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Review

Science and technology capacity in Africa: A new index

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In 2001, the RAND Corporation's Science and Technology Policy Institute created an Index of Science and Technology Capacity for the World Bank, which ranked 150 countries on their potential to innovate and collaborate with more scientifically advanced nations. At that time, the African nation that ranked highest on the list was Mauritius, at number 59, and of the bottom 20 countries, 14 were African. In the ensuing years, some African nations have posted their highest growth rates in several decades, and institutional change has begun to take its root in some parts of the continent. Have these changes had any effect on the scientific and technological capacity of African nations? This paper replicates the RAND Index to 2011 to answer this question, and suggests which African nations might be best poised to move forward technologically in coming decades.

Key words: Science and technology capacity, development, Africa.

INTRODUCTION

What drives growth and development? In search of an answer to this question, researchers have explored macroeconomic and institutional factors in depth since the early 20th century to try to identify the keys to sustained economic growth. In recent years, both researchers and policymakers have turned increasing attention to a third factor that may play a role in development, which is the science and technology capacity of countries. Science and technology (S&T) capacity has been shown to be closely linked to variations among countries in productivity. Countries with a larger S&T capacity generally tend to be the most prosperous and most industrialized. They also tend to be more politically stable, often with functioning democratic systems; and they provide high-quality employment for their best talent, which helps to stem the brain drain and bolster the country's human capital. Clearly, S&T capacity

has a role to play in the development process of the world's lagging and emerging economies, and in maintaining technological competitiveness in the most developed ones.

What constitutes S&T capacity, and how can different countries be compared? One effort to answer this question is the S&T index developed by the RAND Corporation for the World Bank in 2001, in the context of a study on collaborative research. This index ranked most countries in the world according to their S&T capacity, into scientifically advanced countries, scientifically proficient countries, scientifically developing countries and scientifically lagging countries. The 22 countries which they identified as scientifically advanced accounted at that time for 90-95% of all research and development (R&D) spending in the world, or some \$450bn per year (Wagner et al., 2001).

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In the interim since this index was published, the process of globalization has intensified, a group of emerging economies have experienced unprecedentedly high Gross Domestic Product (GDP) growth rates, and the developed countries have suffered their worst economic crisis since the 1930s. Have these events changed the ranking of countries in the world by S&T capacity? Has very fast growth in some emerging economies helped them to narrow the gap with developed countries? Most importantly, are there signs among the poorest nations, particularly in Africa, of an emerging S&T capacity that will underpin their development processes? This report attempts to answer these questions.

The outline of the paper will be as follows. First, the original S&T index developed by RAND Science and Technology for the World Bank (Wagner et al., 2001) will be described and critiqued. Second, an updated version of their index with 2011 data will be presented in two versions: one with the same variables, and one that adjusts the original variable for country size. Finally, the new rankings, in which many emerging nations and some African countries move up, will be discussed, and a leading indicator will be proposed to help identify the nations that are poised to advance in S&T capacity in coming years. While African nations are still far behind and most remain near the bottom of the list, countries like Morocco, Algeria, Nigeria, Botswana, Mozambique, Ethiopia, Sudan and Libya had advanced in the ranking by 2011. This may give some clues as to which nations on the continent could develop most quickly and take larger economic strides in the decade to come.

SCIENCE AND TECHNOLOGY AND DEVELOPMENT

Development economists for years have sought to identify the specific factors that drive sustained economic growth. Early researchers proposed that growth was a function of capital and labor inputs (Harrod-Domar model from Harrod, 1939 and Domar, 1946). The discovery of the “residual” in growth accounting in the 1950s pointed up the fact that measures of conventional inputs such as capital and labor failed to fully explain observed outputs such as GDP. Economists embraced the explanation that progress came not only from improvements in the quality and quantity of labor and capital, but also from unmeasured sources of efficiency and technical change, which in turn proceeded from formal and informal R&D spending and the unmeasured contributions of science and other spillovers (Griliches, 1994). In most recent years, research has turned to the role of institutions and governance in promoting economic development, specifically whether those institutions facilitate and encourage factor accumulation, innovation and the efficient allocation of resources (Acemoglu et al., 2004).

Interest in the role of science and technology capability in development has intensified in recent years.

Successive researchers have identified and quantified the links between S&T inputs and economic outcomes for advanced economies, beginning with the groundbreaking work of Solow (1956) for the U.S. economy, and in later work by Comin (2004), Denison (1979) and Griliches (1973), who estimated the contribution of R&D to productivity growth in the United States.

In developing countries, evidence of the link has been more elusive. One study on South Korea (Yuhn and Kwon, 2000) found that technological progress accounted for only 7% of the real output growth in the country’s manufacturing sector over 1962-1981, which was similar to findings for Japan and Singapore. One reason for the differences could be that returns to S&T are largely dependent on the country’s already existing S&T capacity, so that countries starting out along the path to higher technological capabilities may at first reap little visible fruit from their efforts.

Even though empirical evidence of the link is only partial, development economists generally accept that greater S&T capacity is one of the building blocks that puts poorer countries on the path to development; and amassing knowledge and social/organizational capital in developing countries is a way for them to fully participate in and “own” the process of transformation implied in development and eventually have a greater international voice (Stiglitz, 1998). As a reflection of this consensus, the World Summit for Sustainable Development in Johannesburg in 2002 centered on the role of science and technology in driving more successful and more sustainable development paths.

THE RAND S&T INDEX

In this spirit, the different S&T capabilities of countries around the world have become an important indicator, both as a predictor and as a reflection of their levels of development. Yet many facets of these capabilities are unobservable. Much of the human capital involved in S&T activities exists at an individual level, and only manifests itself when the human capital interacts with the institutional environment and scientific infrastructure. And the capacities implicit in the country’s S&T infrastructure are built up gradually over time, so that they cannot be entirely captured by annual data.

Various indicators have been developed to attempt to quantify S&T capacity across countries, such as the OECD’s Science, Technology and Industry Scoreboard or the European Innovation Scoreboard. Many of these cover only developed countries. RAND Science and Technology, in a 2001 report for the World Bank, built a broad composite indicator that could reflect the most relevant observable features of S&T infrastructure and output for most countries in the world. This index selected seven components for which national-level data were available for most countries for 2001 or an immediately

preceding year. The variables were the following:

1. Gross National Product (GNP) per capita, which is a proxy for the country's general economic infrastructure;
2. The number of universities and research institutions in the nation, per million people, as a representation of S&T infrastructure;
3. Number of scientists and engineers per million people, to reflect the human resources that are potentially available to become engaged in S&T activities;
4. The number of students studying in the United States, adjusted for those who decided not to return home when their studies were over, again to capture human resource potential for S&T;
5. The proportion of GNP spent on R&D, as a representation of the financial resources that the economy is devoting to S&T activities;
6. The number of academic S&T journal articles published by citizens of the nation;
7. The number of patents registered by citizens of the nation with the U.S. Patent and Trademark Office (USPTO) and the European Patent Office (EPO) (see Griliches (1998) for a survey of the literature on the usefulness of patent statistics as economic indicators).

A quick glance at the list reveals that the first two were selected to give a picture of the infrastructure backdrop against which S&T activities could take place; the next three show the human and financial resources available to carry out those activities; and the last two reflect the measurable or observable S&T outputs. The most developed countries could be expected to show good results on all seven indicators. In contrast, countries that are earlier along in the process of developing an S&T capability might be expected to make a good showing on the first two (income and research institutions) and then proceed to the next three (students studying in the United States, scientists and engineers and R&D spending) before beginning to show results on the last two (patents and academic publications).

To combine these very different components into a single index, the World Bank/RAND team standardized the numbers to show national performance. The value of each national characteristic was compared to the international average, and "performance" was ranked based on the number of standard deviations of the national value away from the international mean. Hence above-average numbers produced a positive contribution to the index and below-average numbers made a negative contribution. The indicators were then weighted as follows:

1. one point each for infrastructural and human resource factors –GDP per capita, number of university and research institutions and students studying in the United States—as well as for patents;
2. two points for the primary output, which the RAND

team considered to be S&T journal articles;

3. Three points for indicators of capacity to conduct S&T: R&D spending as a per cent of GNP and the number of scientists and engineers per million population.

The weighted sum of the standardized values yielded an index that ranked 150 countries in the world into four categories:

1. Scientifically advanced countries (a total of 22), which evidenced scientific capacity well above the international mean;
2. Scientifically proficient countries (24 countries), which had positive standing in scientific capacity compared to the rest of the world (with a final score greater than 0);
3. Scientifically developing countries (24) which were below the international mean even though they had some features of S&T capacity; and
4. Scientifically lagging countries (80) which either had very poor S&T indicators or insufficient data to make comparisons on these components with the rest of the world.

The original country ranking is presented in the Appendix (Table A1) and included few surprises. The leading countries were the United States, Japan, and Germany, and all countries in the top group (scientifically advanced) were developed economies except for the Russian Federation. In the second group of scientifically proficient countries were the rest of the world's developed economies plus some emerging nations such as various East European economies, China, India, Brazil, South Africa and (surprisingly) Cuba. For the third and fourth groups, the composite score was less than zero and the ranking passed through middle-income East European and Latin American states and Turkey to end with some of the world's poorest nations at the bottom: Cambodia, Myanmar, Mozambique, North Korea, Laos, Chad and Eritrea. For only the African nations that were included in this original RAND index, South Africa was at the top, followed by Mauritius, Benin, Egypt, Uganda, Togo and Tunisia. Mozambique, Chad and Eritrea were at the bottom.

Since 2001, the world has undergone many transformations. Not only have emerging nations—some of them African—shown some of the world's highest economic growth rates, but many of these same nations were left relatively unscathed by the financial crisis that began in mid-2007 and which is still dampening spending and output in some of the richest developed countries. At the same time, globalization has continued apace, stimulating S&T investments and cross-border scientific linkages while making travel, communication and the exchange of information less expensive. All of these changes have potential spillovers to the S&T capability of lagging countries.

The time seemed ripe, therefore, to broaden and

update RAND's 2001 S&T Index to provide a window on the process of evolving S&T capabilities in developing countries, especially the ones in Africa that were near the bottom of the previous list. The exercise would make it possible not only to identify success stories but also to point out potential future performers where investments in higher-value-added sectors could become more attractive and/or the pace of development might be expected to quicken.

In order to do this, the original RAND index was replicated with the latest available data in 2011, broadening it to include more countries for which data were now available. The same methodology was followed: the numbers were standardized, the value of each national characteristic was compared to the international average, and "performance" was ranked based on the number of standard deviations away from the international mean. Above-average numbers produced a positive contribution to the index and below-average numbers made a negative contribution. The indicators were weighted in the same way. Hence the first index presented here takes exactly the same form as the RAND index of 2001, but with 63 new countries added for a total of 213 (compared to 150 in the original index). Many of the new countries were either very small island nations (Vanuatu, Turks and Caicos, Virgin Islands) or were relatively new countries (Uzbekistan). However, some were African nations that were omitted from the 2001 report (e.g., Zimbabwe, Liberia, Equatorial Guinea), presumably for lack of data. Eight new African countries were added to the index. Tables 1 and 2 below present descriptive data on the variables used in the index for 2011, and the 2011 ranking of African countries is given in the Appendix (Table A2).

The most remarkable results of the new index were that some emerging countries advanced strongly and joined the developed nations at the top of the list. The most notable of these were China, which climbed from 38th in the old index to third in the new one; and India, which rose from 44th to 12th. What propelled China forward was a dramatic increase in articles in science and technology journals, a key output; and strong rises in the number of scientists and engineers as well as patents and students studying in the United States. India also showed a sharp increase in patents, with improvement across all indicators. Four other important moves upward in the rankings were for Turkey, which rose from 53rd to 19th; Brazil, from 39th to 16th; Spain, from 25th to 10th; and Italy, from 17th to ninth. For Spain the driving factor was the number of academic publications; for Turkey it was a dramatic increase in patents. Italy boosted R&D spending and universities per capita, but it dropped off in number of patents; while Brazil rose in R&D spending and number of scientists and engineers. Some of the developed countries that dropped significantly in the ranking were Canada (from 4th to 8th), Sweden (from 5th to 15th),

Switzerland (from 8th to 17th) and Finland, Denmark and Norway.

On the African continent, the leader of the 53 countries included in the new index was South Africa, the same as in 2001. However, the other positions showed considerable change and some of the top countries showed impressive gains. Morocco and Algeria showed the most progress, advancing from 116th to 62nd in the world, in the case of Morocco, and from 123rd to 68th, in the case of Algeria. In sub-Saharan Africa, Nigeria moved forward to 77th from 104th, and Botswana, Mozambique, Ethiopia and Sudan also improved. In contrast, African leader Mauritius declined in the 2011 index, from 58th to 79th; as did Benin, Uganda, Libya, Togo, Congo and others. The ranking of African nations can be consulted in the Appendix (Table A4). It should be noted that for some indicators, many African countries show no data. Following RAND researchers it is assumed that this data vacuum reflects very low levels, whose values are 0.

What indicators are holding sub-Saharan Africa behind, according to this version of the index? The widest differences, as could be expected, are in those indicators that reflect science and technology output. In the number of scientific and technical articles published in academic journals, every African nation was below the sample average, with Tunisia, South Africa, the Seychelles and Botswana as the best performers on the continent. In patents, only Seychelles was above the world average, with other nations lagging seriously behind. The human resource indicators also were substantially lower than for the rest of the world. In number of scientists and engineers per million, every African nation was below the global average except for Tunisia; and in university students studying in the United States, all were below the average except for Libya, where median incomes were relatively high. For indicators reflecting the basic infrastructure for science and technology, some differences were also large: in GDP per capita, only two countries (oil producers Equatorial Guinea and Libya) had incomes above the global average.

Research and development spending, an indicator reflecting the financial resources for S&T activities is the one where Africa does best compared to the rest of the world. South Africa, Tunisia, Benin, Morocco, Togo and the Democratic Republic of the Congo all have figures that are above the average for the sample of the 213 countries, and Botswana, Sudan, Mauritius and Uganda are not far behind. This might show in part that development funds have been made available for R&D spending in some of these countries. In number of universities and research institutions per million inhabitants, which reflects human resource potential, the continent also shows some good figures: Mauritius, Guinea-Bissau, Gabon, South Africa and Botswana all have numbers that are above average.

However, the original RAND index included a number of indicators that were susceptible to country size, and therefore "discriminated" against smaller countries. Those indicators are the main output indicators: number of science and technology indicators published in academic

Table 1. Descriptive statistics for variables in 2011 S&T index, 213 countries.

	GNP per capita	No of Scientists and engineers per million	S&T journal articles per million	Expenditures for R&D (% of GNP)	Institutions and universities per million population	Patents (USPTO and EPO) per million	Adjusted metric for students studying in USA per million
Minimum	136	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	84,640	7,382	1,188.7	4.6	91.8	18,573.7	3,166.4
Average	11,326	811.8	124.8	0.4	3.0	203.9	231.7
Std dev.	15,483	1,489.2	248.1	0.8	8.9	1,453.6	389.7

^aAll from World Bank except adjusted metric for students studying in United States (U.S. State Department).

Table 2. Descriptive statistics for variables in 2011 S&T index, African countries only (53 countries).

	GNP per capita	No of Scientists and engineers per million	S&T journal articles per million	Expenditures for R&D (% of GNP)	Institutions and universities per million population	Patents (USPTO and EPO) per million	Adjusted metric for students studying in USA per million
Minimum	136	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	12,420	1,587.0	72.6	0.9	7.5	352.4	243.8
Average	2125	103.7	7.5	0.2	1.0	7.7	40.2
Std dev.	2,886	253.7	14.1	0.2	1.7	48.4	50.4

^aAll from World Bank except adjusted metric for students studying in United States (U.S. State Department).

journals, and number of registered patents. Both could be expected to be smaller in countries with smaller populations, all other things remaining equal. Additionally, the number of students from any given country studying in the United States is likely to be lower in countries with small populations. To adjust for these differences, the same methodology as outlined above is used, but these three indicators were divided by country population to adapt human resources and output better to the size of the country. They then entered the index with the same weights as in the RAND 2011 index.

Unsurprisingly, this adjustment boosts in the global index some countries with smaller populations, such as Finland, Sweden, Israel, Iceland, Denmark and Canada (these become the top six countries, just ahead of the United States). At the same time, it pushes down countries with large populations like Japan and Germany, but especially China and India, which drop back down to 44th and 80th, respectively.

For African countries, the new weighting actually meant declines on the global ranking for most countries. Because of their large populations, South Africa, Morocco, Egypt, Algeria and especially Nigeria all moved downward. Tunisia moved up, as did little Mauritius (from 79th to 75th) and tiny Seychelles (from 98th to 87th). Gabon and Libya moved up but remained below the average. The countries lagging the furthest behind were the same as in the first index: Mauritania, Tanzania, Niger, Sierra Leone, Liberia, Comoros, Eritrea, Chad and Somalia. Hence the need for this correction is not an explanation for the poor S&T performance of Africa; in fact, it makes

the picture worse. The ranking for the 53 African countries on this adjusted index is shown in Table A3 in the Appendix.

Following a ranking exercise like this one, an obvious question that arises is which countries are best poised to move forward in the next decade, as some have done since 2001. In order to do this, one or several indicators must be identified that capture the process during which countries prepare themselves for better science and technology capabilities, whose results may be seen in coming years first in human and financial resources and later in S&T “outputs”, like scientific articles or patents. Of the available indicators, the one that seemed most like a “leading” indicator—one that could predict where S&T capability could go in the future—and which offered the most complete and comparable data was the gross enrollment rate in tertiary education (as a per cent of all students in the university age bracket)¹.

¹ I had originally intended to add another variable to this final index, which was public expenditure per student in tertiary education, expressed as a percentage of GDP per capita. However, the data from UNESCO, which includes government spending on educational institutions and administration, whether they are public or private, and any subsidies to private education, showed figures that were well above the average for developed countries. In fact, the top 10 countries in spending per student/GDP were African: Lesotho, Eritrea, Ethiopia, Mozambique, Burundi, Niger, Swaziland, Botswana, Burkina Faso and the Central African Republic. There is potential bias in the indicator, since countries with a tiny university population might spend their entire budget on a few students, giving a large per-capita figure; and a very low GDP would tend to boost the ratio (spending per student/GDP) in small, poor countries. However, the figures were such dramatic outliers that I decided not to use the indicator at this time, until I could determine what produced such high values.

Tertiary education in poorer countries has recently come back into the limelight as an important indicator of economic development, as well as S&T capacity. Higher education has taken on increasing importance as a driver of growth and technological capability as primary education has advanced, and cases like Japan, Finland, Sweden, Korea, Taiwan and Korea manifest how efforts to raise higher educational standards can deliver high benefits in terms of capacity for technological innovation (López-Claros and Mata, 2010). The World Bank, after years of emphasizing the key role of primary and secondary education in poverty reduction, published *Knowledge in Development* in 1998 to demonstrate how developing countries could use knowledge to narrow their income gap with high-income countries (World Bank, 1998). Many experts on Africa now acknowledge the key role played by higher education in development, as an “essential complement to educational efforts at other levels as well as to national initiatives to boost innovation and performance across economic sectors” (Bloom et al., 2006). Among other benefits, higher education yields a capacity to understand and use global knowledge in science and technology, for application to agriculture and to other sectors. Bloom et al. found that investment in higher education could accelerate the rate of technology catch-up in Africa and boost per-capita incomes.

The data used is not a completion rate, and it excludes the very capable students who might be studying in the United States or in another developed country. However, it does reflect the human resources that could potentially become available for future science and technology activities in a country. Although enrollment rates in tertiary education are the lowest in the world in Africa – the African average is 7.1%, compared to 25.1% for the world –, there is one country that stands above the global average, which is Libya. Others that are at the top of the African ranking and well above the African average enrollment rate are Tunisia, Egypt, Algeria, Mauritius, Morocco and Cape Verde. These countries are already at the top of the S&T index, so their figures on college enrollments are unsurprising. Botswana, Gabon and Senegal are also relatively high on both African rankings.

However, there is a small group of sub-Saharan African nations that show above-average enrollment rates in tertiary education and which are still lagging in science and technology capability. These countries are Liberia (17%), Nigeria (10%), Guinea and Namibia (around 9%), Cote d’Ivoire (8.4%) and Cameroon (7.8%). If higher education is indeed a key determinant of future S&T capacity, these nations could advance in an S&T index for the continent in coming years. See Table A4 in the Appendix for a full ranking of African countries by tertiary enrollment.

This exercise in updating and adjusting an index launched by RAND in 2001 offers some insights into the readiness of African countries to move into a more advanced stage of development and join a higher value-

added global economy. A few African countries show signs of moving upward in science and technology capabilities, in particular South Africa, Egypt, Tunisia, Morocco, Algeria, Nigeria and Mauritius. Within sub-Saharan Africa, the countries with the greatest promise besides South Africa and Nigeria appear to be Benin, Botswana, Uganda, Mozambique, Ethiopia and Sudan. The countries that today are ranked rather low but that show some promise for joining them in the future, judging by their current participation in higher education, are Liberia, Guinea, Namibia, Cote d’Ivoire and Cameroon.

CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

Any index, no matter how comprehensive, provides only a static picture of a single moment in time; and it relies for its accuracy on the quality of the underlying data. This index is no exception. The countries with poor or missing data are left at the bottom of the index, which might not be a fair reflection of their true capabilities.

This exercise also leaves out of the picture all of the dynamic external factors that could influence the context in which S&T capability can flourish. A nation’s S&T capacity, or in a broader sense, a national system of innovation, is deeply influenced by a country’s institutional features (Lundvall et al., 2002). One of the key factors in fostering these systems of innovation is political stability (Allard et al., 2012). When this political stability is either interrupted or restored, the framework for science and technology capabilities is fundamentally altered, and will heavily influence the course of its future. In this sense, the spread of political unrest in recent months in some African countries could mean that their evolving S&T potential could be cut short, to recover in better political circumstances at a later date. Particularly at risk could be countries like Liberia, Cote d’Ivoire, Sudan, Egypt and Tunisia, which are revealing a nascent S&T capability that relies on a politically stable environment in order to flourish. Tracking the dynamics of manifest science and technology capabilities as the political context changes would give important insights into the nature of this relationship, and would provide guidance to policymakers interested in their countries’ development potential.

As the new S&T index shows, some countries experiencing fast economic growth can advance quickly in the ranking of nations, if the benefits of that growth are invested in human and technical resources. If Africa in fact registers some of the fastest growth rates on the globe in coming years, the foundations for its future S&T success could be laid quickly, and an updated index in another decade could give a radically different picture of the continent. More importantly, as African countries advance in S&T capability, their chances of orienting their economies toward sustained and sustainable growth are

greatly enhanced. Hence this becomes a key indicator for the future.

Conflict of Interests

The author has not declared any conflict of interests.

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APPENDIX A. Items in Scales.

Table A1. Original RAND index 2001, Africa only.

Country	2001 rank	Rank in world 2001
South Africa	1	43
Mauritius	2	58
Benin	3	60
Egypt, Arab Rep.	4	65
Uganda	5	70
Togo	6	74
Tunisia	7	77
Gabon	8	80
Burundi	9	85
Cape Verde	10	86
Congo, Dem. Rep.	11	87
Central African Republic	12	91
Burkina Faso	13	96
Guinea	14	97
Madagascar	15	98
Guinea-Bissau	16	99
Botswana	17	101
Nigeria	18	104
Libya	19	105
Kenya	20	107
Zimbabwe	21	110
Namibia	22	111
Senegal	23	112
Rwanda	24	115
Morocco	25	116
Ghana	26	119
Zambia	27	120
Malawi	28	121
Algeria	28	123
Tanzania	30	124
Cote d'Ivoire	31	126
Cameroon	32	127
Lesotho	33	129
Gambia, The	34	131
Congo, Rep.	35	133
Ethiopia	36	134
Mali	37	135
Mauritania	38	136
Angola	39	137
Sudan	40	138
Sierra Leone	41	140
Niger	42	141
Mozambique	43	144
Chad	44	147
Eritrea	45	148

Table A2. 2011 S&T index for African nations only.

Country	Rank in Africa	Rank in World 2011
South Africa	1	37
Egypt, Arab Rep.	2	42
Tunisia	3	51
Morocco	4	62
Algeria	5	68
Nigeria	6	77
Mauritius	7	79
Benin	8	80
Botswana	9	89
Uganda	10	93
Seychelles	11	98
Kenya	12	99
Mozambique	13	102
Togo	14	103
Ethiopia	15	109
Congo, Dem. Rep.	16	112
Sudan	17	113
Senegal	18	115
Gabon	19	119
Cameroon	20	122
Madagascar	21	123
Burkina Faso	22	126
Burundi	23	128
Ghana	24	134
Tanzania	25	135
Libya	26	137
Zimbabwe	27	140
Central African Republic	28	141
Guinea-Bissau	29	143
Equatorial Guinea	30	147
Malawi	31	152
Zambia	32	153
Guinea	33	154
Cote d'Ivoire	34	160
Namibia	35	161
Cape Verde	36	167
Congo, Rep.	37	169
Lesotho	38	173
Mali	39	175
Angola	40	180
Rwanda	41	182
Gambia, The	42	183
Niger	43	185
Swaziland	44	189
Mayotte	45	194
Mauritania	46	200
Sierra Leone	47	204
Eritrea	48	207
Sao Tome and Principe	49	208
Comoros	50	210
Chad	51	211
Liberia	52	212
Somalia	53	213

Table A3. 2011 Adjusted S&T index for African nations only.

Country	2011 rank	2001 rank
Tunisia	1	7
South Africa	2	1
Morocco	3	20
Mauritius	4	2
Benin	5	3
Seychelles	6	
Botswana	7	
Egypt, Arab Rep.	8	4
Togo	9	6
Mozambique	10	41
Gabon	11	8
Congo, Dem. Rep.	12	10
Algeria	13	24
Sudan	14	37
Libya	15	17
Uganda	16	5
Senegal	17	23
Burundi	18	9
Equatorial Guinea	19	
Burkina Faso	20	12
Central African Republic	21	11
Madagascar	22	14
Guinea-Bissau	23	15
Ethiopia	24	
Gambia, The	25	33
Guinea	26	13
Cape Verde	27	
Namibia	28	21
Nigeria	29	18
Zimbabwe	30	19
Zambia	31	30
Lesotho	32	34
Congo, Rep.	33	32
Cameroon	34	25
Ghana	35	27
Cote d'Ivoire	36	26
Angola	37	31
Swaziland	38	
Kenya	39	16
Malawi	40	28
Mali	41	35
Rwanda	42	22
Sao Tome and Principe	43	
Mauritania	44	36
Mayotte	45	
Tanzania	46	29
Niger	47	42
Sierra Leone	48	43
Liberia	49	
Comoros	50	
Eritrea	51	40
Chad	52	39
Somalia	53	

^a For the 2001 ranking given in this table, I made the same adjustments to the original 2001 RAND data and re-ranked the countries.

Table A4: Ranking of African countries by gross enrollment rate in tertiary education

Country	School enrollment, tertiary (% gross)
Libya	55.74
Tunisia	33.70
Algeria	24.02
Liberia	17.39
Mauritius	16.04
Morocco	12.29
Cape Verde	11.91
Nigeria	10.07
Guinea	9.22
Namibia	8.94
Cote d'Ivoire	8.37
Senegal	8.00
Cameroon	7.82
Botswana	7.58
Gabon	7.06
Ghana	6.20
Sudan	5.93
Benin	5.85
Mali	5.44
Togo	5.29
Congo, Dem. Rep.	5.05
Swaziland	4.39
Sao Tome and Principe	4.14
Kenya	4.05
Rwanda	3.97
Mauritania	3.83
Zimbabwe	3.80
Uganda	3.69
Lesotho	3.63
Ethiopia	3.60
Madagascar	3.40
Equatorial Guinea	3.26
Burkina Faso	3.06
Guinea-Bissau	2.85
Angola	2.79
Comoros	2.70
Burundi	2.52
Zambia	2.40
Central African Republic	2.29
Sierra Leone	2.05
Eritrea	1.96
Chad	1.92
Tanzania	1.48
Mozambique	1.45
Congo, Rep.	1.37
Niger	1.33
Gambia, The	1.23
Malawi	0.49
South Africa	0.00
Seychelles	0.00
Mayotte	0.00
Somalia	0.00

a Source: World Bank.

Review

The (Un)identical twins: Public administration and public management toward improving education and training for effective governance in Ghana

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There are some disagreements between academics and practitioners on how to improve the performance of government officials in Ghana. While academics advocate for reforms in governance through education and training, practitioners may have differing interests and expectations. Such impasse has contributed to the lack of a unified framework of concepts in nation building. Core concepts for training public managers for good governance have fragmented within public administration, public policy, and public management. However, there is hope that pre-service and in-service training and education may provide opportunities to implement reforms through human development. There should be a closer dialogue among all schools of thought based on a generally agreed paradigm for effective governance through education and training. This article looks at education and training of public officials through the lens of the Ghana Institute of Management and Public Administration (GIMPA). It uses meta-analysis to examine the similarities and differences between public administration and management.

Key words: Public administration, new public management, traditional administration, training, and education.

INTRODUCTION

The management of public affairs by public administrators is a rather complex activity, which entails the balancing of various and sometimes contradictory objectives. These training and education objectives are necessary for the understanding and implementation of public policies. Education and training for public administrators are essential for development in African countries, including Ghana (Okereke, 1985; Jacobs, 1990). One must understand and accept the role and goals of government in both the public and private sectors before such

education and training can be administratively effective and productive. Effectiveness is defined in this paper as government's ability to maximize available resources for the benefit of its citizens, while productivity is the outcome of effective management.

As a unitary administrative country, Ghana more or less practices a centralized administrative system despite the constitutional support for administrative decentralization. The challenges faced by Ghana are due to the negative implications of ineffective governance and the

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“widespread recognition that *Ghana* suffers from a lack of management *and administrative* capacities, and that this scarcity of indigenous talent is a major, if not the major, constraint in stimulating national development” (Kerrigan and Luke, 1989: 904). The historical development and role of public administration education and training in improving managerial and administrative competence in Ghana are discussed in the following sections. This paper utilizes the meta-analysis methodological approach to draw conclusions.

Historical development of public administration education and training in Ghana

In a review of public administration education and training, it became evident that there was no single system that is recognized as a model. As a result, there are various approaches to public administration education and training. These variations may be based on national size, interest of tertiary institutions, and diversity. The type of political system, structures, and the role of the central government are also a key point in understanding a country's approaches to public administration education and training. As the literature shows, there are many different ways for one to become a public administrator or manager with the exception of France, where one has to attend and graduate from the *Ecole Nationale d'Administration* (ENA) to become a public administrator. The same cannot be said about other countries, including Ghana or the United States (Kolishnichenko, 2006). Formal training and education have been the essential components in the attainment of knowledge, skills, abilities, and competencies for various careers for quite some time – for instance, “[t]he apprenticeship method was the accepted procedure for training craftsmen during the era of guild development in industry” (Wingo, 1937: 84). It was not until the early 20th century that formal, institutionalized public administration education and training became a reality. In Ghana, public administration education and training were first seen during the colonial era. It was continued after the country attained its political independence in 1957 (Haruna and Kannae, 2013: Adu, 1965: Haruna, 2004). In terms of governance, Ghana has a checkered local government history and experience. Ayee (2004) noted that before political independence, Ghana did pursue local government policies. This local government experience was deeply rooted in “national bureaucratic framework that tends to hurt rather than promote the transformation of local and rural life,” (Haruna and Kannae, 2013b: 140), hence the need for education and training to improve not only local governance, but also the national government.

In the early 20th century the need for trained public administrators and formalized public administration education and training grew rapidly. This was due to the increase in population, the size and functions of

government, the replacement of the spoils system with a professional civil service (Schachter, 2007), and the increasing complexity of national affairs; the need for government to “widen its activities continually to take up new kinds of work, particularly in the social and scientific fields,” and the establishment of new positions “requiring not only technical skill but *real executive ability*” (Wingo, 1937: 84). Supporting Wingo's argument, though dated but still relevant, Haruna (2004: 176) also noted that the establishment of institutions in Ghana, a new independent country-post colonial Gold Coast, in the early 1960s “contributed to reinforce the bureaucratic perspective of administrative education, training,” and managerial skills. He argues that public administration institutions in Africa were modeled after the colonial occupiers: The British, French, Portuguese and others. For example, Haruna maintains that GIMPA, a public administration institution in Ghana, reflects the Royal Institute of Public Administration in England.

The central administration strategy associated with public administration and management of public affairs in Ghana was evident in the British colonial administration, the post independent civilian administrations of Kwame Nkrumah (1957-1966), Kofi Abrefa Busia (1969-1972), and Hilla Liman (1979-1981) including the 1966, 1972, 1979, and 1981 military administrations. Since the genesis of the Fourth Republic of Ghana (from 1992) and the 1992 Constitution, much emphasis has been placed on local government administration and reforms for effective governance. While the 1992 Constitution clearly supports local government and decentralization, one could argue that not much training and education are given to local government personnel to specifically address the needs of the citizens. This is, in part, due to the centralized governance structures where the central government continues to appoint public administrators for the regions and districts.

These appointments are based on political affiliations (the spoils system) and not solely on the appointees' professional training and educational background. As Ayee (2002: 174) noted, “the president appoints almost every one to practically every key government institution at the national, regional, and local level.” Governance at the local level is different. Education and training in public administration should provide adequate preparation for public management, as they create awareness of the political process for government officials. Unfortunately, one could argue, some government appointees lack the required training to function as expected, since most of the appointees by the government are rejected at the district level.ⁱⁱ Although some institutions of higher learning provide public administration education and training in Ghana, it is the University of Ghana's -School of Business (UGSB) and GIMPA that are known for their quality education and training for administrators, public service personnel, and politicians. A critical examination of GIMPA's curriculum by Haruna and Kannae (2013)

revealed the institution's full commitment in the education and training of future public administrators and managers in Ghana.

Education and training for public administrators and managers in Ghana

As Haruna and Kannae (2013: 502) noted, GIMPA uses a semi-residential modular education and training format, which allows "public managers to combine work with study in a manner that minimizes the losses in man-hours while maximizing education and training." GIMPA, in providing a theoretical-based education in all its programs, places pragmatic emphasis on professional effectiveness. In addition to UGSB and GIMPA, other universities and institutions, such as the Management Development and Productivity Institute (MDPI) and the Civil Service Training Center (CSTC), also provide public administration education and training "for top, middle, and junior level civil service employees" (Haruna, 2004: 178). GIMPA, established in 1961, is undeniably the only institution in Ghana that provides and focuses solely on an extensive education and training for administrators in its graduate school of governance and leadership, where masters degrees are offered in public administration, development, management, executive governance and leadership, along with public sector management training programs. The school also provides consultancy services in many areas, including strategic management, human resources management, and community training (Haruna, 2003).

It should be noted that UGSB, in addition to its masters and doctoral degree awarding programs, also provides weekend and executive masters of public administration (MPA) to serve the educational needs of individuals who may already be in the workforce. Education and training in Ghana for public officials dates back to the colonial era, when the British, a colonial power, laid the foundation for how Ghana should be governed. In so doing, expatriate public administrators were purposely trained in universities in the United Kingdom to conduct administrative business of the British Colonial Empire in Ghana and other occupied British colonies (Kirk-Green, 1969; Haruna, 2004). Such administrative structures only served the interest of the colonizers and not the governed or colonized: Ghanaians, the locals, had absolutely no inputs in the administration of national affairs.

GIMPA is primarily focused on public affairs education and training in the country. This institution was empowered through Act 676, which was passed unanimously by the unicameral legislative Ghanaian parliament in 2004. Referred to as the GIMPA Bill, Act 676 legally gave GIMPA the authority to consolidate and reestablish itself as a self-sustaining public tertiary institution and "graduate-degree-granting university" (Haruna, 2013: 495). Since its inception, Haruna

maintains, GIMPA has taken a bureaucratic perspective of management education and training similar to the British civil service model. GIMPA and the other institutions mentioned above, based on their curricula provide, at least in theory, public managers and officials with the competence to manage national affairs, nation building, and the task of human resource development, but their educational models still mirrors the British system despite attempts for reforms by post-independence governments.

METHODS AND DATA COLLECTION FOR ANALYSIS

Methods incorporating both observational data and quantitative approach were used to explain what is considered triangulation as this strategy is one of the potential solutions to a problem of conflicting tasks, and criteria to be identified in a *multimethod* research (Gerring, 2012). Babbie (2001) defines triangulations as the "use of several different research methods," which he sees as "valuable research strategy" (113). The data gathered from the journal publications qualitatively were used to justify the findings through elaboration. Though the study used mixed methods approach not all methods were overly relied on, since there are some expected methodological disadvantages associate with every method. However, meta-analysis seemed appropriate for this particular study.

Meta-analysis, usually used in statistical methods for contrasting and combining results from different studies, is utilized in this paper by examine the conclusions and results of studies on public administration and management. This article used secondary data by gathering information through publications on education, training, public administration, and management. First, classical definition of public administration and public management as presented in the literature was examined while critical similarities and differences were discussed based on the literature. Meta analysis, seen as a subset of systematic approach to case report, case control study, and cohort study, was used to examine the curricula of UGSB and GIMPA as the selected schools to represent tertiary institution in Ghana. While this may be seen as a small sample of universities in the country, it was determined that these two schools focus more on public administration and management than the others institutions. This determination was based on Internet search, which provided greater ability to extrapolate to the institutions that teach administration and management by providing education and training for public officials. Additionally, we used *word* (education, training) and *phrase* (public administration and management including education and training) Internet search to identify publications directly related to education and training in Ghana. We further narrowed the output of the Internet results by limiting our search to only peer reviewed journals.

Public administration and public management in the context of education and training

The following sections cover first, traditional public administration and the predominant form of public management – the New Public Management (NPM). This discussion then proceeds to an examination of the similarities and differences between public administration and NPM. In the concluding thoughts, major points are reviewed and suggestions are offered with respect to how higher institutions in Ghana, such as GIMPA and UGSB, can provide training and education to ensure competency in public administrators and managers through their degree and certification curricula.

Given the Ghanaian political environment, it is obvious that competence in governing is not restricted to government officials and the public sector alone, but also involves the private sector, including not-for-profit agencies. While much improvement is needed in administrative and managerial capabilities, one is likely to admit that scanty attention has been directed to training and education for nation building. I argue that public administration and NPM can supplement each other in ways that can help promote effective governance, which will improve public welfare through training and education. This will increase managerial productivity and competence at all levels - national, regional, and local governments.

It is most likely that public administration and management are often confused, with many failing to recognize the difference and using the two concepts interchangeably (Leonina-Emilia and Ioan, 2010). According to Kaboolian (1998) there are boundaries, however, surrounding public administration and public management that distinguish the two concepts. Exploring this distinction enables one to compare and contrast public administration and management. Additionally, an understanding of what constitutes the two can help practitioners and academicians initiate steps to understand one another by establishing a unified framework of governance to promote public welfare, where each official's duty is clearly defined and well understood by the citizenry.

Public administration education and training – An overview

The practice of public administration has been around since the emergence of governing structures and is “as old as the governance itself” (Leonina-Emilia and Ioan, 2010: 1020). Public administration education and training generally consists of professional education and training for those who are going to join the public sector and further their professional training and/or education for those who are employed in public administration. It was not until Woodrow Wilson (1887) wrote *The Study of Administration* that public administration emerged as an

academic area of study. This is not to argue that the practice of public administration was absent in traditional societies. The indigenous African societies had their own administrative system unknown to their European slave masters and occupiers (Antwi-Boasiako, 2012). Initially, public administration was considered to be a sub-discipline of political science (Boyne, 1996; Gray and Jenkins, 1995), but with the passage of time it has become a discipline of its own, which is firmly rooted in political science, constitutional law, and other disciplines that touch on the realm of public administration (Henry, 2010).

The concept of public administration can be referred to as the academic area of study (public administration theory), the activity of executing policy (public administration practice), or the administrative structures of a country. As such, it is not surprising that public administration has evaded precise definition (Stillman II, 2010: 1-6). For example, in Ghana, the role of the public administrator is so confusing that most citizens, arguably, look up to the central government - the executive - to provide basic necessities, ignoring the other institutions of government. This situation is further complicated because public administration, “[d]ue to its sociocultural context, its evolving intellectual content and its tacit values . . . is not constituted by a single set of principles or concepts” (Sindane, 2004: 666). The particular forms of administrative structures and systems utilized in a country are path-dependent (Gheorghe, 2012; Kim, 2007; Pollitt, 2002) and are shaped by context – specifically, a country's history, culture, and level of development (Ackroyd, 1995; Jreisat, 2010; Sindane, 2004). Thus, public administration as structure and practice can be characterized by flux and transformation. This, in turn, insinuates that public administration theory can also be characterized by flux and transformation (Haruna, 2003) because “[c]hanges to the study of public administration tend to follow those in the practice of the administration of government” (Gray and Jenkins, 1995: 75). That is, public administration is adaptive, art, and reactive.

Nevertheless, several key characteristics define the traditional conception of public administration. Public administration is Weberian in the sense that it is characterized by command and control structures that are intended to prevent arbitrary decision making, promote accountability, and encourage consistency and coordination, such as bureaucracy, hierarchy, rules, the concentration of power, and clear lines of accountability (Gheorghe, 2012; Kim, 2007; Leonina-Emilia and Ioan, 2010; Riccucci, 2001). Those characteristics could be well understood through education and training. Public administration is also concerned with public management; according to traditional conceptions of public administration, “the fundamental responsibility of public managers was to develop efficient, programmatic means for accomplishing well-defined goals” (Terry, 1998: 195). A well-defined goal for Ghana to ensure continuity in

development has eluded successive administrations since the overthrow of the first president, Dr. Kwame Nkrumah on February 24, 1966. The reason, according to Danso (2007) and Ayittey (2005), is lack of visionary leadership cumulating from the absence of trained public administrators and managers.

The traditional public administration argument

Traditional public administration rejects the politics-administration dichotomy on which classical public administration was based, and accepts that public administration is inherently political (Leonina-Emilia and Ioan, 2010; Lynn, 1998; Sindane, 2004). Nevertheless, "in practice, public administrative questions require political answers" (Sindane, 2004: 666). Unfortunately, those political answers are not provided in Ghana. Public administration, however, goes beyond asking administrative questions that require political answers. It is also "concerned with . . . the politics of service provision" (Boyne, 1996: 79). As such, Ghanaian institutions of higher learning such as GIMPA and UGSB "need to be understood as more than instruments that produce policy outcomes" (Sindane, 2004: 668). These institutions must also be seen as instruments of change in the country's political environment, culture, and development.

Public administrators engage in political management, which is based on the assumption "that public managers have a *legitimate right* to exercise political power in the policy making process" (Terry, 1998: 195) in the interest of the public. The concept of public administration is both instrumental – functioning as a means to attain a collective, public end – and constitutive or formative – defining that end during implementation by placing administrators and managers in the position to either subtly or overtly engage in forming public law (Boyne, 2002; Cook, 1998). In the Ghanaian political unitary administrative structure, public administrators and public managers fulfill this constitutional role through the administrative exercise of delegated authority to give meaning to, or interpret, ambiguous legislative mandates. More often than not, they prioritize competing and sometimes conflicting goals and objectives to identify public goods and services for the people (Sindane, 2004) living in more deprived and rural communities. Given this perspective, "the preferred role of government . . . is viewed as acting as the principal vehicle for socio-economic development" (Kaul, 1997: 14). As long as this lack of clarity remains in defining public service and who is entitled to such service, politics and administration will be inseparable (Kelly, 1998).

Although public administration is closely linked to administrative structures, especially the bureaucracy, "[w]hat is important about the theory and practice of traditional public administration is the value system

embraced and served" (Gray and Jenkins, 1995: 83). Public administration emphasizes what Hood (1991) classifies as lambda-type values; these include resiliency, endurance, robustness, reliability, adaptability, and survival. Additionally, public administration addresses questions of 'how' and 'why' and, as such, is concerned with normative values (Cook, 1998; Sindane, 2004). These normative values include those classified by Hood as theta-type values, which include fairness, honesty, and mutuality. Moreover, public administration is based on political values, including democracy, accountability, due process, collective choice, fairness, justice, participation, and representation (Ricucci, 2001 and Rimington, 2009). Collectively, these values are required by "goals, such as equity and accountability, that are absent in the private sector . . . [and] stem from the common ownership of public organizations, and from attempts to control their behavior in order to achieve collective purposes" (Boyne, 2002: 100). This means if the proper public administration education and training are provided in Ghana, administrators and managers should be able to understand and follow the democratic political process for effective and efficient decision making in the interest of the populace. Thus, administrators must be able to explain to the citizenry within their various constituencies "how" and "why" certain political decisions are taken.

Making sense of public administration training and education in Ghana

Basic public administration education and training usually occur at the university level in both public and private institutions of learning in Ghana. A handful of these institutions offer undergraduate and graduate programs in public administration and public management. Some of these institutions are operating in an increasingly competitive commercialized environment where their programs and curricula are geared toward public servants at all levels are oriented to issues of economy, productivity, efficiency, and social policy (Kolisnichenko, 2006). Education and training are most likely to be the key causes for transformation in any industry, organization or country. These two, education and training are balancing activities that reinforce each other. Education concentrates on explaining concepts, doctrines, beliefs, practices, and teaching procedures; for instance the theory of how a task should be done. Training, on the other hand, deals with *practicing* and *applying* the knowledge acquired through education, which helps to execute what has been learned. The classical public administration literature tends to provide a framework for developed countries and how, in an idealistic democratic political environment, public administrators and managers should function.ⁱⁱⁱ Ghana, like most African countries, was deconstructed and

constructed by external powers in 1844: Colonization. This partition of Africa (Gavshon, 1981) has undeniably affected its political, social, cultural, educational and administrative structures.

Despite these colonial and foreign administrative structures, the native administrative system continues to function; the chieftaincy system. The concept of chieftaincy as a form of administrative authority at the local level still persists and it is constitutionally recognized (Antwi-Boasiako and Bonna, 2012) and functions. Ayittey (2005: 21) admits that the study of the Ghanaian traditional “societies reveal[s] an astonishing degree of functionality: participatory forms of democracy, rule of customary law, and accountability,” but the administrative system of modern Ghana “is a meretricious fandango of imported or borrowed institutions that are little understood by” public officials, administrators, and managers. This imported administrative system has forced tertiary institutions in Ghana, including GIMPA and UGSB to, unfortunately, respond “to external pressures, offering internationally acceptable courses that provide students with generic managerial and technical managerial competencies” to the detriment of traditional administrative structures where the tertiary institutions curricula fail to address issues of traditional administration and policies relevant to Ghana (Haruna, 2013: 507). Haruna notes there is the need for public administration training and education to address domestic issues. Thus, any public administration training and education must “build knowledge and the ethic for administering in the unique context of Ghana” (507).

Localizing public administration in Ghana

The classical writings in public administration do not discuss traditional administration and management, which have been part of the administrative system in Ghana since the pre- and post-colonial eras. This section looks at the concept of public administration and public management from the Ghanaian perspective regarding the type of education and training available for public administrators. Before public administration became an academic discipline there were administrative structures in indigenous societies, including Ghana (Ayittey, 1992). While those structures were not documented, there was consensus in the administration of justice, law making, policy making (taboos), and delivery of public services through local leaders and traditional chiefs (Antwi-Boasiako and Bonna, 2012). Traditional leaders, similar to elected political leaders, have different leadership styles, which varied from chief to chief (region to region). For example, the Ghanaian political heads of state, from the first president, Dr. Kwame Nkrumah (1957-1966), through to John Dramani Mahama (2012-) ^{iv}, have different leadership and administrative skills that affirm the diverse administrative

styles of public administrators. This unsurprisingly diverse nature in public administration is normative in focusing mainly on public interest (King and Chilton, 2009). Each one of these administrators, including those not mentioned here, had their fair share of public criticisms of maladministration, given their respective lack of public administration education and training, yet all of them (including the administration of military leaders Colonel I. K. Acheampong 1972-79 and J.J. Rawlings 1982-2000) are more likely to vow that the performances of their administrative teams were in the interest of the public. Ghana, a country of only 58 years of political independence from British colonial rule, has experienced democratic governance under four different constitutions; nevertheless, 21 out of the 58 years were under military decrees, leaving only 37 years of constitutional administration in Ghana.

These leaders and other public officials in Ghana do exemplify the various definitions of public administration, which means there is no singular definition or approach to managing public resources (Stillman II, 2010). Public administrators are engaged in technicalities but, unfortunately, some Ghanaian politicians and a portion of the populace lack the knowledge of the political process to fully comprehend and understand the role of public administrators, as voters are deceived with election campaign promises. Moreover, Ghanaians are not alone as “empirical descriptions from an external perspective,” have shown, that “no one really sees the big picture” in the definition of public administration (King and Chilton, 2009: 29); hence the education and training of Ghanaian administrators is based on imported public administration theory and practices, which in most cases do not address the needs of domestic issues (Haruna, 2013).

One can therefore argue that some of the citizens may not fully understand the duties of their public administrators and managers. In addition to budgetary preparations and job classifications, public administrators in Ghana are equally concerned with development of human resources and achieving goals of the people, but the question remains; do public administrators and managers have adequate education, training, and competence to perform their duties? Haruna (2013) attempts to answer this question; first, he sees the challenges facing tertiary institutions in Ghana through their curriculum development. Using GIMPA’s curriculum as a case study, for public administrators to acquire adequate training and education, Haruna posits that good governance principles must be incorporated into “public affairs education and training in the larger society” (508). He provides a sample framework for curriculum ^v for development management, which is more likely to focus on, and address domestic administrative and political challenges facing Ghana. Haruna calls for specific course components to address domestic (local) issues and conditions to foster competencies geared toward development, management, and public administration.

DEFINING PUBLIC ADMINISTRATION IN GHANA

Public administration in Ghana, like any other academic discipline, is not isolated but intertwined with the critical dilemmas confronting the entire country. Its diverse nature makes it difficult for ordinary Ghanaians who are not part of an administration to identify the goals of that administration, if those goals are not clearly defined. Many studies, including King and Chilton (2009), Stillman (2010: 2-4), and Starling (1998) have offered different definitions of public administration. Cropf (2008: 8) also agrees "no single, and authoritative definition of public administration is possible." For example, Starling (1998) argues that public administration is the process by which resources are marshaled and then used to cope with the problems facing a political community. It is also the use of managerial, political and legal theories, and the processes to fulfill legislative, executive, and judicial governmental mandates, for the provision of regulatory and service functions for Ghana or some segments of the country. Given the complexities and the amalgamation of traditional (chieftaincy) and modern administrative structures in Ghana, it becomes more confusing if the administration of local communities is laid only on the shoulders of the central government. The logical definition of public administration, the author argues, must be derived from sagacity of different premises. To Ghanaians, despite how ill-defined the field is, public administration must be seen as including transparency, accountability, and decentralization, where the needs of the public are addressed by both elected and appointed government officials. Public administration should be a collective effort to manage the human resources, both skilled and unskilled, for effective implementation of public policies within the budgetary constraints of the country for the local, regional, and national administrative agencies.

Public administration is defined here as an art, which strategically combines available resources to maximize their utilization in the interest of the citizens within a governed jurisdiction. For public administrators to be seen as effective and productive, the area of administration must be politically and clearly defined, hence the importance of education and training to build competent leaders who understand the political processes. The next section looks at public management in the Ghanaian context.

NEW PUBLIC MANAGEMENT IN GHANA

The transfer of business, management techniques, and market principles from the private to the public sector may be referred to as the new public management (NPM). This concept is based on neo-liberal interpretation of the state and economy where a state's involvement in public activities is expected to diminish while business principles of efficiency are promoted. Unfortunately, in

Ghana, any agency (for example, Ghana Water Company Limited and Electricity Company of Ghana Limited) run by the central government does not perform well, hence the need for government to adopt best practices in the business world. According to Hunt (2008: 398), management is an art, a science, a philosophy, and most importantly a technique. Management, as he puts it, "has been called the art of persuading other people to pursue enthusiastically your [ones] own particular objective." Hunt noted that management is expressed in the techniques of administration and organization that have been developed throughout organized society. As a social process, management is based on the acceptance of the philosophy of co-operation. It is, therefore, not a discipline for few individuals but for all. In Ghana, because of the parochial politicians, political party leaders are always at impasse with each other. This has not helped in the administration, management, and development of the country. To Boyne (1996: 684) public management has had a far stronger impact on practice than theory; indeed, "The very word management implies a practical focus." Nevertheless, various "different approaches to advance the understanding of public management research and practice" have been developed, including quantitative/analytic management, political management, market-driven management, and liberation management (Terry, 1998: 194).

Unfortunately, the two leading political parties (National Democratic Congress-NDC and National Patriotic Party-NPP) ideological approaches to managing the affairs of the country do not seem to complement each other, hence lack of development in Ghana. Haruna (2003: 347), in his article *Reforming Ghana's Public Service: Issues and Experiences in Comparative Perspective*, argues that "a composite framework of reform blending the social and cultural experiences of the people of Ghana with Anglo-American values offers an opportunity for transforming the Ghanaian society." Here, the author strongly argues that management skills and values of the Anglo-America framework of administration could help educate and train competent administrators in Ghana, where certain characteristics exhibited by the Ghanaian government worker - inefficiency, absenteeism, and tardiness - could be minimized, if not eradicated.

The cultural and political uniqueness of Ghana must be considered as tertiary institutions develop their curricula. In so doing, the blend between the Anglo-American management style, as suggested by Haruna and Kannae (2013), and that of Ghana- the traditional administrative system could help to address domestic needs of the country. The most prominent form of public management since Ghana's Fourth Republic is NPM, which has its theoretical roots in public choice theory, rational choice theory, economic and micro-economic theory. However, as Ayittey (2005: 21) would argue, Ghanaian elites and administrators have very little understanding of these borrowed theoretical concepts developed from afar with

little or no relevance to domestic issues; hence the managerial competence in public administration has become “a product of mass confusion and an internally contradictory system that bears no affinity to either the indigenous system” or the imported Anglo-American system. He maintains that the concept and understanding of management in Ghana is elitism, which runs parallel to the NPM concept.

CHALLENGES: PUBLIC ADMINISTRATION AND NEW PUBLIC MANAGEMENT

NPM directly challenges the ideological core of public administration – particularly the political-administrative dichotomous relational context, its basic values, and concept as understood in the Ghanaian context – and, as such, NPM represents a departure from prior traditional public management approaches. Management reforms are viewed as important developments to improve governance, but reforms are seen as rejections of previous administration’s political ideas. Despite these challenges facing Ghana, waves of NPM reforms have been undertaken in developed and, more recently, developing countries (Gheorghe, 2012; Kim, 2007; Sindane, 2004; and Haruna, 2003). However, the impact of the various political administrative reforms for improvement is yet to be seen by the governed in Ghana. The spread of NPM has not been universal; in fact, in Ghana, the various administrative structural adjustment reforms have had abysmal results. For example, Hood (1991: 8) recognizes the absence of any significant impact at the local level. He states,

NPM seems to have had much less impact on international bureaucracies than on national ones, and less on controlling departments than on front-line delivery units. Moreover, much was made of the need for local variation in management styles – so long as such variations did not challenge the basic framework of NPM.

Nevertheless, it is undeniable that there has been increasing discursive and decisional convergence of NPM reforms on a global scale (Pollitt, 2002). The extent to which countries are also transitioning toward practice convergence is debatable; however, if practice convergence is increasing, this “would mark an important departure from the prevailing belief in cultural determinism” (Lynn, 1998: 232).

Practical applications of NPM may result in many different types of management reforms; consequently, a wide range of new definitions of NPM have been proposed, few of which are identical. Nevertheless, there are various characteristics that broadly define the NPM movement and encompass its various structural forms (Betley et al., 2012). NPM rejects public administration and bureaucratic structures as inefficient, ineffective, and failing to ensure accountability, something that is common in Ghana. In seeking to improve the efficiency and

effectiveness of government, NPM conceptualizes the role of the central government as facilitative and collaborative (Hope Sr., 2001; Kim, 2007). As such, NPM encourages marketization, managerial entrepreneurship, private sector management practices, structural decentralization through the institution of lean, flexible, disaggregated, and autonomous organizations, and the substitution of hierarchical relationships with competitive, contractual relationships and privatization (Kim, 2007; Rimington, 2009). Thus, NPM can be understood as promoting governance instead of government due to the “narrowing of government institutions and responsibilities,” which is based on the assumption that “governments need not be involved in many aspects of policy implementation” (Kaul, 1997: 14).

For example, Behn (1998: 210) asserts, “Public managers can help to improve... [a] system of governance . . . [by] help[ing] correct seven failures of governance: organizational, analytical, executive, legislative, political, civic, and judicial.” To enable Ghanaian public administrators and public managers, both at the local and national level, to succeed in this endeavor of improving the efficiency, effectiveness, and accountability of administrative systems, NPM reforms must be incorporated in the curricula of institutions at all levels. Additionally, NPM shifts the managerial focus from inputs and processes to outputs and outcomes or results, thereby elevating the importance of performance measurement in promoting accountability through unambiguous output control (Kim, 2007; Pollitt, 2002).

NPM reinstates the Wilsonian politics-administration dichotomy that has been discarded by traditional public administration (Gheorghe, 2012). Hood asserts that ‘political neutrality’ contributes to NPM framework’s flexibility, which enables the adoption and implementation of reforms in a variety of contexts such as district, local, and traditional governments in Ghana. Additionally, NPM reforms distinguish between political responsibilities (policy formulation) and managerial responsibilities (policy implementation), thereby rejecting the constitutive role of public administrators and public managers in favor of a solely institutional role (Cook, 1998; Kaul, 1997). Unfortunately, in Ghana, such distinction is not made clear by politicians to voters making the latter confused in what is expected of the public administrators and managers. Advocates of NPM overlook the rhetorical-reality disconnect that this rejection of constitutive roles and elevation of institutional roles causes and instead view this as “a necessary precursor to strengthening accountability” (Kaul, 1997: 17). In his article, *The new public management: Context and practice in Africa*, Hope Sr. (2001: 123) argues that all societies need a capable public management structure to keep order, collect revenue, and carry out programs.” Ghana, like most African countries, in the 1960s, 70s, and 80s, experienced severe political instability (series of military coups), which made it difficult to implement the reforms identified by

Hope Sr. The disruptions by non-democratic administrations (military coups in 1966, 1972, 1979, and 1982) in Ghana's political history and the absence of well defined national policy for development have affected progress in this regard. For example, any time there is a military administration, the programs by civilian governments are abandoned, while a change in civilian administration tends to reject previous administration's projects and political ideology.

According to Hood, the politically neutral framework of NPM also allows many different values to be effectively incorporated into management reforms. Among the most commonly emphasized values in NPM are sigma-type values, which "match resources to defined tasks" and, in doing so, promote frugality (Hood, 1991:12). Due to its incorporation of private sector management practices, NPM also emphasizes private sector values including efficiency, effectiveness, quality, responsiveness, empowerment, innovation, and entrepreneurialism (Hope Sr., 2001; Pollitt, 2002; Sindane, 2004). These values associated with the private sector suffered under the various military regimes in Ghana. For example, in the 1982 military coup, led by Flight Lieutenant Jerry John Rawlings, the properties of some private companies were confiscated while others were sold through the military government's divestiture programs.^{vi} Some scholars have expressed concerns that the values NPM promotes, however, may not be mutually exclusive or universal. Indeed, Gray and Jenkins (1995: 86) claim that the values underlying NPM are inherently in conflict, due to the conflicting values of the political ideologies on which it draws. They argue that this conflict can be seen in different conceptualizations of "a seemingly common reform strategy, decentralization," as either administrative decentralization or political decentralization, "each leading to different frameworks of analysis and offering differing structural solutions." Such different conceptualizations are what have affected the lack of development in Ghana.

PUBLIC ADMINISTRATION AND PUBLIC MANAGEMENT: COMPARATIVE ANALYSIS

Although public administration and public management are distinct concepts as discussed above, they are not mutually exclusive (Hope Sr., 2001). Indeed, there are numerous differences and similarities between public administration and NPM; however, they are sometimes used interchangeably. The following sections attempt to examine some similarities and differences.

Similarities between political and public administrators

It would not be out of place if one argues against the

claim that public administration is both political and public. "Public administrators are, after all, public servants" (Terry, 1998: 197). So how do education and training given to public administrators and managers create awareness of Diver's argument, that public administrators are servants, given the Ghanaian traditional understanding the role of public officials who are mostly referred to, and seen as *Honorables*? Advocates of NPM claim that it is 'apolitical' or politically neutral due to its acceptance of the politics-administration dichotomy and its corresponding separation of political responsibilities from managerial responsibilities. Nevertheless, both public administration and NPM are inherently political and public; everything is about politics in Ghana. For one to be an effective administrator, one has to understand the administrative and political processes. Here, the role of GIMPA and other tertiary institutions becomes essential. The education and training provided must not only focus on the theoretical understanding of public administration, but also incorporate the idea that public officials are elected or appointed to serve not to be served.

Public administration and NPM both focus – or at least claim to focus – on promoting the public welfare, although the two conceptualize the public welfare differently as a result of their different underlying values and definitions. As such, both public administration and NPM are concerned with "politics of the most fundamental sort . . . the politics of fulfilling, maintaining, and enhancing the character of the regime," an undertaking which is in and of itself *public* (Cook, 1998: 229). In addition, Moe posits that "all reports on government organization and management have as the basis some theory about the nature of government and about the management of that government" and, as such, are political and public (Gray and Jenkins, 1995: 75).

Furthermore, both public administration and NPM are concerned with administration and management that, in practice, is carried out by public organizations, which "are controlled predominantly by political forces . . . [such] political control is the essence of *publicness*" (Boyne, 2002: 98-99). Thus, public administration and NPM are inherently political and public in that both seek to define the proper role of administration and management in the public sector. In Ghana, the question of who gets what, when, and how depends on the type of leadership and political party in power, though all political parties claim to work in the interest of public at large.

Taken together, these points insinuate that, regardless of whether NPM is regarded as neutral or 'apolitical' by its advocates, NPM is, in fact, both political and public. NPM's prescriptions, which seek to answer political questions in terms of enhanced efficiency, in an attempt to promote the public welfare, are carried out in a political and public context, making both administration and management political instrument for development. Moreover, NPM's conceptualization of the proper role of

the administrative state should be rooted in agreed-upon values and political ideologies of the government of Ghana, which are central in determining the proper role of public administration and public management as a political instrument. For this reason, Cook (1998: 227) insists that: “An understanding of an appreciation of the inescapable fact of public administration’s character as a political institution and its complex implications should be the foundation of the administrative enterprise. It should stand at the center of the conception of the public manager’s job.”

Differences: The impasse; public administration and NPM

Perhaps the most fundamental concern of public administration and NPM is how the relationship between the public and the private sector is perceived. This difference sees “[t]he boundary between the public . . . [and] private sector[s] . . . has a crucial importance in the understanding [of] the future course of public administration” (Leonina-Emilia and Ioan, 2010: 1022). Where this boundary is drawn has implications concerning the management practices, values, and accountability systems that can appropriately be applied in the public interest. In Ghana, it is not uncommon to argue that some of the administrative decisions and policies implemented are not seen to be in the interest of the public. Public administration is based on the presumption that, while there are similarities between the public and private sectors, they are “fundamentally alike in all unimportant respects” (Boyne, 2002: 98). With my understanding of public administration, the public sector is characterized by several peculiarities – most notably that the public sector is *publically owned* and *publically accountable* since its operations are funded via taxation and is also concerned with the *public good* (Rimington, 2009; Sindane, 2004). These peculiarities cause the public and private sectors to be fundamentally different with respect to their environments, goals, structures, and values (Boyne, 2002).

As such, advocates of public administration claim that these fundamental differences should inhibit the blind application of private sector practices in the public sector (Boyne, 2002; Chandler, 1991; Sindane, 2004). It is not uncommon that public officials do not know their exact role as public administrators; therefore education and training for public administrators and managers by tertiary institutions must incorporate in their curricula a pragmatic approach in ensuring the courses offered are not solely theory-based but a blend of theory and practice. Education and training for public administrators are crucial in Ghana since administrators need to understand how the traditional system functions within the modern political system: Democracy.

As a result “[r]ecent management reforms have

recognized the interdependency between the public and private sectors . . . [and] are clarifying the boundary between the two” (Kaul, 1997: 21). NPM blurs – and, according to some scholars (Kim, 2007; Pollitt, 2002), erodes or eliminates – the distinction between the public sector and the private sector, due to its incorporation of private management practices and reliance on privatization, contractual relationships, and public/private partnerships. The adoption of private sector management practices “was one of the earliest features of NPM, and remains one of the most enduring,” demonstrating the centrality of the blurred distinction between the public and private sectors and the re-clarification of public-private boundaries in NPM (Boyne, 2002: 97). Critics of NPM identify this blurred distinction and consequential removal of traditional barriers as the fundamental flaw of NPM, arguing, in the spirit of public administration, that the distinction between the public and private sectors is too great to allow for the adoption of private sector management practices in the public sector (Riccucci, 2001; Sindane, 2004), but the practices in the private sector could be adopted in improving the public sector. We should remind ourselves that the main focus of the private sector is profit while the public sector maintains provision of service to its clientele.

Researchers have examined whether there are fundamental differences between the public and private sectors that should inhibit the application of private sector practices. For instance, Boyne (2002) tested thirteen hypotheses concerning the supposed differences between public management and private management by analyzing 34 studies of the public and private sectors. Boyne found that statistically significant distinctions do exist between the two sectors – specifically, that “public organizations are more bureaucratic, public managers are less materialistic, and organizational commitment is weaker in the public sector” – but concluded that these differences are too “narrow and uncertain [of a] foundation for rejecting the element of NPM that seeks to draw lessons from the private sector” (116). Boyne’s conclusions play squarely into the Ghanaian public attitude toward public sector workers. Through education and training public administrators and managers’ commitment in the public sector would increase productivity. Unfortunately, the Ghanaian public official is not only overly bureaucratic, but far more materialistic.

Boyne’s findings, however, are not widely accepted especially in Ghana, which is illustrated by the continued persistence of some scholars to point to the distinctiveness of the public sector from the private sector (Rimington, 2009; Sindane, 2004). One can hardly argue that the public and private sectors are completely distinct – indeed, “there are great similarities between private and public organizations in as far as administration is a cooperative group effort” – but in adopting private sector management practices, one cannot lose sight of the fact that “the purposes or goals of human [public] and

material [private] organizations vary and . . . that it is the cardinal principle of democratic government that public servants be *guided by public opinion*" (Sindane, 2004: 671). The public sector (government) provides the basic infrastructure, which benefits the public including the private sector. In Ghana, the activities of the public sector are not inherently different from the private sector, as the two sectors seem to supplement each other. For example, private cocoa farmers rely on the assistance of government or public resources for supplies to improve productivity.

Values. Another fundamental difference between public administration and NPM is related to the values that are espoused in theory and practice. This difference has been widely recognized and is viewed by advocates of public administration as concerning. As such, "[t]here has . . . been extensive discussion of the shifting set of values that underlies the transition from traditional public administration to the new public management" (Gray and Jenkins, 1995: 76). The "different administrative values have different implications for fundamental aspects of administrative design – implications that go beyond altering the 'settings' of the systems" (Hood, 1991: 9); in part, because the emphasis on certain values may result in ignoring other critical values, which may have a dramatic impact on the ability of public administration and public management to improve the public welfare. In Ghana, more often than not, most public policies are implemented without any explanation to the citizens. This could be due to the lack of proper education and training for public administrators and managers.

Although public administration and NPM differ in their underlying values, there is a need for advocates of both public administration and public management to recognize the importance of morality as a primary value in the interest of the public. Viewed in this way, public administration's emphasis on equity and NPM's on efficiency and economy (the 'three Es') should be considered secondary values "that only have merit worthy of pursuit if affixed to some more primary value" – in this case, morality (Chandler, 1991: 390). According to Chandler, without morality as the primary value, the 'three Es' "can lead to ethical difficulties, which not only may be objectionable in themselves, but can also undermine the whole enterprise" (390).

Accountability. How accountability is ensured represents another fundamental difference between public administration and NPM in Ghana. The accountability systems associated with public administration and NPM vary due to different conceptualizations of the division between the public and private sectors, different underlying values (profit vs. service) that result in different organizational structures, and different conceptions of the role of the public. The differences surrounding the accountability systems of public administration and NPM merit further

discussion regarding education and training in Ghana because accountability systems must be appropriate to ensure that the public sector is fulfilling its purpose of providing service for the public welfare.

Unfortunately, in Ghana, given its democratic structure and process of appointing public officials, public administrators and managers are directly accountable "to the president, not customers of government agencies, for the execution of the laws of the land" (Ricucci, 2001: 172). Accountability is proactively promoted through control mechanisms such as bureaucratic structures, policies and procedures (Boyne, 2002). In sum, "traditional visions of public service . . . place administrators as [proactively and retroactively] accountable to the public through the *political system*" (Gray and Jenkins, 1995: 92).

In Ghana, the accountability systems of public administration are not effective in the NPM framework due to decentralization and the devolution of resource control. The question of decentralization in Ghana tends to favor the well to do districts in the country. Indeed, "[t]he relatively simple notion of the formal elected representative holding the bureaucracy accountable for delivering goods and services is less viable within this framework;" decentralization (Kelly, 1998: 205). Instead, accountability is maintained primarily through performance measurement and the empowerment of citizens as customers. Given the fact that public administrators and public managers are granted increased authority through NPM reforms, it is essential that they are held accountable; again, the education and training provided in our tertiary institutions for public administrators and managers must emphasize on accountability to ensure continuous performance of public officials. Monitoring performance is important in continually improving the provision of goods and services in an effort to improve the public welfare. It is also necessary to ensure accountability in an environment of delegated authority characterized by contracting, privatization, and the devolution of resource control with "[a]uthority . . . explicitly delegated to senior officials in exchange for accountability for performance" (Kaul, 1997: 20). As such, performance measurement should effectively promote accountability in the NPM framework and this can be achieved through education and training of public administrators and public managers.

PUBLIC ADMINISTRATION EDUCATION AND TRAINING AND TRADITIONAL ADMINISTRATION IN GHANA

The lenses used to scrutinize public administration and management in Ghana tend to ignore the role of traditional administrative practices, let alone lack of adequate education and training for those leaders, like chiefs and community leaders in the traditional

administrative authority. The administrative practices in Ghana would better be understood with a deepened appreciation if the various perspectives (traditional and democracy) were looked at together and synthesized, instead of wholly importing the administrative systems of other societies with very little or no understanding of how those systems operate (Ayittey, 2005). To Haruna (2013), tertiary institutions such as GIMPA must provide education and training for administrators within the context of the Ghanaian social, cultural, and political environment. For example, any solitary approach to examining a phenomenon tends to miss critical aspects of what is to be studied. The Anglo-American understanding of administrative theories tends to either reject or ignore presence of the traditional and chieftaincy administrative systems in Ghana (Antwi-Boasiako and Bonna, 2012). The theoretical understanding of the classical public administration literature does not usually translate to the practice of administration in Ghana, since it does not incorporate the Ghanaian culture, or the traditional systems of administration, which is unknown to the proponents of these theories.

For example, pre-colonial traditional Ghanaian administrative practices do not separate religion from public administration and public management. Any in-depth understanding of administration needs epistemic pluralism, which is the amalgamation of different perspectives of the multiplicity for administrative data analyses. For instance, would the classical administrative theories even consider traditional Ghanaian administrative practices? This pluralism, along with other related questions not asked here, is what must be considered as the theoretical framework of administration to address domestic needs as one develops educational training for public administrators and managers in Ghana. The 1992 Constitution of Ghana acknowledges the role and importance of traditional institutions in the country; therefore, any effective educational training for public administrators and managers must incorporate the traditional chieftaincy administrative heads as partners in development in the interest of the public. There are attempts by some of the tertiary institutions in the country, such as GIMPA and UGSB, to provide public administration education and training for academics and practitioners through their programs, but such education is not extended to traditional system of administration.

Since the 1960s, Ghana has been steadily increasing its proportion of the limelight in African and world affairs. However, governance and political administration in the country, some studies^{vii} have affirmed, has been on the decline since independence in 1957. It is often easier to document and discuss the collapse of public administration and governance in postcolonial Ghana. There is a “complex notion of subalternity pertinent to any academic enterprise, which concerns itself with historically determined relationships of dominance and subordinations” (Gandhi, 1998: 2). Ayee (2000) refers to

such phenomenon as proclivity for experimentation or laboratories for investigation. It is good to question or challenge assumptions of classical public administration theories to effect change as noted by Farmer (2010), who insists, “radical change is needed in the way that we conceptualize the role and nature of *political administrative theory*” (Farmer, 1995: 4). To expand on Farmer’s claims, one could argue that Ghana’s pre-colonial traditional administrative system, which focuses mainly in the developments at the local level, has been ignored in public administration education training in the country, despite the efforts of tertiary institutions to train public administrators. Though many studies (Ayittey, 2005; Danso, 2007) have criticized the failures of public administration, leadership, and governance in Ghana, very little has been done to the deconstruction and constructing of theories to advance and effect positive change through public education and training. Given a postmodernist approach of reinventing government for effective performance and efficiency, there is every reason to re-examine the pitfalls of postcolonial political administration in Ghana from a critical theoretical and pragmatic perspective, where education and training are embraced in all formal educational institutions in the country. In an attempt to develop a blueprint for Ghana to address a political structure that encourages development, Ghana must develop a national policy that would be followed by all governments regardless of which political party may be in power.

Conclusion

Public administration and management are both concerned with effective government and governance; however, they are distinct theories and practices that are rooted in different theoretical foundations and, because of this, define ‘effectiveness’ differently. There are similarities between public administration and NPM – most notably they are both essentially political and public due to their focus on government and governance. Nevertheless, there are also important differences between public administration and NPM regarding whether a fundamental distinction between the public and private sectors exists, which values are of the most importance in promoting effective governance, and how accountability to the public is to be ensured. This can be achieved through education and training for public administrators and managers including traditional leaders. Since, Ghana’s Fourth Republic 1992-Constitution recognizes the role of traditional institutions, education and training must consider incorporating the traditional administrative system in national affairs.

To ensure effective government and governance, there is the need for public administration education and training in Ghana. Fortunately, there are tertiary institutions that have incorporated public administration

education and training in their curricula, especially GIMPA and UGSB. Academically, as Haruna (2013) noted, GIMPA has provided the platform to educate and train public administrators and managers. However, the impact of the education and training provided to public officials for effective governance is yet to be realized by the governed. GIMPA and UGSB, despite their impressive curricula, are said to be responding to international pressure to the neglect of addressing domestic issues. Haruna (2013: 509) therefore suggests “a nominative comprehensive curricular” through informed pragmatic local and foreign political conditions as “basis for developing a true global curriculum of public affairs education and training.” It is not clear, if the education and training provided by the tertiary institutions in Ghana are having any positive impact on public officials. However, African tertiary institutions need to incorporate the traditional administrative system in their curricula.

Conflict of Interests

The author have not declared any conflict of interests.

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Endnotes

- ⁱ There are several objectives, which are not discussed. This article limits itself to two main objectives: Education and Training.
- ⁱⁱ It is not uncommon for government appointees to be reject by citizenry: The basic argument for the rejection is that those individuals are incompetent and lack managerial skills to govern (see *Rejection Galore at DCE Elections* at <http://www.ghanaweb.com/GhanaHomePage/regional/artikel.php?ID=279836>. Retrieved on November 18, 2014
- ⁱⁱⁱ See *Classics of Public Administration* 6th ed. by Jay M. Shafritz and Albert C. Hyde 2004. This is a collection of some classical writings, which provide some foundations for public administration, management, and governance.
- ^{iv} The end date (year) of the John Mahama is not provided because he was still the president of Ghana at the time writing this article.
- ^v See Haruna, Peter F. and Lawrence A. Kanna, "Connecting good governance principles to the public affairs curriculum: The case of Ghana Institute of Management and Public Administration," *Journal of Public Affairs Education* 19, 3:480-93.
- ^{vi} There are a number of published articles in the Ghanaian print media indicating how governments over the years have discouraged economic growth by the private enterprises. See for example, "Where is the hand of President Mahama in this?" Retrieved on December 23, 2014 from <http://www.ghanaweb.com/GhanaHomePage/features/artikel.php?ID=339722> See also Dr. Akada Mensema "All Die be Die Ewe/North Elites tell JJ to apologize" Retrieved on December 23, 2014 from <http://www.ghanaweb.com/GhanaHomePage/features/artikel.php?ID=304118>

Full Length Research Paper

African growth, non-linearities and strong dependence: An empirical study

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The aim of this paper is to examine the behaviour of GDP growth in various African countries allowing for possible non-linearities that are particularly relevant in their case since they have been affected by various conflicts. Specifically, first we carry out standard unit root tests and then follow an approach that combines fractional integration and non-linearities (modelled using Chebyshev polynomials) in a single framework. The results for a sample of 28 countries confirm the existence of non-linearities in most cases, the only exceptions being the Central African Republic, Niger, Sierra Leone and Somalia. Further, there is heterogeneity across countries in terms of the degree of persistence, the GDP series being characterised in different cases by mean reversion, unit root behaviour, and orders of integration significantly higher than 1 respectively. The policy implications of the empirical analysis are also discussed, namely whether or not activist policies are required.

Key words: GDP growth, African countries, non-linearities, fractional integration, Chebyshev polynomials.

JEL Classification: C22, C50

INTRODUCTION

This paper examines the statistical properties of the growth rates of several African countries using statistical techniques based on the concepts of fractional integration and long-range dependence. It is normally assumed that GDP (and/or its log transformation) is a non-stationary, integrated of order 1 (or I(1)), series and its first difference, i.e. the growth rate, a stationary I(0) one (Nelson and Plosser, 1982). However, this is a rather restrictive assumption: the possibility of fractional

degrees of integration has more recently been taken into account in several studies on GDP growth (Michelacci and Zaffaroni, 2000; Silverberg and Verspagen, 2000; Mayoral, 2006; Caporale and Gil-Alana, 2013). For instance, Michelacci and Zaffaroni (2000) provided evidence of long memory and mean-reverting behaviour in US per capita output. Their paper, however, was criticized by Silverberg and Verspagen (2000), who questioned its methodology and reported I(1) non-

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stationary behaviour in US output. Mayoral (2006) examined annual real GNP and GNP per capita in the US for the time period 1869-2001, using several parametric and semiparametric fractional integration methods. Her results, though slightly different depending on the technique used, suggested that the orders of integration lie in the interval $[0.5, 1)$, which implies nonstationarity, high persistence and mean-reverting behaviour. Caporale and Gil-Alana (2013) showed that the behaviour of US per capita real output is captured well by a linear trend model with stationary long-memory behaviour and breaks, and that mean reversion occurs.

It is well known that fractional integration, non-linearities and structural breaks are intimately related issues (Cheung, 1993; Diebold and Inoue, 2001; Giraitis et al., 2001; Kapetanios and Shin, 2003; Mikosch and Starica, 2004; Granger and Hyung, 2004). In particular, fractional integration can be an artifact generated by the presence of breaks that are not taken into account. Further, changes can occur smoothly rather than suddenly as implied by structural breaks; Ouliaris et al. (1989) therefore proposed regular polynomials to approximate deterministic components in the data generation process (DGP). However, as later pointed out by Bierens (1997), Chebyshev polynomials might be a better mathematical approximation of the time functions, since they are bounded and orthogonal; being cosine functions of time, they are a very flexible tool to approximate deterministic trends.

In the specific case of the African countries, growth rates might be not only persistent, but also subject to non-linearities resulting from civil wars, ethnic conflicts etc. Therefore the present study adopts a GDP growth model incorporating both features (non-linearities and persistence) in a single framework.

The objectives of this study are the following: first, we examine the stochastic behaviour of GDP in various African countries by carrying out standard unit root tests; second, to examine persistence in these series by means of fractional integration techniques allowing for nonlinearities. The policy implications of the empirical analysis are also discussed.

The remainder of the paper is structured as follows. Section 2 briefly reviews the previous literature on economic growth in Africa. Section 3 outlines the methodology. Section 4 describes the data and discusses the empirical results. Section 5 concludes the paper.

LITERATURE REVIEW

Relatively few studies have focused on economic growth in Africa. In the paper by Fosu (1992a), who used data from 1956 to 1985 for 31 sub-Saharan countries, the country-specific analysis is complemented by an investigation of the extent to which growth differentials between countries can be explained by differences in production output. Political instability and corruption are

found to have adverse effects on growth and to have played a major role in the economic stagnation of sub-Saharan Africa, accounting for a substantial reduction in the region's overall GDP growth over the period 1956-1985.

Fosu (1992b) investigated the effect of export instability on GDP growth in Africa, and found that these are particularly significant in the case of sub-Saharan Africa. Karikari (1995) examined the role of the government in the growth of a developing nation, using data for Ghana from 1963 to 1984. He concluded that the impact of government on economic growth was negative. Savvides (1995) investigated the factors that explain the differences in per capita growth across Africa, and concluded that these are: initial conditions, investment, economic growth, trade orientation, inflation, financial development and the growth of the government sector. Easterly and Levice (1997) showed that ethnic diversity helps explain cross-country differences in public policies and other economic indicators. Sub-Saharan economic growth is associated with low schooling, political instability, an underdeveloped financial system, distorted foreign exchange markets, high government deficits and insufficient infrastructures.

Guillaumont et al. (1999) showed, using a cross-section including a sample of African and non-African countries, that instability lowered African growth in the seventies and eighties. They concluded that Africa has a higher level of primary instability (climatic, terms of trade and political instability) which lowers growth. Brempong and Traynor (1999) also found an inverse relationship between political instability and economic growth (as well as joint endogeneity of these two variables), and an indirect effect of political instability on economic growth through lower long-run capital accumulation. Gomanee et al. (2005) found a positive relationship between foreign aid and growth in a sample of 25 sub-Saharan countries: on average, a percentage point increase in the foreign aid/GNP ratio contributes one-quarter of a percentage point to the growth rate. Aghion et al. (2008) showed that mark-ups are higher in South Africa manufacturing industries than in corresponding industries worldwide, which has a large negative effect on productivity growth in the South African manufacturing industry.

METHODOLOGY

As a first step, we carry out standard unit root tests, specifically the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979), as well as its generalization, i.e. the GLS specification (Elliot et al., 1996), and the Kwiatkowski et al. (KPSS, 1992) test for the null of stationarity against the alternative of a unit root.

We then consider the following non-linear model:

$$y_t = \sum_{i=0}^m \theta_i P_{iT}(t) + x_t, \quad t = 1, 2, \dots, \quad (1)$$

with m indicating the order of the Chebyshev polynomial, and x_t following an $I(d)$ process of the form

$$(1 - L)^d x_t = u_t, \quad t = 0, \pm 1, \dots, \quad (2)$$

with $x_t = 0$ for $t \leq 0$, and $d > 0$, where L is the lag-operator ($Lx_t = x_{t-1}$) and u_t is $I(0)$.

The Chebyshev polynomials $P_{i,T}(t)$ in equation (1) are defined as:

$$P_{0,T}(t) = 1, \\ P_{i,T}(t) = \sqrt{2} \cos(i\pi(t-0.5)/T), \quad t = 1, 2, \dots, T; \quad i = 1, 2, \dots \quad (3)$$

(see Hamming (1973) and Smyth (1998) for a detailed description of these polynomials). Bierens (1997) uses them in the context of unit root testing. According to Bierens (1997) and Tomasevic and Stanivuk (2009), it is possible to approximate highly non-linear trends with rather low degree polynomials. If $m = 0$ the model contains an intercept, if $m = 1$ it also includes a linear trend, and if $m > 1$ it becomes non-linear - the higher m is the less linear the approximated deterministic component becomes.

An issue that immediately arises here is how to determine the optimal value of m . As argued in Cuestas and Gil-Alana (2015), if one combines (1) and (2) in a single equation, standard t -statistics will remain valid with the error term being $I(0)$ by definition. The choice of m will then depend on the significance of the Chebyshev coefficients. Note that the model combining (1) and (2) becomes linear and d can be estimated parametrically or tested as in Robinson (1994), Demetrescu, Kuzin and Hassler (2008) and others (see Cuestas and Gil-Alana, 2015).

The method proposed here is a slight modification of Robinson's (1994). He considers the same set-up as in (1) and (2) with the first component in the right hand side in (1) replaced by θz_t , and testing the null hypothesis:

$$H_0 : d = d_0, \quad (4)$$

for any real vector value d_0 . Under H_0 (4), the model in Robinson (1994) becomes:

$$y_t^* = \theta' z_t^* + u_t, \quad t = 1, 2, \dots, \quad (5)$$

where $y_t^* = (1 - L)^{d_0} y_t$, $z_t^* = (1 - L)^{d_0} z_t$, and the symbol $'$ indicating transposition. Then, given the linear structure of the above relationship and the $I(0)$ nature of the error term u_t , the coefficients in (5) can be estimated by standard ordinary least square/generalized least square (OLS/GLS) methods.¹ The same applies in our case, with (1) containing the Chebyshev polynomials: despite the non-linear structure, the relationship is linear in the parameters. Thus, combining equations (1) and (2) we obtain,

$$y_t^* = \theta' P_T^*(t) = \sum_{i=0}^m \theta_i P_{iT}^*(t) + u_t, \quad t = 1, 2, \dots, \quad (6)$$

where

¹ Although Robinson (1994) focuses exclusively on the linear case, he argues (p. 1421) that "(...) undoubtedly a non-linear regression will also leave our limit distributions unchanged, under standard regularity conditions." These conditions can be found in Robinson (1994).

$P_{iT}^*(t) = \rho(L; d_0) P_{iT}(t)$, which can also be expressed as in Robinson (1994) ($P_T^*(t) = z_t^*$), and then, using OLS/GLS methods, under the null hypothesis (4), the residuals are,

$$\hat{u}_t = y_t^* - \sum_{i=0}^m \hat{\theta}_i P_{iT}^*(t);$$

with

$$\hat{\theta} = \left(\sum_{t=1}^T P_T^*(t) P_T^*(t)' \right)^{-1} \left(\sum_{t=1}^T P_T^*(t) y_t^* \right),$$

and $P_T^*(t)$ as the $(m \times 1)$ vector of transformed Chebyshev polynomials. Using the above residuals \hat{u}_t , we estimate the variance,

$$\hat{\sigma}^2(\tau) = \frac{2\pi}{T} \sum_{j=1}^T g(\lambda_j; \hat{\tau})^{-1} I_{\hat{u}}(\lambda_j); \quad \lambda_j = 2\pi j/T, \quad (7)$$

where $I_{\hat{u}}(\lambda_j)$ is the periodogram of \hat{u}_t ; g is a function related to the spectral density of u_t (i.e., s.d.f. $(u_t) = (\sigma^2/2\pi)g(\lambda_j; \tau)$); and the nuisance parameter τ is estimated, for example, by $\hat{\tau} = \arg \min_{\tau \in T^*} \sigma^2(\tau)$, where T^* is a suitable subset of the R^d Euclidean space.²

The test statistic (based on Robinson (1994)) for testing H_0 (4) in (1) and (2) uses the Lagrange Multiplier (LM) principle, and is given by,

$$\hat{R} = \frac{T}{\hat{\sigma}^4} \hat{a}' \hat{A}^{-1} \hat{a}, \quad (8)$$

where T is the sample size, and

$$\hat{a} = \frac{-2\pi}{T} \sum_j^* \psi(\lambda_j) g(\lambda_j; \hat{\tau})^{-1} I_{\hat{u}}(\lambda_j), \\ \hat{A} = \frac{2}{T} \left(\sum_j^* \psi(\lambda_j) \psi(\lambda_j)' - \sum_j^* \psi(\lambda_j) \hat{\varepsilon}(\lambda_j)' \left(\sum_j^* \hat{\varepsilon}(\lambda_j) \hat{\varepsilon}(\lambda_j)' \right) \sum_j^* \hat{\varepsilon}(\lambda_j) \psi(\lambda_j)' \right)$$

with $\psi(\lambda_j) = \text{Re} \left(\frac{\partial}{\partial d} \log \rho(e^{i\lambda_j}; d) \right)$, and

$$\hat{\varepsilon}(\lambda_j) = \frac{\partial}{\partial \tau} \log g(\lambda_j; \tau) \Big|_{\tau = \hat{\tau}},$$

and the sum over $*$ above refers to all the bounded discrete frequencies in the spectrum. Under very mild regularity conditions,³ it can be shown that, as in Robinson (1994),

$$\hat{R} \rightarrow_d \chi_1^2 \quad \text{as } T \rightarrow \infty, \quad (9)$$

and, based on Gaussianity of u_t , one can also show the Pitman efficiency of the test against local departures from the null. In other words, if one considers local alternatives of the form:

² Alternative methods for estimating the variance, e.g., non-parametric ones, could also be used. Here we take the same approach as in Robinson (1994).

³ These conditions only include moments up to a second order.

$H_a: d = d_o + \delta T^{-1/2}$, where δ is a non-null parameter vector, $\hat{R} \rightarrow_d \chi_1^2(\Lambda)$ as $T \rightarrow \infty$, indicating a non-central chi-squared distribution with a non-centrality parameter which is optimal under Gaussianity of u_t . Note that this method is a testing procedure and therefore we do not directly estimate the fractional differencing parameter vector but simply present confidence intervals based on the non-rejections for a given set of values. However, we display estimates of d , based on the values minimizing the absolute value of the test statistic. Monte Carlo evidence suggests that this approach performs well (Cuestas and Gil-Alana, 2015).

EMPIRICAL RESULTS AND DISCUSSION

We use data on real GDP per capita in 28 African countries at 2005 constant prices. The source is the Penn World Table.

Table 1 provides a list of the countries with the corresponding sample periods, the longest being those starting in 1950 for the Congo Democratic Republic, Ethiopia, Morocco, Nigeria, South Africa and Uganda. The start date is 1954 for Zimbabwe, 1955 for Zambia and Ghana, 1960 for Algeria, Botswana, Burundi, Central African Rep., Chad, Congo Republic, Cape Verde, Equatorial Guinea, Gambia, Guinea Bissau, Mali, Mauritania, Mozambique, Namibia and Niger, 1961 for Sierra Leone and Tunisia, 1970 for Angola and Somalia. The end date is 2010 in all cases.

The unit root test results (ADF, KPSS and ERS) reported in Tables 2 (in levels) and 3 (in first differences) suggest that the level series are $I(1)$, whilst the GDP growth rates are $I(0)$ in all cases. However, it is well known that such tests have very low power if the DGP is characterised by fractionally integration (Diebold and Rudebusch, 1991; Hassler and Wolters, 1994; Lee and Schmidt, 1996; Nasr *et al.*, 2014); on the other hand, fractional integration may be a spurious phenomenon caused by the presence of non-linearities and structural breaks in the data that have not been taken into account.⁴ For these reasons, next we allow for non-linear trends in the context of fractional integration, and consider the following model,

$$y_t = \sum_{i=0}^m \theta_i P_{IT}(t) + x_t, \quad (1-L)^d x_t = u_t, \quad (10)$$

assuming that u_t is a white noise process. Allowing for autoregressive behaviour in the error term u_t in (10) produced coefficients close to 0 in all cases. We also performed a LR test that strongly supports the white noise specification for all the series examined.

First we assume that $m = 3$ to allow for a high degree of non-linear behaviour. Table 4 displays in the second column the estimates of d along with their corresponding 95% confidence bands showing the values of d for which the null hypothesis (4) cannot be rejected. The remaining columns display the estimated coefficients along with their corresponding t-values.

For the Central African Republic, Niger, Sierra Leone and Somalia there is no evidence of non-linearities, since the two coefficients on the non-linear terms (i.e., θ_2 and θ_3) are statistically insignificant. Further, the order of integration varies considerably across these countries: for the Central African Republic and Somalia, the estimated value of d is significantly smaller than 1 (0.37 and 0.49 respectively), which implies in both cases mean-reverting behaviour; for Niger the estimate of d is below 1, but the unit root null hypothesis cannot be rejected; and for Sierra Leone the estimated value of d is 1.32 and the hypothesis of $d = 1$ is decisively rejected in favour of $d > 1$.

The countries exhibiting a large degree of non-linearity are those for which all four coefficients are statistically significant, namely Cabo Verde, Equatorial Guinea, Gambia, Mauritania, Mozambique and Uganda. In four of them (Cabo Verde, Equatorial Guinea, Mozambique and Uganda) the unit root null (i.e., $d = 1$) cannot be rejected, while for the remaining two (Gambia and Mauritania) the null of mean reversion (i.e., $d < 1$) cannot be rejected.

In between, there are some cases with at least one of the two non-linear coefficients being statistically significant. Specifically, a significant θ_3 is found for Algeria, Ethiopia, Gambia, Morocco, Nigeria, Namibia, South Africa, Tunisia and Zambia, and a significant θ_2 -coefficient for Botswana, Burundi, Chad, Congo Democratic Republic, Congo Republic, Guinea Bissau and Mali. For this group of countries, mean reversion ($d < 1$) is found in Algeria, Botswana, Guinea Bissau, Malia, Namibia and Tunisia, whilst the unit root null cannot be rejected in Angola, Burundi, Chad, Congo Democratic Republic, Congo, Ethiopia, Ghana, Morocco, Nigeria, South Africa, Zambia and Zimbabwe. Therefore, we can conclude by saying that there is some evidence of non-linearity in all except the above mentioned four countries (Central African Republic, Niger, Sierra Leone and Somalia).

Tables 5 and 6 display the results for $m = 2$ and $m = 1$ respectively. They are completely in line with those reported above for the case of $m = 3$. Table 7 reports the selected model for each country. In fourteen countries the specification with $m = 3$ is found to be the most appropriate - these are Algeria, Cabo Verde, Equatorial Guinea, Ethiopia, Gambia, Ghana, Mauritania, Mozambique, Namibia, Nigeria, South Africa, Tunisia, Uganda and Zambia. For another group of countries, including Angola, Botswana, Burundi, Chad, Congo Democratic Republic, Congo Republic, Guinea Bissau, Mali, Morocco and Zimbabwe, the best model is the one with $m = 2$; for Somalia, the specification includes a linear time trend, and finally, for Central African, Niger and

⁴ This point has been made by several authors including Bhattacharya *et al.* (1983), Teverovsky and Taqqu (1997), Smith (2005), Ohanissian *et al.* (2008), Perron and Qu (2010), etc.

Table 1. List of countries and sample size.

Country	Starting date	Ending date	No. of observations
Algeria	1960	2010	51
Angola	1970	2010	41
Botswana	1960	2010	51
Burundi	1960	2010	51
Cape Verde	1960	2010	51
Central African Rep.	1960	2010	51
Chad	1960	2010	51
Congo Dem. Rep.	1950	2010	61
Congo Rep.	1960	2010	51
Equatorial Guinea	1960	2010	51
Ethiopia	1950	2010	61
Gambia	1960	2010	51
Ghana	1955	2010	56
Guinea Bissau	1960	2010	51
Mali	1960	2010	51
Mauritania	1960	2010	51
Morocco	1950	2010	61
Mozambique	1960	2010	51
Namibia	1960	2010	51
Niger	1960	2010	51
Nigeria	1950	2010	61
South Africa	1950	2010	61
Sierra Leone	1961	2010	50
Somalia	1970	2010	41
Tunisia	1961	2010	50
Uganda	1950	2010	61
Zambia	1955	2010	56
Zimbabwe	1954	2010	57

Table 2. Unit root test results (levels).

Country	ADF		KPSS		ERS	
	Intercept	T. trend	Intercept	T. trend	Intercept	T. trend
Algeria	-0.629196	-2.961852	0.783198***	0.102005	14.24983	11.32340
Angola	1.836251	0.518612	0.399583*	0.187202**	32.79653	66.76069
Botswana	-0.107168	-3.055937	0.933389***	0.179059**	153.4363	12.79852
Burundi	-1.993673	-1.678875	0.240580	0.220282***	13.50598	41.10326
Cape Verde	4.246626	0.823215	0.855589***	0.227643***	250.1908	105.5559
Central African Rep.	-0.949002	-3.270792*	0.913144***	0.089585	33.80204	8.450531
Chad	-0.096397	-0.813696	0.359030*	0.193348**	11.78548	25.67639
Congo Dem. Rep.	-0.272646	-3.218803*	0.783635***	0.202449**	20.92074	47.22060
Congo Rep.	-1.653857	-1.378591	0.650773**	0.201905**	37.91988	25.24673
Equatorial Guinea	2.389068	-3.028438	0.609258**	0.202397**	1.184983***	0.172974***
Ethiopia	0.341809	-0.208754	0.422679*	0.134162*	35.60427	27.64280
Gambia	-2.428238	-2.430300	0.191464	0.185197**	4.997211	12.26448
Ghana	0.403107	-0.296392	0.414326*	0.174116**	20.58400	23.93080
Guinea Bissau	-2.080610	-2.322633	0.221729	0.173441**	5.749240	16.62405
Mali	1.001084	-2.837289	0.892943***	0.213381**	46.06339	30.07915
Mauritania	-2.383145	-2.531172	0.655820**	0.171435**	43.97707	21.38731

Table 2. Contd.

Morocco	1.120514	-1.826865	0.951615***	0.080592	145.5967	17.23232
Mozambique	3.378613	1.442896	0.562350**	0.195555**	114.5698	116.0452
Namibia	-1.669098	-1.843135	0.300645	0.127344*	22.41283	20.02045
Niger	-0.780237	-2.410178	0.860278***	0.139081*	26.41376	15.52441
Nigeria	-2.166709	-2.142204	0.113443	0.116760	4.180557	9.872862
South Africa	-0.287500	-1.418518	0.828434***	0.122150*	86.17429	16.62109
Sierra Leone	-1.943010	-1.946805	0.155448	0.143902*	10.34364	14.31889
Somalia	-1.055053	-3.359393*	0.715713**	0.067251	14.63175	9.032007
Tunisia	-0.370069	-2.266093	0.917923***	0.080777	276.6127	9.951711
Uganda	0.149478	-0.548710	0.308285	0.181477**	17.70829	39.34480
Zambia	-1.027385	-0.834667	0.399372*	0.137932*	9.303952	30.47720
Zimbabwe	-1.933025	-1.447110	0.381560*	0.381560***	13.87958	22.59612

*Rejection at 10%; **Rejection at 5%; ***Rejection at 1%.

Table 3. Unit root test results (first differences).

Country	ADF		KPSS		ERS	
	Intercept	T. trend	Intercept	T. trend	Intercept	T. trend
Algeria	-8.031377***	-8.035174***	0.136037	0.086206	1.261192***	3.817498***
Angola	-4.265845***	-5.075182***	0.485975**	0.110410	1.388506***	5.313196**
Botswana	-7.102229***	-7.040803***	0.144804	0.128882*	1.075163***	3.638831***
Burundi	-6.098586***	-6.566598***	0.277927	0.088027	3.828045*	7.697453
Cape Verde	-4.522635***	-6.154891***	0.678958**	0.112596	1.468414***	4.822752**
Central African Rep.	-7.091284***	-7.016827***	0.083676	0.081268	1.295454***	3.169795***
Chad	-5.484588***	-5.673970***	0.271841	0.062483	1.044450***	3.716404***
Congo Dem. Rep.	-7.543291***	-7.609963***	0.278939	0.112461	2.999226*	4.710365**
Congo Rep.	-5.376108***	-5.349663***	0.146577	0.058986	1.315274***	4.093757***
Equatorial Guinea	-1.562729	-3.101588	0.293199	0.076178	6.292617	5.687500**
Ethiopia	-7.915775***	-8.073409***	0.269474	0.224027***	1.423644***	4.164478***
Gambia	-7.251590***	-7.230887***	0.095739	0.075360	1.912782**	4.597054**
Ghana	-6.770594***	-7.040604***	0.314692	0.149621**	1.416303***	4.426892**
Guinea Bissau	-8.051499***	-8.239527***	0.151576	0.050941	1.280371***	4.316129**
Mali	-6.051802***	-6.997345***	0.455721*	0.103298	0.984308***	2.057099***
Mauritania	-8.772692***	-9.003160***	0.248982	0.139610*	1.586479***	4.669348**
Morocco	-8.754953***	-9.080136***	0.300751	0.097564	0.995380***	3.117883***
Mozambique	-4.392688***	-5.133809***	0.536365**	0.196035**	1.450947***	3.902841***
Namibia	-7.529205***	-7.451359***	0.154072	0.154333**	1.084579***	3.706657***
Niger	-7.097787***	-7.016457***	0.115738	0.117548	1.559816***	4.227351**
Nigeria	-5.467455***	-5.421933***	0.103756	0.103436	0.974573***	3.401545***
South Africa	-5.349220***	-5.319508***	0.168457	0.166160**	1.016475***	3.446017***
Sierra Leone	-4.252713***	-4.137187***	0.173099	0.142885*	2.780876**	6.506296*
Somalia	-7.193110***	-7.089378***	0.087792	0.086363	1.669479***	5.014989**
Tunisia	-7.846147***	-7.759871***	0.051523	0.051546	1.033970***	3.767401***
Uganda	-5.542541***	-6.082612***	0.377880*	0.167617**	3.152519*	6.618272*
Zambia	-6.098201***	-6.105915***	0.205915	0.182011**	1.398511***	4.191256***
Zimbabwe	-8.286360***	-8.571890***	0.286539	0.045342	0.908183***	3.453683***

*Rejection at 10%; **Rejection at 5%; ***Rejection at 1%.

Sierra Leone it only includes an intercept. Mean reversion is only found for the following countries: Central African Republic, Gambia, Mali, Mauritania and Somalia, and

orders of integration significantly above 1 are estimated only for Angola and Sierra Leone. For the remaining countries, the unit root null cannot be rejected.

Table 4. Estimated coefficients in a model with $m = 3$.

Country	d (95 interval)	θ_0	θ_1	θ_2	θ_3
Angola	1.16 (0.93, 1.45)	2355.81 (1.87)	-315.19 (-0.41)	555.24 (1.73)	-240.75 (-1.20)
Algeria	0.60 (0.33, 0.93)	4991.13 (16.39)	-663.64 (-3.82)	-53.06 (0.41)	-265.79 (-2.57)
Botswana	0.56 (0.21, 0.98)	4882.13 (14.67)	-3103.37 (-16.13)	306.28 (2.07)	-192.36 (-1.60)
Burundi	0.88 (0.61, 1.25)	468.54 (7.56)	-13.64 (-0.38)	-75.24 (-3.72)	-0.67 (-0.04)
Central African Rep.	0.37 (0.11, 0.72)	760.41 (43.43)	-163.42 (-14.19)	-1.65 (-0.16)	-7.19 (-0.83)
Chad	0.97 (0.65, 1.40)	838.6281 (3.41)	-78.58 (-0.55)	122.42 (1.65)	-62.39 (-1.24)
Congo Dem. Rep.	0.93 (0.67, 1.19)	421.55 (2.74)	185.01 (-2.08)	-90.63 (-1.88)	-16.68 (-0.50)
Congo Rep.	1.03 (0.68, 1.44)	1963.07 (3.48)	-376.50 (-1.13)	-281.73 (-1.75)	-24.47 (-0.23)
Cabo Verde	1.16 (0.96, 1.39)	1691.49 (2.95)	-669.56 (-1.90)	257.05 (1.75)	-179.91 (-1.96)
Equatorial Guinea	1.06 (0.81, 1.34)	4750.37 (1.67)	-3744.48 (-2.16)	2790.42 (3.45)	-1951.67 (-3.71)
Ethiopia	0.98 (0.78, 1.17)	409.13 (4.23)	-33.71 (-0.59)	-2.22 (-0.07)	-50.02 (-2.56)
Gambia	0.51 (0.11, 0.98)	1229.70 (28.12)	4.27 (0.16)	-58.52 (-2.84)	-42.83 (-2.50)
Ghana	0.88 (0.54, 1.21)	1365.27 (6.37)	-114.28 (-0.93)	100.80 (1.43)	138.54 (-2.81)
Guinea Bissau	0.70 (0.49, 0.97)	915.37 (8.05)	21.18 (0.33)	-100.56 (-2.30)	-12.68 (-0.38)
Mali	0.69 (0.47, 0.97)	670.18 (14.78)	-150.70 (-5.94)	46.81 (2.66)	-10.94 (-0.81)
Mauritania	0.53 (0.26, 0.82)	1454.17 (16.36)	-252.74 (-4.74)	-128.31 (-3.14)	-178.55 (-5.30)
Morocco	0.92 (0.77, 1.11)	2085.21 (6.36)	-774.31 (-4.09)	15.95 (0.15)	-136.88 (-1.91)
Mozambique	1.01 (0.77, 1.28)	422.38 (6.40)	-80.86 (-2.06)	64.80 (3.38)	-65.28 (-5.12)
Namibia	0.52 (0.15, 0.90)	3737.79 (23.97)	-223.94 (-2.43)	51.13 (0.70)	-400.10 (-6.67)
Niger	0.70 (0.28, 1.10)	660.64 (10.24)	171.06 (4.74)	26.69 (1.07)	-26.46 (-1.39)
Nigeria	1.09 (0.81, 1.50)	1408.27 (2.38)	21.07 (0.05)	-22.01 (-0.13)	-201.32 (-1.94)
South Africa	1.12 (0.93, 1.40)	5329.23 (6.36)	-856.77 (-1.68)	-161.35 (-0.72)	-432.70 (-3.06)
Sierra Leone	1.32 (1.07, 1.67)	352.28 (0.66)	168.06 (0.49)	-109.71 (-0.92)	-21.50 (-0.30)
Somalia	0.49 (0.17, 0.90)	606.98 (17.37)	125.96 (6.01)	1.22 (0.07)	-5.35 (-0.38)
Tunisia	0.58 (0.29, 0.95)	3940.28 (32.34)	-1229.80 (-17.69)	24.94 (0.47)	-259.58 (-6.08)
Uganda	0.94 (0.69, 1.31)	746.92 (7.54)	-55.40 (-0.96)	88.52 (2.87)	-94.87 (-4.50)
Zambia	0.87 (0.59, 1.23)	1167.55 (4.82)	162.23 (1.17)	74.11 (0.92)	-201.23 (-3.57)
Zimbabwe	0.81 (0.47, 1.19)	1.380 (5.45)	0.271 (1.90)	-0.138 (-1.67)	0.075 (1.17)

In bold, significant coefficients according to the t-values at 5% level.

Table 5. Estimated coefficients in a model with $m = 2$.

Country	d (95% interval)	θ_0	θ_1	θ_2
Angola	1.19 (1.02, 1.44)	1819.25 (1.87)	-174.43 (-0.20)	544.00 (1.77)
Algeria	0.77 (0.58, 1.02)	5032.94 (9.43)	-740.27 (-2.44)	-68.93 (-0.35)
Botswana	0.66 (0.40, 1.02)	4776.53 (10.34)	-3160.05 (-12.17)	299.14 (1.79)
Burundi	0.88 (0.61, 1.26)	467.82 (7.78)	-13.76 (-0.39)	-75.24 (-3.72)
Central African Rep.	0.38 (0.11, 0.73)	759.31 (41.76)	161.71 (13.80)	-1.84 (-0.18)
Chad	1.03 (0.78, 1.40)	738.28 (2.56)	-69.34 (-0.39)	120.92 (1.40)
Congo Dem. Rep.	0.94 (0.71, 1.19)	397.13 (2.58)	184.57 (1.99)	-90.42 (-1.82)
Congo Rep.	1.03 (0.68, 1.43)	1926.36 (3.56)	-375.09 (-1.12)	-281.74 (-1.75)
Cabo Verde	1.24 (1.10, 1.42)	1208.17 (1.71)	-485.39 (-1.04)	228.41 (1.27)
Equatorial Guinea	1.28 (1.11, 1.52)	1315.71 (0.22)	-3428.94 (-0.87)	2915.99 (2.01)
Ethiopia	1.08 (0.97, 1.21)	305.87 (2.28)	-10.34 (-0.12)	-5.60 (-0.14)
Gambia	0.70 (0.42, 1.05)	1205.72 (14.60)	-9.40 (-0.20)	-58.69 (-1.81)
Ghana	1.06 (0.89, 1.26)	1094.52 (2.84)	-64.32 (-0.26)	92.91 (0.82)
Guinea Bissau	0.70 (0.49, 0.97)	906.98 (8.11)	17.16 (0.27)	-100.89 (-2.30)
Mali	0.71 (0.51, 0.99)	665.26 (13.96)	-154.24 (-5.75)	46.36 (2.50)
Mauritania	0.86 (0.72, 1.04)	1211.90 (4.34)	-281.78 (-1.73)	-124.78 (-1.88)

Table 5. Contd.

Morocco	0.99 (0.86, 1.15)	1903.88 (4.67)	-768.91 (-3.08)	6.76 (2.05)
Mozambique	1.28 (1.17, 1.43)	236.59 (1.69)	-5.20 (-2.04)	54.12 (13.91)
Namibia	0.96 (0.82, 1.15)	3017.15 (4.30)	-223.58 (-0.53)	62.61 (0.28)
Niger	0.79 (0.42, 1.11)	622.62 (7.31)	164.88 (3.39)	27.15 (0.88)
Nigeria	1.19 (0.99, 1.54)	988.58 (1.23)	111.42 (0.21)	-24.06 (-0.11)
South Africa	1.26 (1.13, 1.48)	4216.21 (3.22)	-465.41 (-0.53)	-209.17 (-0.63)
Sierra Leone	1.33 (1.11, 1.75)	284.97 (0.55)	195.31 (-0.57)	-111.81 (-0.91)
Somalia	0.49 (0.16, 0.91)	605.53 (17.40)	124.46 (6.04)	1.05 (0.06)
Tunisia	0.99 (0.85, 1.19)	3507.53 (7.16)	-1230.76 (-4.14)	28.65 (0.19)
Uganda	1.21 (1.07, 1.43)	518.16 (2.09)	4.23 (0.02)	84.58 (1.31)
Zambia	1.09 (0.94, 1.31)	751.44 (1.49)	239.27 (0.75)	70.77 (0.49)
Zimbabwe	0.86 (0.60, 1.22)	1.45 (4.86)	0.28 (1.68)	-0.13 (-1.67)

In bold, significant coefficients according to the t-values at 5% level.

Table 6. Estimated coefficients in a model with $m = 1$.

Country	d (95% interval)	θ_0	θ_1
Angola	1.25 (1.11, 1.47)	2376.49 (1.88)	-18.71 (-0.02)
Algeria	0.77 (0.59, 1.03)	4949.06 (10.36)	-743.33 (-2.45)
Botswana	0.75 (0.56, 1.06)	4102.00 (9.12)	-3137.99 (-8.88)
Burundi	1.14 (0.99, 1.39)	372.66 (2.81)	-14.54 (-0.16)
Central African Rep.	0.37 (0.12, 0.73)	758.57 (44.51)	161.72 (14.15)
Chad	1.10 (0.91, 1.42)	879.58 (2.64)	-48.72 (-0.21)
Congo Dem. Rep.	1.03 (0.87, 1.23)	231.16 (1.21)	201.54 (1.54)
Congo Rep.	1.15 (0.93, 1.50)	1481.14 (1.99)	-350.40 (-0.68)
Cabo Verde	1.27 (1.15, 1.42)	1431.93 (1.94)	-413.11 (-0.80)
Equatorial Guinea	1.37 (1.23, 1.50)	5259.44 (0.69)	-3262.64 (-0.61)
Ethiopia	1.09 (0.97, 1.22)	293.05 (2.31)	-7.21 (-0.08)
Gambia	0.80 (0.61, 1.09)	1126.75 (10.94)	-8.54 (-0.12)
Ghana	1.08 (0.93, 1.27)	1205.25 (3.20)	-50.48 (-0.19)
Guinea Bissau	0.82 (0.67, 1.04)	764.22 (5.09)	18.35 (0.18)
Mali	0.84 (0.70, 1.05)	763.30 (11.17)	-153.92 (-3.60)
Mauritania	0.90 (0.77, 1.07)	1018.59 (3.56)	-271.53 (-1.44)
Morocco	0.99 (0.86, 1.15)	1913.43 (5.21)	-768.91 (-3.08)
Mozambique	1.30 (1.21, 1.44)	295.49 (1.82)	7.96 (0.07)
Namibia	0.96 (0.82, 1.15)	3104.69 (4.93)	-223.46 (-0.53)
Niger	0.83 (0.58, 1.13)	648.59 (7.50)	167.50 (2.99)
Nigeria	1.19 (0.99, 1.54)	955.76 (1.28)	110.32 (0.21)
South Africa	1.27 (1.14, 1.51)	3911.36 (3.05)	-461.12 (-0.51)
Sierra Leone	1.38 (1.16, 1.81)	75.75 (0.13)	228.14 (0.56)
Somalia	0.49 (0.17, 0.92)	606.23 (18.40)	124.54 (6.05)
Tunisia	0.99 (0.85, 1.19)	3547.91 (8.03)	-1230.76 (-4.13)
Uganda	1.24 (1.12, 1.44)	613.50 (2.38)	21.20 (0.11)
Zambia	1.10 (0.95, 1.31)	838.61 (1.75)	248.11 (0.75)
Zimbabwe	0.93 (0.73, 1.24)	1.268 (3.81)	0.284 (1.68)

In bold, significant coefficients according to the t-values at 5% level.

Conclusion

This paper applies a fractional integration approach

incorporating Chebyshev polynomials to allow for possible non-linearities in GDP per capita. This is particularly appropriate in the case of African countries, where growth

Table 7. Order of integration of each series according to the selected models.

Country	m = 0	m = 1	m = 2	m = 3
Angola	1.25 (1.09, 1.49)	xxx	1.19 (1.02, 1.44)	xxx
Algeria	xxx	0.77 (0.59, 1.03)	xxx	0.60 (0.33, 0.93)
Botswana	xxx	xxx	0.66 (0.40, 1.02)	xxx
Burundi	1.14 (0.99, 1.40)		0.88 (0.61, 1.25)	xxx
Central African Rep.	0.37 (0.12, 0.73)	xxx	xxx	xxx
Chad	1.09 (0.89, 1.42)	xxx	0.97 (0.65, 1.40)	xxx
Congo Dem. Rep.	xxx	xxx	0.94 (0.71, 1.19)	xxx
Congo Rep.	1.15 (0.93, 1.49)	xxx	1.03 (0.68, 1.43)	xxx
Cabo Verde	xxx	xxx	xxx	1.16 (0.96, 1.39)
Equatorial Guinea	xxx	xxx	xxx	1.06 (0.81, 1.34)
Ethiopia	1.08 (0.94, 1.24)	xxx	xxx	0.98 (0.78, 1.17)
Gambia	xxx	xxx	xxx	0.51 (0.11, 0.98)
Ghana	1.06 (0.89, 1.29)	xxx	xxx	0.88 (0.54, 1.21)
Guinea Bissau	0.83 (0.68, 1.04)	xxx	0.70 (0.49, 0.97)	xxx
Mali	xxx	xxx	0.71 (0.51, 0.99)	xxx
Mauritania	xxx	xxx	xxx	0.53 (0.26, 0.82)
Morocco	xxx	xxx	0.99 (0.86, 1.15)	xxx
Mozambique	xxx	xxx	xxx	1.01 (0.77, 1.28)
Namibia	0.93 (0.75, 1.14)	xxx	xxx	0.52 (0.15, 0.90)
Niger	0.83 (0.58, 1.13)	xxx	xxx	Xxx
Nigeria	1.19 (1.02, 1.44)	xxx	xxx	1.09 (0.81, 1.50)
South Africa	1.20 (1.00, 1.54)	xxx	xxx	1.12 (0.93, 1.40)
Sierra Leone	1.24 (1.08, 1.50)	xxx	xxx	xxx
Somalia	xxx	0.49 (0.17, 0.92)	xxx	xxx
Tunisia	xxx	0.99 (0.85, 1.19)	xxx	0.58 (0.29, 0.95)
Uganda	xxx	xxx	Xxx	0.94 (0.69, 1.31)
Zambia	1.15 (0.99, 1.38)	xxx	xxx	0.87 (0.59, 1.23)
Zimbabwe	xxx	Xxx	0.86 (0.60, 1.22)	xxx

has been affected by various conflicts. The results for a sample of 28 countries confirm the existence of non-linearities in most cases, the only exceptions being the Central African Republic, Niger, Sierra Leone and Somalia. For the remaining countries strong evidence of non-linearities is obtained for Cabo Verde, Equatorial Guinea, Gambia, Mauritania, Mozambique and Uganda, followed by Algeria, Ethiopia, Gambia, Morocco, Nigeria, Namibia, South Africa, Tunisia and Zambia (where θ_3 is statistically significant), and for Botswana, Burundi, Chad, Congo Democratic Republic, Congo Republic, Guinea Bissau and Mali (with a significant θ_2 -coefficient).

Heterogeneity across countries is another feature of our results, mean-reversion, unit root behaviour and orders of integration significantly higher than 1 being found in different cases. Overall, the evidence presented in this study confirms the importance of taking into account non-linearities when modelling GDP per capita in countries such as the African ones where various types of conflicts have disrupted economic growth at different stages.

Concerning the interpretation and the policy implications

of these results, it should be noticed that in countries where d is smaller than 1 mean reversion occurs and therefore in case of negative shocks (for instance due to wars) the series will return by themselves to their growth path and no policy intervention is necessary; in contrast, in countries where d is equal to or higher shocks will have permanent effects and consequently activist policies will be required to recover from negative shocks.

Conflict of Interests

The author has not declared any conflict of interests.

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