Can food availability influence economic growth – the case of African countries

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Abstract: There is a growing consensus that food security is vital to the general wellbeing of any economy, but a far less consensus on whether food security can spur economic growth in a country. Many economic growth strategies focus on specific interventions (trade openness index, tropical climatic variables, working age population share etc.), but many factors, such as food availability, female education and health outcomes, can potentially have a profound influence on economic growth. To explore this hypothesis more systematically, this paper employs a rich cross-country dataset of 124 countries to examine the impact of food security, using food availability as a proxy on economic growth. This paper examines the impact of food shortages on African economic growth rates. It does so by extending the Barro growth model to include food availability as a right hand-side variable and by distinguishing African countries with food shortages from others. Based on the cross-country regressions results, the paper concludes that the improved food availability indeed contributes to the improved economic growth in general, as well as in Africa.

Key words: African dummy, food crisis, food security, Africa

The importance of the determinants of economic growth cannot be emphasized enough. Despite an impressive number of literatures available on this subject, it is still imperative to establish, with some level of certainty, the factors that policy makers should focus on whilst pursuing economic growth, particularly in Africa, where a struggle in achieving economic growth has been evident. Despite a significant number of available literatures in this area, there are contrasting opinions with regard to the determinants of economic growth. Various models and variables have been identified by various authors over the years. Among these authors, there are Barro (1991), Barro and Sala-i-Martin (1992) and Block (2001), who have used the cross-country data to compare economic growth across different regions and countries. The conjecture is that countries within Africa tend to grow differently and that these growth differences can be attributed to various factors, such as the tropical climatic variables, the working age population share, the trade openness index, life expectancy, the resource abundance and the access to the sea, Sachs and Warner (1997) and Burger and du Stan (2006). On the other hand, the findings of Easterly and Levine (1998) reveal that the life expectancy, the resource abundance, the institutional quality index and the access to the sea are not robustly significant in determining growth, but that instead the primary enrolment, the black market premium and the neighbourhood effect are a part of the important variables that account for the difference in economic growth.

The cross country data of 124 countries has been used, following the work of Barro (1991), with the inclusion of food supply as a new variable. Over the years, the emphasis has been on the policy action to resolve food shortages in Africa and authors such as Scanlan (2001) have attributed the inadequacy in food supply to the lack of economic growth within the continent. Using an OLS regression on food security change, Scanlan's findings suggest that both the population pressure and the over-urbanization have a negative impact on food security, while the fertilizer application technologies, the land use intensification, the infrastructural development and the internationalization of the food market have helped to offset these negative effects. Similarly, the findings of Yang et al. (2003) reveal that food insecurity and hunger are a direct result of low income. Also, the poor and populous countries might experience water deficit induced food insecurity, and the symptoms of starvation could intensify, if proper actions are not put in place over the next 30 years. Timmer (2004), using the Asian markets as an example, suggests that

economic growth and food security are mutually reinforcing. He argues that most Asian countries have been able to escape food insecurity through economic growth and at the same time economic growth has been achieved within this economy via an increase in food security. Dorward (2012) has also shown that the short term food security can be improved by increasing economic growth and lowering domestic prices.

Despite a significant success in the aforementioned school of thought, little has been achieved with regard to the increasing economic growth within African countries. This begs the question whether the low food supply really is due to the poor economic growth or whether it is actually the other way round. This forms the basis of this research work and the research paper attempts to provide an answer by using the traditional cross country dynamics in growth model.

The next section of this paper examines the review of different contending opinions with regard to what accounts for the growth differences between Africa and other continents. The third section explains the model and the data used for this work. The fourth section, by using a descriptive analysis, examines the relationship between food supply and the GDP growth rate over the length of the study. The findings and the subsequent discussion will be outlined in the fifth section and the sixth section provides a conclusion and recommendations based on the findings of this work.

REVIEW OF DETERMINANTS OF GROWTH

The past decade has witnessed a remarkable surge of interest in food security and the economic growth issues. There is now abundant evidence that these two issues are intertwined. The Asian story is a valid indicator of the current link of these two areas. The word food shortage or crisis is gradually becoming an appellation for the African continent. The continent, especially with regard to the Sub Saharan African countries, shows the weakest signs for food security and human welfare indicators within this timeline. It has to be noted though that a number of African countries recorded a tremendous economic growth within the same timeline. Five African countries made the list of the World's ten fastest growing economies between 2001–2010, with Angola (11.1%), Nigeria (8.9%) and Rwanda (7.6%) all featuring on the list. Estimating and measuring economic growth is not a new field of research, although the variables for measurement are not static. Different variables have been identified as determinants for economic growth. According to the Solow growth model, the major determinants for growth are initially the level of income, technology, the population growth rate, depreciation and the level of capital stock. Several studies and methods have been used to analyse the determinants for economic growth. Such studies include the work of Alfaro et al. (2004), which suggests that foreign direct investment alone has an uncertain impact on economic growth and countries with well-developed financial markets tend to gain more from it. Similarly, the determinants of growth within regions of Russia have been identified as export and foreign direct investment (Ledyaeva and Linden 2008). This study suggests that the export within the Russian regions is mainly due to oil and gas. In as much as this spur growth rests in the short-term, it may not be sustainable in the long-term considering the high volatility of oil prices. Policy makers in Russia should look into other exports, rather than solely relying on the oil export as a source for economic growth. Furthermore, Rupasingha et al. (2002) have identified both social and institutional factors for different states within the United States that are important factors with regard to explaining the difference in convergence rates amongst the states. In particular, these are the ethnic diversity and the high social capital. Both appear to contribute positively to economic growth, while the income inequality hampers growth in the studied states.

Studies on Africa economic growth have discovered that most of the mentioned variables or factors fail to correctly capture the African economic growth story. Their findings suggest that perhaps there are other factors apart from those commonly employed, which can explain the retrogression in growth within the African region. Hoeffler (2002) has identified low investment and high population growth rates as some of these factors. Similarly, Easterly and Levine (1997) have argued that the inhibited economic growth within the Sub Saharan Africa is due to several variables, such as the low enrolment numbers for school, political instability, underdeveloped financial systems, the distorted foreign exchange markets, high government deficits, and the insufficient infrastructure. Glewwe et al. (2007) found that, since the quality of education in Africa is lower compared to other developing countries, the contribution to growth is lower as well, and it would be more useful to focus on a country specific microeconomic study rather than the cross country studies, if the credible evidence on the impact

of education on economic growth is to be obtained. Block (2001) argued that an abundance of natural resources is detrimental to institutional development within Africa, and other factors that tend to reduce the population growth and enhance the institutional quality outside Africa do not have the same positive impact within Africa. Other important works that buttress this point include the work of Bloom and Sachs (1998), which reveals that the major obstacle for growth within Africa is its climate, soils, topography, demography and the disease ecology, leading to a low agricultural productivity, high disease burdens and a low international trade. Acemoglu et al. (2001) also suggest that the dysfunctional extractive institutions using high settler mortality rates as a proxy is one of the reasons for the slow growth within the newly independent Sub Saharan African countries. Englebert (2000) reveals that most African countries are faced with substantial limitations with regard to powers and are therefore constrained in their responses. Instead of pursuing developmental policies, they opt for the policies from which they can gain power.

Diop et al. (2010) suggest that poor governance and weak institutions, such as the rule of law, property rights, the regulatory burden, the political violence, and the governmental ineffectiveness hinder growth within the ECOWAS countries. Similarly, Tsangarides (2005) reveals that the convergence of per capita income in Africa is particularly dependent on the political and institutional variables. This paper examines the impact of food availability on economic growth within Africa and attempts to investigate if the inadequate food availability is one of the reasons, why some African countries have experienced stunt growth over the years. In order to accomplish this goal, two sets of dummies were introduced in this study; a 0–1 dummy variable and a second 0–1 dummies for African countries with food crisis over the last decade.

ECONOMETRIC MODEL

In the work of Burger and du Plessis (2006), "model selection is very complex, especially in the field of growth where there are a remarkable large number of potential regressors and insufficient theoretical guidance to form a consensus on model specification". Therefore, for this study, the traditional dynamic Solow model for the cross country analysis was followed using data from 124 countries from 1970 to 2007. As the researchers are interested in the overall impact of food supply on economic growth, all variables were averaged out in order to net out the cyclical fluctuations and to average out each country's time series into a single data point, in order to eliminate variations within each country over the study period. Many authors have used this method of single point averaging, including Barro (1991), Barro and Sala-i-Martin (1991, 1992) and Kormendi and Mequire (1985).

$$\ln y_{it} - \ln y_{io} = a_0 - a_1 \ln y_{io} + a_2 \ln s_i + a_3 \ln f_i + a_4 \ln n_i + a_5 \ln h_i + \\ + a_6 \ln \pi_i + \sum_j a_j \ln X_{ij} + \xi_i \quad (1)$$

where ***i*** is an index of country, t is the final year, variable y_{it} is the final years real GDP, the initial real GDP per capita (y_{i0}), using the Lespeyre's index, *is* expected to have a negative impact on growth, meaning that due to diminished returns on marginal investment, the higher initial real GDP per capita will result in the lower future growth making any convergence conditional on the remaining explanatory variables, investment share (s_i), food supply per day (f_i), and human capital (h_i) are all expected to spur economic growth. Life expectancy (leb_0), primary school enrolment (P_e) and secondary school enrolment (S_e) were used as a proxy for human capital. Variable $\sum_j \ln X_{ij}$ is the sum of the African dummies and the interaction term, a_j is the coefficient for each dummy and the interaction term that will be used in the model, while ξ_i is the error term. The African dummy, inflation rate (π_i) and population growth (n_i) are all expected to have a negative impact on growth. Data on the investment share, the population growth rate, the inflation rate and human capital were obtained from the World Bank data base, the Real GDP Lespeyre's Index was obtained from the Penn World Table 7.0, while the daily food supply data was obtained from the FAOstat[1]. The African dummy (SSA2) was assigned a value of 1 for countries within Africa with food crises in the last decade, while the remaining countries were assigned a value of 0, while the Sub-Saharan African dummy (SSA), which represents all African countries included in the study, was also assigned a value of 1 and 0 for rest of the world (ROW)

[1]FAOStat are food agriculture organisation statistics and the data on food supply is measured in kilocalories per capita per day and it was obtained from there. To have a correct measurement of food supply, the population was excluded from the data, making the unit of measurement for food supply the food supply per day.

countries. The Stata software package was used for the regression analysis.

From the 26 of the 40 countries that experienced food crisis in the last decade in Africa, 20 of those for which the data was available represent the countries with the SSA2 dummy, while other countries are considered to be non-African. Furthermore, the SSA dummy represents 45 African countries included within the study and the reasoning behind the choice for this study is to reveal the impact of food shortage on the economic growth of these African countries and not to take all African countries at face value, since most of the countries within Africa that do not have food crisis are in a better situation in terms of economic growth.

Endogeneity and valid instruments

To test if the Ordinary Least Square (OLS) is consistent with regard to estimating the regression model and to ensure that it does not produce an unbiased coefficient for the growth regression, it is important to test, whether all of the explanatory variables are exogenous. In the growth model (1), it is expected that the food supply and the primary and secondary school enrolment rate might be exogenous, hence yielding a biased coefficient estimate. One would expect that an increase in income measured as the gross domestic income would enhance a higher purchasing power, in order to achieve a sufficient food supply and demand for education. Therefore, to detect the presence of endogeneity in this study, particularly between food supply and economic growth, both the OLS and two stages least square (TSLS) in order to obtain estimates for the growth analysis coefficients. For the TSLS, it is important to get a valid set of instrumental variables[2], so as to obtain consistent parameter estimates with meaningful inferences.

For this study, the instruments of choice are the lagged variables of measures for education and the determinants of food supply. The researchers expect that if endogeneity is a problem in the OLS estimates, then the size of the regressor coefficients in the TSLS would either increase altogether or decrease (Webber 2002). To obtain the determinants for food supply (food availability) that can serve as valid instruments for the TSLS, this study examined the joint impact of some of the variables identified as important determinants for food security by Scanlan (2001), namely the adaptive measures, such as the fertilizer application, the arable land size, the renewable freshwater and the food import ratio on food security. If these variables jointly[3] determine food supply which is a proxy for food security, then they will be considered as valid instruments for the growth model. The choice of these variables is to ensure that the instrument is not correlated with either the explained variable or other explanatory variables, and that these variables only affect the explained variables via the endogenous variable.

$$\ln f_i = b_0 + b_1 \ln \varpi_i + b_2 \ln \psi_i + b_3 \ln \ell_i + b_4 \ln \iota_i + \zeta_i \quad (2)$$

where f_i is the food supply, which is the suspected endogenous variable in the growth model, ϖ_i is the renewable water available, ψ_i is the fertiliser consumption, ℓ_i is the arable land size use in agricultural production ι_i is the food import ratio and ζ_i is the error term. b_0 represents the constant, b_1, b_2, b_3 and b_4 are the coefficients of each variable . All variables are in the log form for each specific country over the studied period.

Comparison of the average food supply and the gross domestic product across different regions

Figure 1 shows the average food supply per capita between 1970 and 2007 across different regions. From the figure, it can be observed that the rest of the world countries have the highest food supply, followed by African countries. African countries with food in-

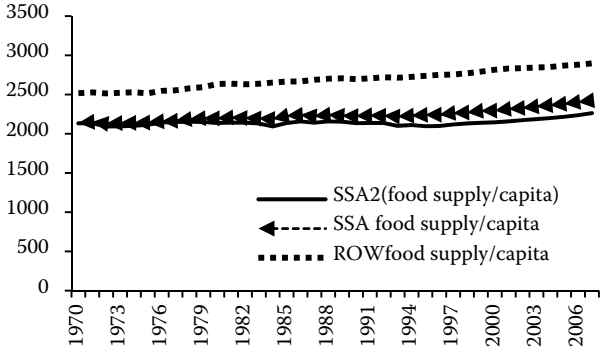

Figure 1. Average food supply across different region

[2]Ashley(2009) defines an instrument as an observable regressor which is both substantially correlated with the endogenous variable and asymptotically uncorrelated with the model error term.

[3]The *F*-statistics test will help to determine the level of their joint significance.

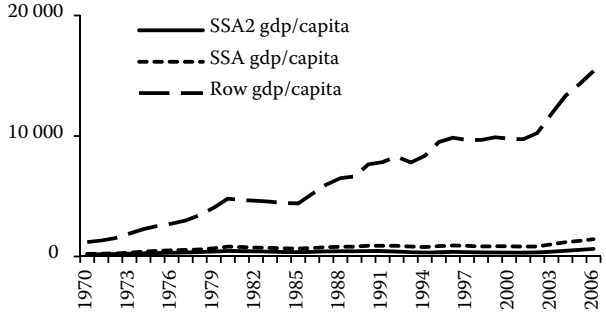

Figure 2:Average real GDP per capita across different regions

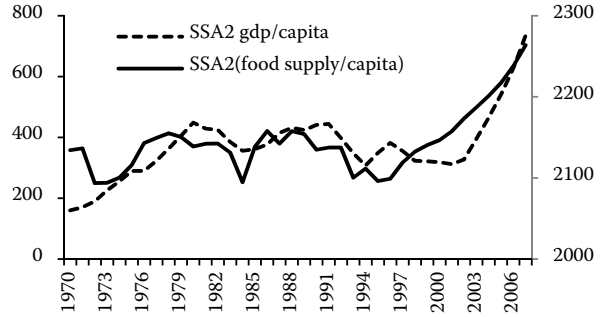

Figure 3. Gross domestic product and food supply for the SSA2 countries

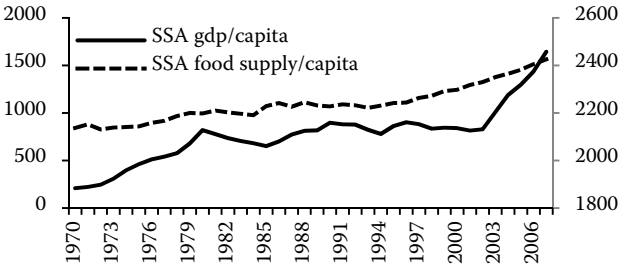

Figure 4. Gross domestic product and food supply for vSSA countries

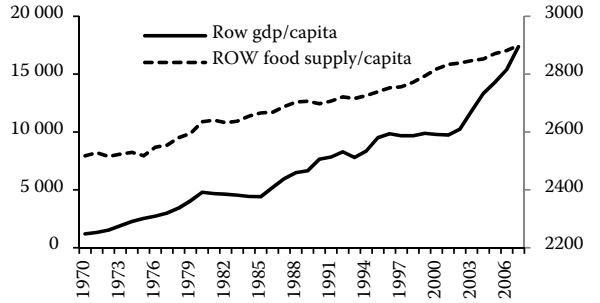

Figure 5. Gross domestic products and food supply for the ROW countries

security have the least average food supply. Figure 2 shows the average gross domestic products across the three major regions according to the classification of this study. The rest of the world countries have the highest gross domestic product per capita, followed by all African countries, while African countries with food insecurity have the least average gross domestic product between 1970 and 2007.

Figures 3, 4 and 5 compare the trend in the GDP per capita and the food supply per capita for the SSA2 countries, the SSA countries and the ROW countries, respectively. The three graphs show a co-movement between the growth in the gross domestic products and food supply. The food supply and the GDP growth rate within vSSA2 countries with food insecurity are more closely related, unlike the ROW and the SSA, where the food supply appears more smooth and does not fluctuate as much as the gross domestic product. This suggests that the SSA2 countries with food insecurity may tend to feel the impact of food insecurity more on their gross domestic product than other countries.

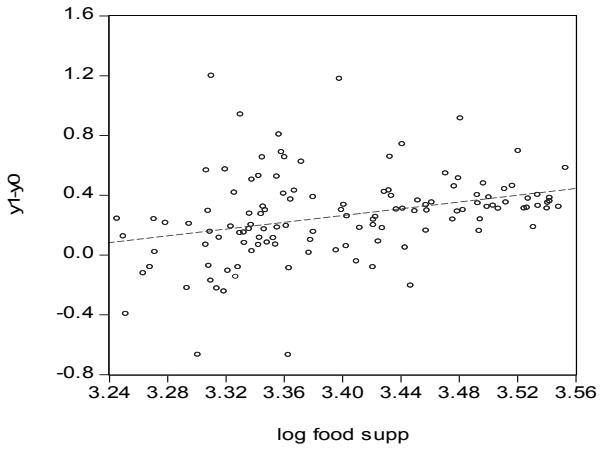

Figure 6. GDP versus log of food supply for the entire country

Figure 6 shows a scattered diagram of the relationship between economic growth and the log of food supply for all countries. With a positive correlation of 0.29, the figure indicates that there is the possibility of a relationship between food supply and economic growth.

RESULT AND DISCUSSION

The result in Table 1 (appendix) from model 2 shows the impact of the determinants of food supply as a proxy for food security. All of the variables except those for food import are significant in explaining food security within the cross countries studied. The joint

Table 1. Determinants of food supply a proxy for food security, 1970–2007 from model 2

Basic model: OLS regression	
Dependent variable: Food security using food supply as a proxy	
Variables	Regression coefficients
ψ	0.140767** (0.0212)
ϖ	0.502590*** (0.0000)
ℓ	0.635342*** (0.0000)
ι	–0.172071 (0.1099
Constant	3.911285*** (0.0000)
R^2	0.639350
H_o: All the included variables jointly explain food security	
P-value: 0.0000	
F-statistics: 44.76250	

All variables are in log form and *p*-values in parenthesis with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

p-value and *F*-statistics signify that all the variables jointly explain food supply as a proxy for food security. Since the model is a log-log model, each coefficient signifies the response of food supply to a 1% change in each of the variables. In the order of importance, land availability has the largest impact on food supply as a proxy for food security. A 1% increase in arable land size increases food supply by 0.64%. With a 1% increase in water availability, food supply is expected to increase by 0.50%, and a 1% increase in fertilizer will increase food supply by almost 0.14%. The food import dependency ratio has a negative and insignificant long-term impact with regard to food security. This result is urprising, since the previous studies found a positive and significant relationship between food security and the food import dependency ratio[4]. The only explanation for this surprising result could be that the previous studies considered this impact for a short time span, whilst in this study, we have considered the impact over a long time span. Therefore in the short run, the food import dependency ratio may be helpful in ensuring food security, but in the long run this is not the case. Also countries that are highly food import dependent are likely to be more affected during the periods of global food scarcity with high fluctuations in food prices.

The *F*-statistics and *P*-value of the regression suggest that all the variables jointly affect food security. Therefore, these variables will be considered as instruments for the TSLS to rule out the possibility of endogeneity between the GDP growth rate and food security. Furthermore, the Hansen's *J*-statistics test will be carried out to ensure the validity of these instruments.

Tables 2 to 4 show several results of the growth model with different measures for human capital. Table 2 presents the regression results with different measures for human capital with the SSA2 dummy. Column 1 of the table shows that there is a positive relationship between economic growth and three major variables, namely the investment, the life expectancy and the food availability, while the initial gross domestic product, the population growth rate and the inflation rate all have a negative impact on the economic growth rate. This result is in line with the researchers' prior expectation. Except for the inflation rate, all coefficient estimates in the ordinary with the least square with a robust standard error model in column 1 of Table 2 are significant at the 5% level. For this study, the food availability measure is the main focus and it has a positive and significant impact on economic growth within all the 124 studied countries, with a 1% increase in food availability leading to about 0.06% rise in economic growth. Column 2 of Table 2 introduces the SSA2 dummy, which attempts to identify, if there is a growth difference between the SSA2 and the ROW countries. The result suggests that the dummy is negative and significant[5] and furthermore that, with all the variables except for inflation being significant at the 5% level, food availability is positive and significant. Column 3 of Table 2 shows the fully unrestricted specification with interaction between the SSA2 dummy and all the previously included dimensions. The result indicates that the SSA2 slope terms differ in three dimensions, namely the life expectancy, the investment and the

[4]Scanlan (2001) found a positive relationship between food security and the food import dependency ratio.

[5]Different authors have different interpretations for the significant African dummies. Some believe that this dummy is significant only because of the omitted variables, while others believe that it is negative, because African countries are disadvantaged in terms of location. Since there is a significant amount of literature available on this issue, this study did not consider either view. Instead this paper focuses on the major theme of the study.

food availability. The food security interaction term is positive and significant, suggesting that the SSA2 countries with food insecurity over the last decade could have done better in terms of economic growth if they have had access to sufficient food.

Columns 4 to 6 of Table 2 show the effect of adding the average primary school enrolment as a measure for human capital instead of life expectancy. The result in column 4 of the table suggests that all variables have the expected signs and are significant at the 5% level with the food availability having an estimated 0.06% increase impact on economic growth. Column 5 shows that all the variables except the primary school enrolment are significant at the 5% level. The SSA2

Table 2. Determinants of Cross Section Growth, 1970–2007. OLS regression using alternative measures of human capital and the ssa2 dummy from model 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
y_0	−0.290*** (0.0710)	−0.316*** (0.0673)	−0.414*** (0.0565)	−0.203*** (0.0530)	−0.246*** (0.0529)	−0.270*** (0.0527)	−0.316*** (0.0774)	−0.328*** (0.0731)	−0.442*** (0.0605)
n_i	−0.203*** (0.0573)	−0.224*** (0.0608)	−0.159** (0.0658)	−0.280*** (0.0562)	−0.285*** (0.0567)	−0.277*** (0.0583)	−0.189*** (0.0559)	−0.213*** (0.0569)	−0.129** (0.0613)
leb_0	1.301*** (0.495)	0.997* (0.535)	1.971*** (0.543)						
s_i	1.044*** (0.220)	0.897*** (0.196)	0.723*** (0.236)	1.029*** (0.236)	0.914*** (0.212)	0.722** (0.285)	0.799*** (0.258)	0.740*** (0.238)	0.366 (0.253)
f_i	0.0571*** (0.0216)	0.0530** (0.0206)	0.0529** (0.0203)	0.0626*** (0.0221)	0.0571*** (0.0212)	0.0582*** (0.0211)	0.0476** (0.0217)	0.0466** (0.0210)	0.0380* (0.0202)
π_i	−0.0656 (0.0490)	−0.0679 (0.0478)	−0.0902** (0.0408)	−0.107** (0.0489)	−0.0961** (0.0471)	−0.127*** (0.0405)	−0.103* (0.0530)	−0.0965* (0.0515)	−0.135*** (0.0344)
ssa_2		−0.192** (0.0741)	3.059* (1.623)		−0.197*** (0.0704)	−1.239 (1.707)		−0.164** (0.0749)	−4.173*** (1.373)
$ssa_2{}^*f_i$			0.233* (0.131)			0.188 (0.151)			0.301** (0.129)
$ssa_2{}^*s_i$			0.711** (0.336)			0.584 (0.387)			1.298*** (0.384)
$ssa_2{}^*n_i$			−0.161 (0.532)			−0.439 (0.683)			−0.922 (0.660)
$ssa2^*y_0$			0.0850 (0.0914)			0.0290 (0.122)			0.161* (0.0888)
$ssa_2{}^*leb_0$			−4.284*** (1.014)						
$ssa_2{}^*\pi_i$			0.0593 (0.100)			0.164 (0.122)			0.190** (0.0794)
P_e				0.465*** (0.171)	0.283 (0.180)	0.672*** (0.234)			
$ssa_2{}^*P_e$						−0.965*** (0.293)			
S_e							0.428*** (0.129)	0.326** (0.137)	0.686*** (0.116)
$ssa_2{}^*S_e$									−1.288*** (0.207)
Constant	−2.872*** (0.643)	−1.975** (0.799)	−3.098*** (0.892)	−1.789*** (0.369)	−1.052** (0.440)	−1.465*** (0.492)	−0.744 (0.490)	−0.424 (0.458)	−0.0119 (0.452)
R^2	0.496	0.534	0.607	0.482	0.520	0.550	0.517	0.543	0.646

All variables are in log form and robust standard error in parenthesis with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

dummy is negative and significant just as obtained in column 3 and a 1% increase in the food availability will increase economic growth by about 0.06% within all of the studied countries. Column 6 presents the fully unrestricted form of the model and the result suggests that the SSA2 slope terms differ from the rest of the world and other African countries with regard to one dimension – the primary school enrolment. A 1% increase in the average primary school enrolment over the studied period increases economic growth by about 0.7% for all other countries, but decreases economic growth within African countries with the food insufficiency by about 0.3%. This result implies that African countries with food insecurity do not benefit from the primary enrolment as it occurs in the rest of world, and this may be due to the fact that a year of schooling within this region produces less productive skills than a year of schooling in other regions (Glewwe et al. 2007).

Columns 7 to 9 of Table 2 show the effect of adding the average secondary school enrolment as a measure for human capital. The result in these columns appears to suggest that the impact of the average secondary school enrolment over the studied period on economic growth is not as different from the aforementioned. The only difference is that the secondary school enrolment has a positive and significant impact on economic growth for all of the results reported in the three columns. This result implies that the secondary school enrolment has a more significant impact on economic growth than the primary school enrolment and this is similar to the findings of Webber (2002), only that Webber's result suggests an insignificant impact for all three measures of education when considered in the light of economic growth. Column 9 presents the fully unrestricted regression result and the result suggests that African countries with food insecurity differ from the rest of the world in five dimensions, namely the food availability, vinitial real GDP levels, investment, vinflation rate and the secondary school enrolment. Food availability is still significant at the 5% level for all countries and it does contribute to the growth differentials for African countries with food insecurity.

Table 3 presents the result for different measures for human capital with the SSA dummy. Columns 1 to 3 present the regression result with life expectancy as a measure for human capital and the results suggest that the SSA dummy is negative and significant. Similarly, all variables except the life expectancy and the inflation rate are significant at the 5% level and the fully unrestricted specification reveals that the SSA slope terms differ from the rest of the world only in one dimension, namely the population growth rate, and this is similar to the existing findings in literature (Bloom and Sachs 1998; Block 2000; Hoeffler 2002).

Columns 4 to 6 of table 3 present the regression results with regard to the primary schools as a measure for human capital and the result in column 4 suggests that all the explanatory variables are significant at the 5% level. In column 5, all variables except for the primary school are significant at 5% with the SSA dummy being negative and statistically significant with regard to explaining economic growth. Column 6 reports that the SSA dummy is no longer significant with regard to explaining the slope differential between African countries and the rest of the world, but instead the slope differential is due to the population growth as found in column 3 of Table 3.

Columns 7 to 9 of Table 3 report the impact of the average secondary school enrolment over the studied period on economic growth. The result suggests that the average secondary school enrolment enhances economic growth within all the studied countries and the result is not as different from the aforementioned. The only difference is that the secondary school enrolment has a positive and significant impact on economic growth for all of the results reported in the three columns. This result implies that the secondary school enrolment has a more significant impact on economic growth than the primary school enrolment and this is similar to the findings of Webber. Food availability is still significant at the 5% level for all countries, the only difference now is that it is not significant with regard to explaining the growth differences between the SSA and the ROW countries.

It is obvious from Tables 2 and 3 that combing all African countries does not provide a true picture of the cause for growth differentials between Africa and the rest of the world. Instead, the cause of growth differentials between the food secure and insecure African countries clearly differs. While the population growth appears to be the sole growth differential between all African countries and the rest of the world, the food availability and investment in both physical and human capital has stood out as the reason for growth differentials between the SSA2 countries and the ROW countries. The investment in physical capital has more gain in the SSA2 countries than the ROW countries. This result clearly supports the major bedrock of the Solow model – that the return

to capital will be much higher within regions with a lower initial capital stock. On the other hand, the investment in human capital has a negative significant differential impact on economic growth within the SSA2 countries and the ROW countries. As puzzling as this may seem, the only reason why this might be true may be in the terms of the quality of capital. A low quality of both education and health may have contributed to this negative relationship. Block (2001) reports a similar finding based on the differential impact of the initial life expectancy as a measure for the investment in human capital. Although Block's study did not find a significant negative impact of the initial life expectancy as a reason for the growth differentials between Africa and the rest of the world, it yet suffices to mention this finding. Similarly, the negative relationship between economic growth and the school enrolment, which is a proxy for human capital within these African countries, is not totally new, although there are studies that argue that edu-

Table 3. Determinants of cross-section growth, 1970–2007. OLS regression using alternative measures of human capital and the SSA dummy from model 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
y_0	−0.290*** (0.0710)	−0.300*** (0.0646)	−0.320*** (0.0608)	−0.203*** (0.0530)	−0.262*** (0.0513)	−0.258*** (0.0524)	−0.316*** (0.0774)	−0.321*** (0.0722)	−0.348*** (0.0703)
n_i	−0.203*** (0.0573)	−0.180*** (0.0541)	−0.120** (0.0598)	−0.280*** (0.0562)	−0.214*** (0.0544)	−0.169*** (0.0536)	−0.189*** (0.0559)	−0.169*** (0.0544)	−0.0715 (0.0618)
leb_0	1.301*** (0.495)	0.621 (0.578)	0.970 (0.804)						
s_i	1.044*** (0.220)	0.934*** (0.192)	0.620** (0.288)	1.029*** (0.236)	0.920*** (0.211)	0.644** (0.318)	0.799*** (0.258)	0.792*** (0.240)	0.413 (0.316)
f_i	0.0571*** (0.0216)	0.0502** (0.0206)	0.0452** (0.0216)	0.0626*** (0.0221)	0.0524** (0.0209)	0.0510** (0.0223)	0.0476** (0.0217)	0.0450** (0.0207)	0.0418* (0.0216)
π_i	−0.0656 (0.0490)	−0.0919* (0.0483)	−0.125*** (0.0452)	−0.107** (0.0489)	−0.112** (0.0494)	−0.151*** (0.0413)	−0.103* (0.0530)	−0.110** (0.0520)	−0.150*** (0.0379)
ssa		−0.221*** (0.0723)	−0.430 (1.692)		−0.232*** (0.0626)	0.204 (1.374)		−0.202*** (0.0652)	−1.104 (0.945)
ssa*S_i			0.543 (0.386)			0.602 (0.412)			0.799* (0.414)
ssa*n_i			−0.818*** (0.292)			−0.849*** (0.309)			−0.832** (0.338)
ssa*f_i			0.0660 (0.0632)			0.0643 (0.0638)			0.0645 (0.0671)
ssa*y_0			0.0106 (0.0147)			0.00996 (0.0151)			0.00995 (0.0151)
ssa *leb_o									
ssa*π_i			0.105 (0.116)			0.128 (0.112)			0.123 (0.114)
P_e				0.465*** (0.171)	0.215 (0.174)	0.757 (0.518)			
ssa*P_e						−0.892 (0.545)			
S_e							0.428*** (0.129)	0.246* (0.147)	0.486** (0.196)
ssa*S_e									−0.452** (0.193)
Constant	−2.872*** (0.643)	−1.335 (0.908)	−1.373 (1.443)	−1.789*** (0.369)	−0.774* (0.438)	−1.452 (1.177)	−0.744 (0.490)	−0.324 (0.461)	−0.0681 (0.593)
R^2	0.496	0.562	0.602	0.482	0.559	0.604	0.517	0.571	0.618

All variables are in log form and robust standard error in parenthesis with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

cation has a positive impact on economic growth. Krueger and Lindahl (2000), using cross the country analysis and the years of schooling as a proxy for human capita, argue that there is a possibility that education might not contribute to economic growth as one would expect, especially when the unemployment rates are rising with an increase in education and where the return to physical capital is higher than the return to human capital. Gyimah-Brempong (2010) on the other hand suggests that human capital using educational attainment as a proxy has a positive and significant impact on economic growth within all 52 African countries that were analysed. As different as these findings may seem, one thing that is certain:

Table 4. TSLS using alternative measures for human capital and the ssa_2 dummy from model 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
y_0	−0.288*** (0.0686)	−0.315*** (0.0642)	−0.338*** (0.0506)	−0.252*** (0.0835)	−0.219*** (0.0631)	−0.385*** (0.111)	−0.517*** (0.132)	−0.502*** (0.138)	−0.605*** (0.105)
f_i	0.0702* (0.0378)	0.0587* (0.0339)	0.0638* (0.0346)	0.0599 (0.0441)	0.0733 (0.0468)	0.0141 (0.0501)	0.0182 (0.0328)	0.0201 (0.0329)	0.0103 (0.0261)
n_i	−0.203*** (0.0560)	−0.224*** (0.0587)	−0.219*** (0.0601)	−0.257*** (0.0605)	−0.303*** (0.0747)	−0.183*** (0.0963)	−0.0427 (0.0934)	−0.0633 (0.112)	0.00900 (0.113)
leb_0	1.282*** (0.490)	0.990* (0.522)	1.100** (0.456)						
s_i	1.043*** (0.216)	0.897*** (0.191)	0.829*** (0.231)	0.710 (0.547)	1.129** (0.541)	0.348 (0.878)	0.192 (0.405)	0.229 (0.404)	−0.126 (0.370)
π_i	−0.0684 (0.0479)	−0.0692 (0.0465)	−0.0992** (0.0399)	−0.139** (0.0674)	−0.0706 (0.0741)	−0.2111*** (0.0762)	−0.125* (0.0669)	−0.121* (0.0662)	−0.157*** (0.0383)
ssa_2		−0.191*** (0.0708)	−1.790 (1.979)		−0.255 (0.175)	2.307 (3.559)		−0.0487 (0.136)	−4.740*** (1.338)
$ssa_2{}^*s_i$			0.243 (0.379)			1.654* (0.905)			1.790*** (0.463)
$ssa_2{}^*n_i$			−0.550 (0.777)			−0.533 (0.652)			−1.060* (0.637)
$ssa_2{}^*y_0$			0.0640 (0.143)			0.790 (0.125)			0.232** (0.0949)
$ssa_2{}^*f_i$			0.0947 (0.176)			0.232 (0.151)			0.329*** (0.124)
$ssa_2{}^*\pi_i$			0.115 (0.130)			0.249* (0.132)			0.212*** (0.0778)
P_e				1.156 (1.055)	−0.321 (1.445)	3.652 (2.407)			
$ssa_2{}^*P_e$						−3.945 (2.413)			
S_e							1.016*** (0.333)	0.933** (0.432)	1.251*** (0.365)
$ssa_2{}^*S_e$									−1.853*** (0.401)
Constant	−2.978*** (0.632)	−2.025*** (0.765)	−2.065*** (0.798)	−2.493*** (0.909)	−0.430 (1.790)	−0.928 (1.744)	0.102 (0.711)	0.125 (0.585)	0.555 (0.467)
R^2	0.495	0.534	0.545	0.425	0.478	0.524	0.401	0.434	0.580
Hen-*j*	8.73824	6.90103	8.9564	8.94681	9.33036	3.69084	2.02919	2.12073	0.809437

All variables are in log form and robust standard error in parenthesis with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

there is a form of relationship between education and economic growth, despite the difference in methodology or approach. This study has reconfirmed this.

Another finding that stood out in this research is the positive relationship between the food availability and economic growth for food insecure African countries (SSA2). Although this may appear interesting, it is possible that this result has emerged due to an endogeneity issue, which we do not intend to ignore in this study. Moreover, education might also be both

Table 5. TSLS using alternative measures for human capital and the SSA dummy from model 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
y_0	−0.288*** (0.0686)	−0.301*** (0.0620)	−0.323*** (0.0582)	−0.252*** (0.0835)	−0.230*** (0.0637)	−0.278*** (0.0501)	−0.517*** (0.132)	−0.487*** (0.137)	−0.570*** (0.165)
f_i	0.0702 (0.0378)	*0.0475 (0.0320)	0.0335 (0.0312)	0.0599 (0.0441)	0.0561 (0.0411)	0.0483 (0.0323)	0.0182 (0.0328)	0.0167 (0.0301)	0.00727 (0.0305)
leb_0	1.282*** (0.490)	0.624 (0.561)	0.980 (0.766)						
n_i	−0.203*** (0.0560)	−0.180*** (0.0523)	−0.120** (0.0565)	−0.257*** (0.0605)	−0.219*** (0.0572)	−0.158*** (0.0537)	−0.0427 (0.0934)	−0.0577 (0.0939)	0.149 (0.180)
s_i	1.043*** (0.216)	0.934*** (0.186)	0.618** (0.266)	0.710 (0.547)	1.190** (0.554)	0.515* (0.310)	0.192 (0.405)	0.287 (0.427)	−0.253 (0.513)
π_i	−0.0684 (0.0479)	−0.0914* (0.0473)	−0.122*** (0.0442)	−0.139** (0.0674)	−0.0843 (0.0688)	−0.171*** (0.0419)	−0.125* (0.0669)	−0.124* (0.0635)	−0.172*** (0.0416)
ssa		−0.221*** (0.0698)	−0.539 (1.570)		−0.289* (0.149)	2.498 (3.976)		−0.0921 (0.111)	−0.750 (1.059)
P_e				1.156 (1.055)	−0.494 (1.431)	2.032 (1.975)			
ssa*f_i			0.0776 (0.0652)			0.0660 (0.0666)			0.0737 (0.0723)
ssa*s_i			0.546 (0.360)			0.744** (0.379)			1.489*** (0.574)
ssa*n_i			−0.815*** (0.276)			−0.842*** (0.297)			−0.814** (0.373)
ssa*y_0			0.0106 (0.0139)			0.00977 (0.0143)			0.0113 (0.0154)
ssa*leb_0			−0.615 (0.852)						
ssa*π_i			0.102 (0.110)			0.150 (0.106)			0.160 (0.129)
ssa*P_e						−2.157 (1.955)			
S_e							1.016*** (0.333)	0.839* (0.449)	1.529** (0.774)
ssa*S_e									−1.326** (0.658)
Constant	−2.978*** (0.632)	−1.309 (0.897)	−1.264 (1.330)	−2.493*** (0.909)	0.0975 (1.824)	−3.716 (3.924)	0.102 (0.711)	0.208 (0.567)	0.142 (0.517)
R^2	0.495	0.562	0.601	0.425	0.504	0.571	0.401	0.473	0.491
Hen-*j*	8.73824	5.28702	7.05883	8.94681	6.70971	7.02965	2.02919	2.27484	2.03748

All variables are in log form and robust standard error in parenthesis with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

a cause and a consequence of economic growth. It is therefore logical to anticipate the existence of bias in the coefficients for both the food availability and education proxies.

To tackle this issue of endogeniety, two stages least square (TSLS) was carried out and Tables 4 and 5 in the appendix report the findings of the regression. Both tables show that the OLS coefficients do not differ significantly from the coefficients obtained from the two stage regressions. The same deduction can be obtained from all the results. If endogeneity was present, then the majority of the coefficients would move in the same direction (Webber 2002). In this case, the majority of coefficients have an almost identical size to those obtained from the OLS regression, suggesting that endogeneity is not a problem in this study. Also, the Hansen's J statistics are not within the rejection region of the chi square in most cases, implying that the instruments are valid. Although the t-statistics were, in most cases, significantly smaller than those obtained from the OLS, this is usually the case in the two-stage least square estimation, yet we can generally assume that this might be due to the multicollinearity between the endogenous variables and the valid instruments.

CONCLUSION AND RECOMMENDATIONS

This paper reviewed the macroeconomic studies on the determinants of economic growth and the factors that cause growth differentials between African countries and the rest of the world. The analysis was performed using different measures for human capital, life expectancy, the primary school enrolment and the secondary school enrolment. Even with these different measures for human capital and food availability, the proxy for food security was positively significant in explaining growth for all of the 124 studied countries and countries in Africa that have experienced food insecurity over the last decade and that could have performed better if they had had access to sufficient food.

Also, this study suggests that the grouping of all African countries together does not give a true picture of the determinant of growth differentials between African countries and the rest of the world. The results of this study suggest that for African countries with food insecurity, the determinant of growth differentials when compared with the rest of the world is physical and human capital, as well as food security itself. On the other hand, when all African countries are considered together, the major determinant of growth differentials is the population growth rate. Findings from this paper are similar to that of Barro (1991), Sala-I Martin (1997) and Easterly and Levine (1998), who suggests that the African dummy is negative. For both the SSA and the SSA2 dummies that were used in this study, it was observed that the African dummies were negative and significant most times, but the reason for growth differentials in both cases differed, therefore suggesting that not all African countries have the same growth patterns or characteristics and therefore should not be treated as such. The future work could analyse the contribution of the different sources of food availability by comparing the domestic food production within the food insecure countries with the food aid and food import and their impact on economic growth, as this would help the policy makers and the donor countries in opting for the best policies.

Finally, the findings from this research work show that it would be of great benefit for African countries with food crises, famine or near famine over the last decade to pursue economic growth through food security and investment in both physical and human capitals. Donor organizations and countries should support these African countries even more through the domestic food production programs that ensure the domestic food security. If these countries can achieve food security, then economic growth will be much easier to attain.

APPENDIX

List of countries in growth regression

Rest of the world countries

Albania	Chile	Guatemala	Maldives	Romania
Antigua &Barbados	China	Guyana	Malta	Solomon Island
Argentina	Colombia	Haiti	Mexico	Spain
Australia	Comoros	Honduras	Morocco	Suriname

Austria	Costa Rica	India	Mongolia	Sweden
Bahamas	Cuba	Indonesia	Nepal	Switzerland
Bangladesh	Cyprus	Iran	Netherland	Syria
Barbados	Denmark	Ireland	New Zealand	Sri Lanka
Belgium	Dominican Rep.	Israel	Nicaragua	Thailand
Belize	Ecuador	Italy	Norway	Trinidad &Tobago
Bermuda	El Salvador	Jamaica	Pakistan	Turkey
Bolivia	Fiji	Japan	Panama	United States
Jordan	Finland	United Kingdom	Paraguay	Uruguay
Brazil	France	Korea, Rep.	Peru	Venezuela
Brunei	Germany	Laos	Philippines	Vietnam
Cambodia	Greece	Lebanon	Poland	
Canada	Grenada	Malaysia	Portugal	

SSA2 countries

Angola	Chad	Guinea	Liberia	Niger
Burkina Faso	Congo, Dem. Rep	Guinea-Bissau	Madagascar	Sierra Leone
Burundi	Congo, Rep	Kenya	Mali	Uganda
Central African Rep.	Ivory Coast	Lesotho	Mauritania	Zimbabwe

SSA countries

Algeria	Chad	Guinea	Namibia	Mauritania
Angola	Congo, Dem. Rep	Guinea-Bissau	Niger	Uganda
Benin	Congo, Rep	Lesotho	Rwanda	Kenya
Burkina Faso	Ivory Coast	Liberia	Senegal	Zimbabwe
Burundi	Djibouti	Madagascar	Sudan	Zambia
Botswana	Egypt	Malawi	Sierra Leone	
Cameroon	Gabon	Mali	South Africa	
Cape Verde	Gambia	Mauritius	Togo	
Central African Rep.	Ghana	Mozambique	Tunisia	

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Received: 6th July 2013
Accepted: 2nd October 2013

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