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The impact of investments in ICT, health and education on development: a DEA analysis of five African countries from 1993-1999

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The Impact of Investments in ICT, Health and Education on Development: A DEA Analysis of Five African Countries from 1993-1999

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Abstract

For more than a decade international institutions, such as the World Bank, International Monetary Fund, the UN and International Telecommunications Union (ITU) have been pushing African countries to invest in Information and Communication Technologies (ICT) as a strategy for social and economic development. They argue that ICT infrastructure is a prerequisite for adequate development, and suggest ICT will bring 'opportunities of the global digital economy' to remote parts and communities of Africa. Through out the era of the 1990's African countries have followed this advice and invested heavily in ICT infrastructure expansion. However, little research has been done to determine the impact of these policies. Now that much of Africa faces challenges of health epidemics and crumbling civil infrastructure (roads, water supply, etc) African policy makers must make crucial decisions: Should they continue to invest heavily in ICT infrastructure or shift focus to health care and education and so on? In this paper we attempt to fill this gap in research on ICT in Africa. We investigate investments in ICT, health care and education and their efficiency with regard to improving human development measures for five African countries for the period 1993-1999, which is the period during which consistent and sustained ICT investments took place in the countries under study. We use Data Envelopment Analysis (DEA) and archival data from the ITU and World Bank. Our findings suggest that some countries are technically efficient but others could benefit from alternative policies to improve their utilization of ICT and other investments to achieve higher levels of development as defined by key Human Development Index (HDI) measures.

Keywords: *IT and Development, IT and Africa, DEA, Technical Efficiency in Development*

1 INTRODUCTION

Since the early 1990's ICT has been promoted as an engine of growth that would significantly transform the economical, political, cultural and social condition of many developing nation states [12, 23]. Promoters of ICT as an engine of growth encourage its dispersion and praise its potential for increasing the productive capacity of developing nations by creating new work opportunities for their citizens. They argue that the information which these ICTs bring to the residents of developing nations has the capacity to generate new knowledge and bring about unprecedented potential for improvement [1, 10, 29]. International institutions such as the United Nations (UN), World Bank, International Monetary Fund (IMF), and the International Telecommunications Union (ITU), have been pushing governments of developing countries to formulate technology policies and invest heavily in ICT infrastructure expansion. The UN reported that at the end of 2003, more than 90 countries had adopted the strategies [38]. But how appropriate is this course of action from the point of view of needs of people living in developing countries? While there is some anecdotal evidence to suggest that ICT can have an on social and economical development of poor countries (such as those in Africa), there is little research to demonstrates the efficacy of these policies.

In this paper we use economic data published by the UN, United Nations Development Program (UNDP) and ITU to develop and understanding of the impact of ICT investments on development in selected African countries over the last seven years. In this regard we use a well known method DEA to investigate the impact of ICT on development in five West African countries, Benin, Cameroon, the Ivory Coast, Niger and Senegal. Our reason for picking these five countries is that they share a common colonial past and that although data on them were difficult to locate they were available. Our investigation focuses of finding answers to the following questions: (1) Are these African countries efficiently utilizing ICT for social and economic development? (2) Are the ICT investments of these countries contributing to development? (3) Can alternative investment policies lead to higher levels of development?

2 ICT AND DEVELOPMENT

Before going into the discussion of ICT and development it is important for us to establish some understanding of what is meant by development. The concept of development is multi-faceted and encompasses a wide array of dependent variables. For many years, discussions about development focused on national income and the standard of living of citizens of the country of interest. However, during the late 1980's the concept of development has been extended to include social factors beyond national income. As the economist David Fielding [18] explains: "A nation's progress with respect to its material wealth is not independent of its progress in other spheres…economic growth promotes democratic development; education is good for health; and health is good for education". From this perspective development is not purely a measure of the output (GDP), but involves other social measures which mutually enforce the economic success of a nation. Recent research has recognized a strong correlation between economic performance, health, education, and political development. And since the late 1980's there has been considerable debate about monitoring others factors of human wellbeing (education, health, political freedom) as aspects of development.

An outcome of the 1980's debates and research was the publication of the UNDP Human Development Report 1990 (HDR; cf. 38) which introduced the new Human Development Index (HDI). The goal of the HDI is to assess existing social and economic conditions in all countries. HDI measures three basic aspects of human development: longevity (life expectancy at birth), knowledge (literacy rates and school enrollment ratios) and standard of living (GDP per capita) [38]. While there have been arguments about the accuracy of the HDI index it is the currently accepted approach to conceptualize and measure this

complex reality of social and economic development [12, 20, 28, 31, 33]. A practical problem with the HDI index is that a lack of data causes difficulty in applying it to assess the level development of many countries. In this paper we use the HDI index to contextualize the background conditions of the countries that we are studying. More importantly, we use the components of the index (knowledge, longevity, and standard of living) as outputs of our DEA model, as we are interested in how investments (in ICT, Health and Education) contribute to HDI.

2.1 ICT and the African Development Context

Many African nations have consistently ranked close to the bottom of the HDI (UNDP 1998, 1999, 2000, 2001, 2002, 2003, 2004 [38]). In 2003 the UNDP (UNDP 2003) warned that African nations are facing an "acute development crises" and the HIV/AIDS pandemic that could lead socio-economic development reversals. Some researchers have also blamed the decline of socio-economic development on the lack of ICT penetration and the emergence of the 'digital divide' [2, 19, 29, 32]. Institutions such as the ITU [21, 22] argue that ICT infrastructure is a prerequisite for adequate development. Some researchers have suggested that ICT can make significant contributions to development in Africa [1, 3]; bringing 'opportunities of the global digital economy' to remote parts and communities of Africa [30] and 'leap frog' the stages of economic development [5]. However, others such as Stevenson [35] argue that these ICT will not be enough to alleviate poverty, hunger, and alienation in Africa where three quarters of the population is illiterate, living in rural areas and lack basic facilities such as electricity. Recently, The Economist Intelligence Unit (2002) warned that ICT investment may not bring the same returns to developing countries as it has the developed. Their analysis of 60 countries found that ICT begins to deliver GDP per head growth only after a certain threshold of ICT development has been reached.

So what can investments in ICT infrastructure do for social and economic development in Africa given these conditions? Proponents of 'ICT as an engine' offer two popular explanations of how ICT can contribute to development, structural change and technical efficiency [18]. The 'structural change' argument contends that new technologies, such as ICT, contribute to economic growth by spawning new economic sectors (new types of businesses or industries) in developed countries [34]. In recent times the proponents of this argument have pointed to the emergence of the e-commerce sector and outsourcing as examples of the power of ICT to spawn new businesses and industries [34]. The technical efficiency argument holds that technology can free up labor and capital for use in other parts of the economy and thus increase total factor productivity of the economy. With regard to technology in general, this is by far the older argument. In current discourse, the 'technical efficiency' argument holds that ICT is type of capital good, and investment in this good will increase real factor productivity [34].

3 THE DEA METHODOLOGY

DEA is a multifactor methodology for evaluating the relative technical efficiency of any number decision making units (DMU), where the DMUs can be countries, local governments, industries, organizations etc., responsible for converting inputs into outputs. The theoretical underpinnings of the DEA were outlined by Farrell [17] who drew upon the work of Debreu [11] and Koopmans [26]. The methodology was later elaborated by Banker**,** [4], Charnes et al. [7, 8, 9], and others such as Färe and Grosskopf [14, 15, 16]. DEA does not use statistical dependencies between the variables as ordinary production function analysis; instead it uses a non-parametric linear programming technique and input-output data to compute a technical efficient production frontier formed by the most efficient units. This is particularly beneficial when the exact relationships between inputs and outputs variables are unknown. The model generates an efficiency score for each DMU with values ranging from 0 to 1.00, where 1.00 represents 100% or maximum efficiency compared to all other DMUs. The most efficient DMU represents the "best practice" or benchmark unit. All inefficient units are meant to compare their practices to efficient ones and possibly improve their performance. Technical efficiency of a DMU reflects its ability to produce maximum

output attainable from a given set of inputs. A DMU is said to be technically efficient when it operates on the efficient production frontier, and technically inefficient, when it operates below the efficient production frontier. The efficient production frontier is the set of all technologically feasible production plans (development policies) with the highest efficiency (cf. Figure 1).

An important feature of the DEA methodology is a set of techniques for assessing scale efficiencies and "Returns to scale" (RTS) of DMUs [4]. In the classical economics, (RTS) was generally defined for single output situations. Banker and Thrall (1992) extended the single output model and developed a DEA approach to treat multiple output - multiple input cases. And Banker**,** 1984 developed the concept Most Productive Scale Size (MPSS). Färe, Grosskopf and Lovell [15, 16], also developed some important DEA approaches to determining RTS measures. RTS is generally concerned with those DMUs that are operating on is on the efficiency frontier, since it is only at this level of performance that tradeoffs between inputs and outputs that might improve one or the other of these elements can be considered. The MPSS can be explained as the segment of the efficient production frontier (cf. Figure 1) on which an economy's development policies are the most effective for generating its required outputs.

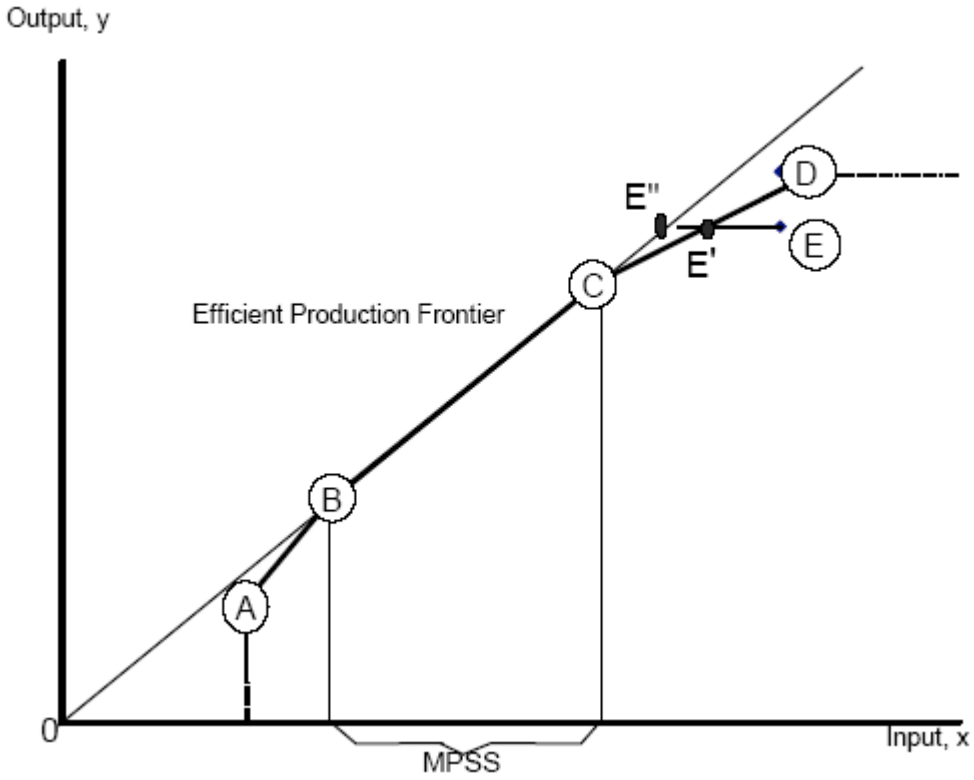

Figure 1: Scale Efficiencies and the Efficient Production Frontier

The RTS analysis helps the decision maker determine how effectively an efficient DMU is utilizing its inputs to product its outputs. The constant returns to scale (CRS) model assumes one unit of input will result in one unit of output (broadly defined). This assumption is not unusual and is in fact implied in both ratio analysis and regression analysis. The variable returns to scale (VRS) model assumes one unit of input can result in output ranging from less than one unit to more than one unit. Figure 1 below shows three different regions of the efficient production frontier that are relevant to this analysis: (i) the segment AB represents increasing RTS; (ii) the segment BC represents constant RTS and MPSS; (iii) the segment

CD represents Decreasing RTS. These concepts are important to our analysis as they can help us understand where on the efficient production frontier the countries in our study are operating and, how and what kind of adjustments they can make to improve their production performance.

4 DETAILS OF THE STUDY

We started this study with the intention of systematically analyzing the efficiency of ICT in several African countries over the last decade. However, as our work progressed we encountered difficulties in data collection which forced us to limit our study to five French speaking countries within the West African group of countries, namely, Benin, Cameroon, the Ivory Coast, Niger and Senegal. While this situation limits our findings to a small number of African countries, these findings are still very important as we will discuss later. All five of these African countries placed close to the bottom of HDI ranking in 2002; Table 1 below summarizes some data about their performance on the HDI measures. Comparing these five countries is relevant for the purpose of this study because these countries present exactly the same pattern with regards to ICT; they have the same policies, their ICT investments started at the same time and have attained the same level at the time of the study. Thus if any one of them happened to be best practice in the study, he would be a good example for the others. The two countries with the largest populations are the Ivory Coast and Cameroon with 16.4 and 17.1 millions respectively are demographically more similar that the rest. They have the highest literacy rate of the group, with Cameroon the highest at 75% and Ivory Coast at 59.8%. Both countries have fairly large urban populations, comprehensive universities and a very high level of enrollment in primary and secondary education. Senegal which has the fourth highest population also has a high urban population but a relatively lower literacy rate to Cameroon and the Ivory Coast. Senegal does however, have a comprehensive university, but it has lower levels of primary and secondary school enrollment than Cameroon and the Ivory Coast.

Countries	Population (Millions)	% Living in urban Area	Land area (Sq km)	Life Expectancy Years	GPD per Capita Constant U$	Literacy Rate %	HDI Score	HDI Ranking 1999
Benin	6.8	45.30	110620	52.96	393.3217	55.5	0.41	159
Cameroon	16.4	51.95	465400	47.99	653.0973	75.0	0.49	142
Ivory Coast	17.1	45.35	318000	45.11	596.7777	59.8	0.39	161
Niger	12.1	22.67	1266700	46.37	179.8453	25.6	0.29	174
Senegal	10.5	50.28	192530	52.31	503.7952	39.2	0.43	156

Table 1: Demographic Background of the countries

4.1 Data Analysis

The data for our study was drawn from the archives datasets of the UNDP and ITU. The data covers the period 1993-1999 inclusively. This period corresponds to the beginning of intensive investments in ICT in the early 1993, their climb to the highest levels in 1998 and 1999 for these five African countries. By one measure of analysis, the ratio of investment to income, produced as a percent of GDP, these investments seem to have been successful. In Figure 2 the reader will notice that for each year of our analysis each of these countries obtained higher levels income from ICT infrastructure than they invested as a percentage of GDP. The reader will also notice that Senegal consistently invested the highest each year and got the highest income from their ICT infrastructure than all the others. But how efficient are

these investments relative to the goal of improving social development (as measured by HDI)? This is the primary question of our investigation, as the basic argument given by proponents for increasing investments ICT, is that ICT is an engine for social and economic development. While there is no doubt that these countries got a monetary return, did they receive a concomitant return on social development as measured by the HDI?

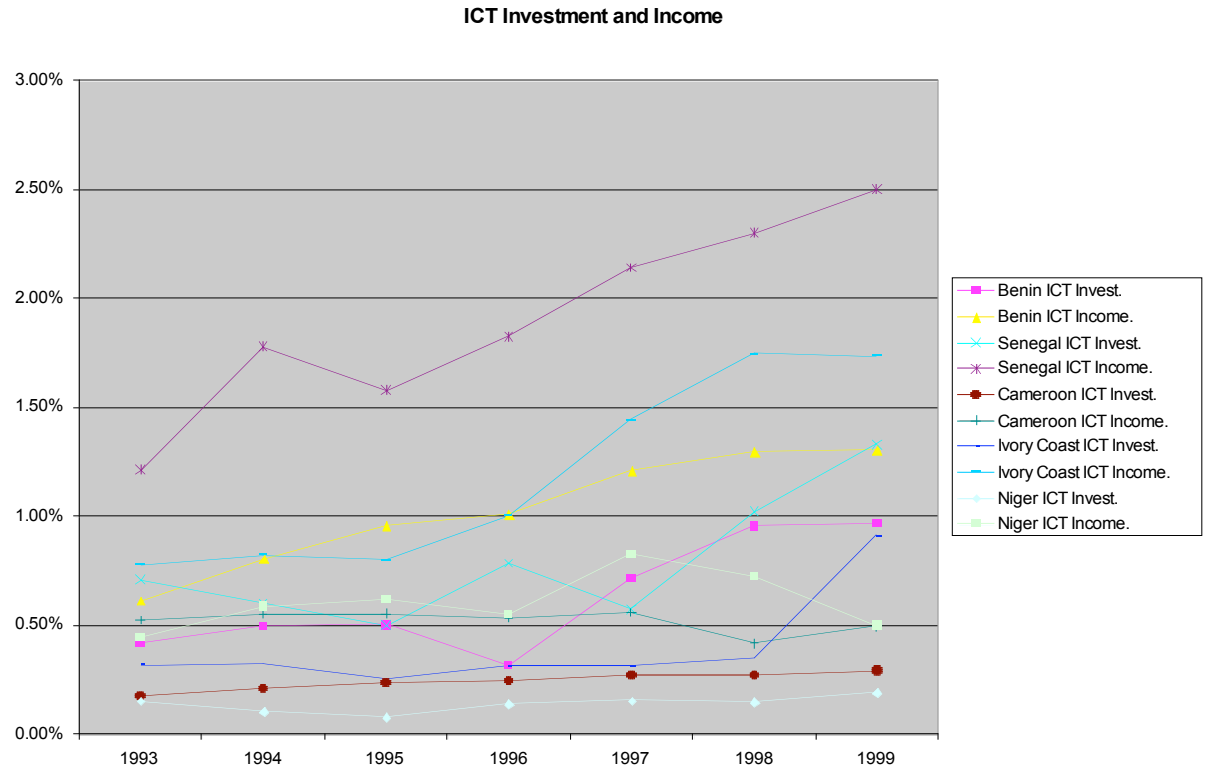

Figure 2: Investments in ICT and income from ICT as a percentage of GDP

4.1.1 Data Used In the DEA Analysis

For our analysis of how technically efficient these countries were in converting investments in ICT, Health and Education into HDI component scores we use two basic DEA models, constant returns to scale (CRS) and VRS. As stated in Section 3, the CRS model examines the DMUs on the efficient production frontier to determine what reductions can be made to their discretionary inputs while maintaining the same level of output. The reader will recall that variable returns to scale (VRS) model assumes one unit of input can result in output ranging from less than one unit to more than one unit. Thus the VRS can assist in determining if there is a potential for higher (or lower) levels of production efficiencies while holding the inputs constant. Our analysis of the data followed a two step procedure: (1) we first ran an input oriented CRS model on our data to determine which of the countries were operating at maximum efficiency. (2) We then ran an output oriented VRS model to determine if there might be other policies regimes that could help inefficient countries to achieve higher levels of efficiency. Further, we also included the efficient countries as a test to determine which if any were operating at MPSS.

The input variables for our DEA analysis were population, investment in health care, education, and ICT. The output variables were chosen to conform to those used by the Human Development Index. They are the components of the HDI, knowledge (which is composed of literacy rate, enrollments in primary, secondary and tertiary education), life expectancy, and level of national income (GDP per capita). In our analysis we treat the input variables, investments in education, health care, ICT as discretionary variables, and population as a non-discretionary input variable. The reader will recall that an aspect of DEA methodology is sensitive analysis of tradeoffs between input variables to ascertain better performance on the production possibility frontier. Holding the population variable as a non-discretionary means that no adjustments will be made to it during the analysis.

4.1.2 Discussion of the CRS Results

Table 2 summarizes the results of the analysis from the CRS model. The column CRS Score gives the efficiency rating for each country for the appropriate year. A 100% rating means that the country was operating at maximum efficiency with regard to the utilization of its inputs in the production of its outputs. The percentages listed under the specific investment columns are the level of utilization of those inputs. This means that these inputs could be cut (by 100- present utilization) and there will be no reduction in outputs. In CRS results reported in Table 2 below the reader will notice that Benin and Cameroon had a maximum efficiency rating for six of the eight years of our study. Benin had a maximum efficiency rating for 1993, 1994, 1996, 1997, and 1999, and Cameroon for 1993, 1995, 1996, 1997, 1998 and 1999. Based on our CRS analysis for these specified years both Benin and Cameroon operated on the efficient production frontier with no over investments (slack). However, in 1995 Benin could have made some input reductions and Cameroon could have done the same in 1994, and both would have suffered no reduction in output. The Ivory Coast was the second most efficient country with an efficiency rating between 91.6 and 100%, and operated at maximum efficiency for three years toward the end of our study period (1997, 1998, 1999). Based on out CRS analysis the Ivory Coast for 1993 we notice that this country's investments in ICT could have been cut by 9.78% (and its investments in education and health by 34.42 and 30.87% respectively) while maintaining the same output of the HDI measures. Appropriate input reductions could also have been made for 1994, 1995, and 1996 and the Ivory Coast could still have maintained its level of performance on the HDI measures.

Niger, the fifth country in our analysis consistently performed at close to maximum efficiency with CRS ratings between 91.64 and 98.31%. However, it could have benefited by reducing inputs appropriately each year and would have suffered no losses in output. This analysis also shows that Senegal was the least efficient country for the entire period, having CRS efficiency scores between 78.14 and 80.54%. In this regard Senegal could have cut inputs (by 100- utilization) and still maintain its levels of output with regard to the HDI measures. For example, if we examine the slack variables in the CRS analysis for Senegal for the year 1993 we will observe that their investments in ICT were only 20.64% efficient with regard to the outputs. This finding suggests that Senegal could have reduced investment in ICT by 79.36% while still maintaining its present performance on the HDI measures. Likewise, in 1993 Senegal could have cut its investment in education in by 43.76% and it investment in health care by 60.86% and still maintain its level of its HDI measures (knowledge, life expectancy, and GDP per capita). We are not suggesting that Senegal reduce spending on education or health care. What we are suggesting is that Senegal should examine policy options that could make their investments more effective.

Countries	Years	CRS Score	Percentage of Efficiency to current Output		
			Investment in ICT	Investment in Education	Investments in Health
BENIN	1993	100.00%			
SENEGAL	1993	79.56%	20.64%	56.24%	39.14%
CAMEROON	1993	100.00%			
IVORY COAST	1993	91.65%	90.22%	65.48%	69.13%
NIGER	1993	92.31%	87.00%	93.59%	50.17%
BENIN	1994	100.00%			
SENEGAL	1994	80.08%	25.53%	56.54%	38.61%
CAMEROON	1994	96.89%	91.08%	92.77%	88.17%
IVORY COAST	1994	90.61%	78.34%	72.00%	65.15%
NIGER	1994	98.24%	100.00%	100.00%	84.20%
BENIN	1995	95.75%	62.29%	100.00%	99.50%
SENEGAL	1995	80.54%	30.48%	56.49%	37.86%
CAMEROON	1995	100.00%			
IVORY COAST	1995	98.31%	100.00%	89.48%	95.30%
NIGER	1995	100.00%			
BENIN	1996	100.00%			
SENEGAL	1996	78.97%	19.26%	54.37%	37.11%
CAMEROON	1996	100.00%			
IVORY COAST	1996	98.01%	100.00%	95.46%	86.66%
NIGER	1996	92.54%	99.27%	88.22%	45.40%
BENIN	1997	100.00%			
SENEGAL	1997	79.74%	26.84%	52.55%	38.30%
CAMEROON	1997	100.00%			
IVORY COAST	1997	100.00%			
NIGER	1997	93.36%	94.91%	100.00%	45.35%
BENIN	1998	100.00%			
SENEGAL	1998	79.03%	16.10%	54.55%	40.61%
CAMEROON	1998	100.00%			
IVORY COAST	1998	100.00%			
NIGER	1998	95.46%	100.00%	100.00%	59.14%
BENIN	1999	100.00%			
SENEGAL	1999	78.14%	12.02%	55.38%	35.88%
CAMEROON	1999	100.00%			
IVORY COAST	1999	100.00%			
NIGER	1999	91.69%	100.00%	74.88%	50.35%

Table 2: Slacks and Factors of reduction on input variables

These results also raise some fundamental questions: Why does Senegal appear to be such a poor performer on these measures? And what can it do to achieve a higher level of performance? What is constraining Senegal from realizing a higher or equal level of performance, with regard to the HDI, to its peers? It is also important to note from Figure 3, that of all the countries Senegal has made the highest ICT investment as a percentage of GDP and obtained the highest income return (as % of GDP) from its

ICT investments for the entire period of 1993-1999. Therefore a decision to reduce inputs might not be palatable to the decision makers. Furthermore the objective is to improve social development, not maintain it at the current low levels as measured by the HDI. So an important question is, are there alternative courses of action that could help Senegal improve development as measured by HDI? For an answer we look to the VRS analysis. The reader will recall that the output oriented VRS model looks for alternate possibilities that could move productive efficiency closer to the efficient frontier.

4.1.3 Discussion of the VRS Results

The results from the VRS analysis are summarized in Table 3. The objective of this analysis was to determine if there were potential alternative development policy options that would move the inefficient countries closer to the efficient production frontier. However, we start our discussion by examining the VRS results for those countries that ranked very high (at or around 100%) on the CRS analysis. For example, a close examination of the VRS results for Benin shows that for the years 1993, 1994, 1996, 1997, 1998, 1999, no other possibilities for higher production efficiency existed for this country within there current ICT development strategy. Consequently, we could say that during these years Benin was operating at MPSS for their current development strategy. However, in 1995 it could have achieved some improvements each output variable by making appropriate changes in its ICT development policy. It is important to note that it is still possible however for Benin to move to still higher levels of productivity. Operating at MPSS does not preclude Benin becoming more efficient; however, achieving higher levels of productivity would entail significant in development policies and/or more efficient technologies. It is important to understand that efficiency/productivity is always constrained by existing productive capacity. Changes in technology, organization, management and human capital can have significant impacts on productivity. The question, what specific policy changes Benin should make requires more investigation that is beyond the scope of this paper.

Our analysis shows a similar pattern for Cameroon, the second most efficient country, operated on the efficient production frontier six of the eight years as determined by the CRS model, and seven of the eight years according to the VRS model. It is also interesting to note that in 1994 Cameroon operated at 96.89 % efficiency as determined by the CRS and 100% on the VRS. This means that although there was slack during that year there were no possibility to move Cameroon closer to the efficient production frontier given its prevailing development policy.

Insert Table 3 about Here

However, the VRS results suggest that there are alternative investment policies within the prevailing socio-economic conditions that could move the Ivory Coast, Senegal and Niger closer to the efficient production frontier for each year that these countries were below the efficient production frontier on the CRS analysis. Table 3 displays the potential improvements in the output variables (GDP per capita; enrollments in primary, secondary and tertiary education; literacy rate; and life expectancy). It also shows what inputs are underutilized in the production of the present output. Thus this information suggests that there are policy investment alternatives that could lead to higher levels of efficiencies and achieving higher HDI scores. To go through each row for each country would be tedious and repetitive. So we will use one example to illustrate how the findings can be interpreted. Let us now examine the 1993 row for the Niger. The reader will notice that alternative options could yield significant improvements (110.97% increase in per capita GDP; 112.08% increase in primary school enrollment; 110.37% increase in secondary school enrollments; 119.27% increase in tertiary education enrollments; 122.55% increase in the literacy rate, and 104% increase in life expectancy). For example the impact discovering and

implementing the appropriate alternative development policies for such improvements would mean that Niger would have achieved a per capita GDP of approximately U$362.8, a literacy rate of approximately 28.13, etc. Note that VRS analysis for the year 1993 shows there is still some investment in health care that is not contributing to the higher level efficiency under alternative policy options. An interested reader can now examine the potential for improvements in the HDI measures for Niger and Senegal.

5 SUGGESTIONS FOR FUTHER RESEARCH

Our analysis shows that investments in ICT are contributing to the social development of the countries. However, some of the countries could benefit from re-examining and reformulating their investments policies to achieve higher performance. For example Senegal, the highest investor in ICT as a percentage of GDP, is also the lowest performer. Our VRS analysis shows there are alternative policies that Senegal could pursue which would be more efficient. However, more research needs to be done to determine what exactly might those policies be? Since DEA analysis cannot identify the alternative policies, other research approaches are needed, such as field work and in-depth. A starting point this field research could be to examine the development policies of Benin and Cameroon, the countries identified as the most efficient in our studies. Benin and Cameroon represent benchmarks for best practices which can be studied, modified and adopted to the needs of Senegal. Such research could be promising as the countries share a common background legal and monetary system. Another approach could be empirical analysis with more advanced analytical techniques, such as multivariate adaptive regression splines. A data mining methodology that could help uncover what factors and conditions lead to highest level of improvements in social development as measured by HDI. More general questions that require attention are: What are the relevant precedents to ICT developments in developing economies? What is the relationship of level of education to technical efficiency of ICT? What is the relationship between investments in ICT, health and education and their impact on HDI?

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			Slacks					Factors of Possible Improvements				
Countries	Years	Score	Invest in ICT	Invest. In Education	Invest. In Healthcare	Population	GDP	Primary schools	Secondary schools	Tertiary schools	Literacy Rate	Life expectancy
enin	1993	100.00%										
enegal	1993	118.28%	0	14.44	1.43	0	107.40%	142.96%	128.27%	165.18%	119.87%	100.83%
ameroon	1993	100.00%										
ory Coast	1993	124.63%	0	10.29	0.35	0	101.19%	118.42%	121.64%	264.29%	116.15%	100.00%
iger	1993	108.81%	0	0	0.02	0	110.97%	112.08%	110.37%	119.27%	122.55%	104.00%
enin	1994	100.00%										
enegal	1994	119.03%	0	11.06	1.47	0	109.26%	139.34%	131.69%	173.63%	117.30%	100.00%
ameroon	1994	100.00%										
ory Coast	1994	113.51%	0	7.27	0.42	0	100.00%	120.53%	122.29%	144.93%	128.64%	105.19%
iger	1994	100.00%										
enin	1995	100.97%	0	0	0.01	0	101.10%	100.84%	100.60%	105.74%	100.10%	100.36%
enegal	1995	118.94%	0	11.14	1.52	0	107.67%	139.20%	134.04%	170.74%	118.76%	100.00%
ameroon	1995	100.00%										
ory Coast	1995	100.00%										
iger	1995	100.00%										
enin	1996	100.00%										
enegal	1996	119.45%	0	12.55	1.27	0	106.65%	136.14%	140.17%	169.82%	122.24%	100.00%
ameroon	1996	100.00%										
ory Coast	1996	106.56%	0	0.99	0.16	0	100.00%	105.55%	106.55%	140.28%	105.91%	100.72%
iger	1996	182.64%	0	0	0.19	0	184.13%	209.23%	261.70%	339.67%	237.56%	111.49%
enin	1997	100.00%										
enegal	1997	115.82%	0	16.28	1.48	0	105.24%	129.21%	144.71%	139.88%	123.35%	100.00%
ameroon	1997	100.00%										
ory Coast	1997	100.00%										
iger	1997	119.82%	0	0	0.01	0	124.85%	124.46%	137.91%	156.75%	131.65%	102.75%
enin	1998	100.00%										
enegal	1998	114.11%	0.28	13.53	1.03	0	103.73%	126.30%	152.98%	118.07%	125.94%	100.00%
ameroon	1998	100.00%										
ory Coast	1998	100.00%										
iger	1998	100.00%										
enin	1999	100.00%										
enegal	1999	116.85%	0.61	12.02	1.28	0	103.34%	129.07%	145.07%	149.03%	125.17%	100.00%
ameroon	1999	100.00%										
ory Coast	1999	100.00%										
iger	1999	215.16%	0	0	0.34	0	229.28%	234.18%	341.87%	426.31%	292.65%	112.13%

Table 3: VRS output oriented method showing the Slacks in the inputs and the possible output increase factors