's (1987) hierarchy of needs (physiological needs, safety needs, belonging needs, esteem needs, and self-actualization needs) explain the human needs in a hierarchy that requires the fulfillment of lower level needs before aspiring for higher level needs. The vicious cycle of drought and subsequent famine and the calamities of infectious diseases that claim many lives are living testament that EDCs are still in the first two levels of the needs hierarchy. As a result, there is a fear that resources spent on non-basic needs would mean less funding for more pressing life-and-death priorities (Hills, 1993). These problems compound the urgent need to find better frameworks that spur economic development in EDCs. Delay in realizing economic benefits may force decision makers to abandon ICT investments to address other critical issues.

This study has proposed a framework to spur ICT-driven economic development despite the financial predicaments faced by EDCs. Further study to validate the application of this framework is needed. We encourage researchers to test this framework by developing case studies. Future studies should look at how EDCs should organize their investment in each quadrant, especially in the first two.

CONCLUSION

We conclude that EDCs are already allocating a large proportion of their budget for telecommunication investments. But these investments are not reaching the needed critical mass to spur economic development. We proposed a framework to change the EDCs' ICT investment focus from individual to community.

Telecommunication investment dollars across countries vary depending on the size of their economies. The dollar amount invested by high-income countries is significantly larger than that of low-income countries. However, the ATI/GDP ratio indicates proportionally higher investment by economically developing countries. To revisit our research question, How strongly do economically developing countries emphasize the importance of telecommunication, a look at the above analysis

indicates that economically developing countries spend a higher proportion of their GDP on telecommunication compared to industrialized countries. Therefore we conclude that economically developing countries strongly emphasize the importance of telecommunications.

Telecommunication investments have to reach a critical level before significant economic development can be achieved (Roller and Waverman, 2001). As indicated in this paper economically developing countries are already spending a higher proportion of their GDP on telecommunication investments. Achieving the critical level of telecommunication investments would require an even larger proportion of their meager GDP. Instead, policies on ICT investments should focus on community access. ICT investments that focus on community access, including libraries, community-based centers, and internet cafés, may provide better economic development.

Understanding the emphasis countries place on their telecommunication investment is important in guiding policy. We believe the issues involved in EDCs are different from those of industrialized nations and a different framework for ICT investments is needed. We have proposed one such framework. Additional research in this area is needed to guide ICT investment policies on how best to allocate the limited funds.

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