Modelling the Effect of a Shock in Human Capital Development on Long-Term Growth and Development: Evidence from a Panel Error Correction Model in Africa

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Abstract

Departing from Cobb-Douglas production function (1928) and Benhabib and Spiegel (1994)'s alternative model for growth accounting, in this paper we estimate the inverse of growth in cumulated government expenditures on education, H_{it}^{c*}, to uncover the effect of a shock in human capital development on growth and development in Africa. The behavior of H_{it}^{c*}, shows that a shock in human capital development lead to a decline in growth and development, as a result of fall in absorption capacity, which is accompanied by a fall in researches for creativity and innovations and decline in capacity of developing, adopting and/ or imitating new technologies. This paper uncovers that African regions for which countries had experienced enormous civil wars and/or political instabilities, compared to others, were subjected to higher H_{it}^{c*} which led to lower growth and development. Therefore, this paper suggests that taking strategies for stopping civil wars and reducing persistent political instability will lead to sustainable growth and development in Africa.

Keywords: Human capital development shock; long-term growth and development; Africa.

1. Introduction

During three decades ago, different initiatives were undertaken to ensure global sustainable development. The earliest ones include Agenda-21 adopted in 1992 to ensure sustainable development in the XXI century which was reinforced in 2000 with the adoption of Millennium Development Goals, and in 2015 by Sustainable Development Goals to replace (MDGs) (United Nations [UN], 1992; UN, 2015). All the initiatives adopted during this period have been in line with promoting a sustained, inclusive and economic growth across all countries in the world. As an input for improving productivity and reach sustainable economic growth and development, increasing the average years of schooling while ensuring human capital development, has been considered to be the key starting point to achieve the main objectives of these initiatives. In one way or another, human capital development as an absorptive capacity in an economy, plays an important role to both economic growth and development. On one hand, competent labors are able to efficiently use capital formation and render them more productive. On other hand, competent labors are able to develop new production technologies and/ or imitate them from one country to another. Both efficient production and technological progress as a result of competent labors are two channels trough which both sustained economic growth and development can be attained.

Nonetheless, as many African countries, over last three decades, were ravaged by different shocks which negatively impacted on human capital development, the main objective of this paper is to investigate the effect of a shock in human capital development on growth and development in Africa. Among others, those shocks include civil wars and political instability that in one way or another took the lives of skilled labor and which have caused a decline in physical capital stocks. In this paper we use panel data analysis and simulate the Benhabib and Spiegel (1994)' s "alternative model for growth accounting" to empirically uncover the effect of a shock in human capital development on growth in Africa the period over 1995-2016. We chose this period because we want to investigate how different initiatives undertaken to improve human capital development in the world, through Agenda-21 and MDGs, had been constrained by different shocks then result in growth instability in Africa. In this paper, economic growth is proxied by growth in gross domestic production (GDP), economic development is proxied by growth in GDP per capital while human capital development is proxied by

government's expenditure on education. Therefore for the purpose of analysis we use five variables: first, growth in GDP and growth in GDP per capital are used as independent variable; and second, labor force, gross capital formation and estimated shock in human capital development are used as independent variables.

2. Methodology

To investigate the effect of human capital development on economic growth and development, the reviewed literature demonstrates that the ordinary approach is to treat human capital or labor-force' s educational attainment, as a variant input in production function (Temple, 1999; Nelson and Edmund, 1966; Solow 1956). An alternative approach which is associated with endogenous growth theory, is to model technological progress, or the growth of total factor productivity, as function of human capital or level of education (Benhabib and Spiegel, 1994). The presumption is that a competent labor force is the one who is well educated. A well coordinated education with sufficient years of schooling improve labor force's ability, commitments, knowledge and skills, which in their turn, enable labor-force to act efficiently and in a wide variety of situation. In addition, developed countries which have rigorous production systems with rapid changes in production technology and in competitive conditions in global markets are more depending on a capable and productive workforce, with the ability of responding to changing needs. Therefore, educated workforce is better for creativity and innovations and adopting and/or imitating new technologies, thereby leading to high productivity and then to economic growth and development.

2.1. Specification of econometric model

We first apply Benhabib and Spiegel (1994)' s "alternative model for growth accounting" on GDP growth as dependent variable to measure the effect of, *H,* on economic growth and second on Income per capita as dependent variable to measure the effect of, *H,* on economic development. Benhabib and Spiegel (1994) estimate the growth model as in equation 1:

$$(logI_T - logI_0) = (logA_T - logA_0) + \alpha(logK_T - logK_0) + \beta(logL_T - logL_0) + \gamma\left(\frac{1}{T\sum_0^T logH_t}\right) + (log\varepsilon_T - log\varepsilon_0) \quad (1)$$

However, as we use panel data analysis based on yearly data and that in our paper H is proxied by government expenditure on education, we found that using $1/T\sum_0^T logH_t$ as in equation 1 by Benhabib and Spiegel (1994) can result in biasing our estimates α, β and γ for a number of reasons. First, using this formula would result in forcing H for country i to be constant over our sample period, t = 1 to t = n, where n is the total number of years covered by this study. Second, as the formula is an arithmetic mean in its nature, growths of recent years is attributed to technological progress of those recent years and also to that of earlier years and vice-versa. To handle this issue we estimate the cumulated H, H^c, for each country, i, and considering shock in human capital development we estimate growth in H^c, H_{it}^{c*} by

$$H_{it}^{c*} = \frac{1}{\log H_{i(t)}^{c} - \log H_{i(t-1)}^{c}} \quad (2)$$

Therefore, in this paper we modify model in Benhabib and Spiegel (1994) and, respectively, specify the model for growth and development as follows:

$$\left(\log Y_{i(t)} - \log Y_{i(t-1)}\right) = \left(\log A_{i(t)} - \log A_{i(t-1)}\right) + \alpha\left(\log K_{i(t)} - \log K_{i(t-1)}\right) + \beta\left(\log L_{i(t)} - \log Lit{-}1 + \gamma Hitc* + \log\varepsilon it - \log\varepsilon it - 1\right) \quad (3)$$

$$(\log I_{i(t)} - \log I_{i(t-1)}) = (\log A_{i(t)} - \log A_{i(t-1)}) + \alpha(\log K_{i(t)} - \log K_{i(t-1)}) + \beta(\log L_{i(t)} - \log Lit-1 + \gamma Hitc* + \log \varepsilon it - \log \varepsilon it-1 \quad (4)$$

where Y stands for growth and I stands for income per capita growth. To understand the role of H_{it}^{c*} in our model, let us start by explaining its association with economic growth and development. Considering how H_{it}^{c*} is estimated, the maximum H_{it}^{c*} corresponds to the minimum $(logY_{i(t)} - logYi(t-1)$ and the minimum $Hitc*$ corresponds to the maximum $logYi(t) - logYi(t-1)$. This behavior show that a shock in human capital development lead to a decline in growth, as a result of fall in researches for creativity and innovations and decline in developing, adoption and/ or imitation capacity of new technologies. This model shows that a shock in absorption capacity affect negatively economic growth and development. As, in this paper, analysis are undertaken with respect to major economic blocks in African, the model suggests that an economic block for which countries had experienced enormous civil wars and political instabilities, it is subjected to higher H_{it}^{c*} and lower $(logY_{i(t)} - logY_{i(t-1)})$ compared to an economic block for which countries had not experienced enormous civil wars and political instabilities.

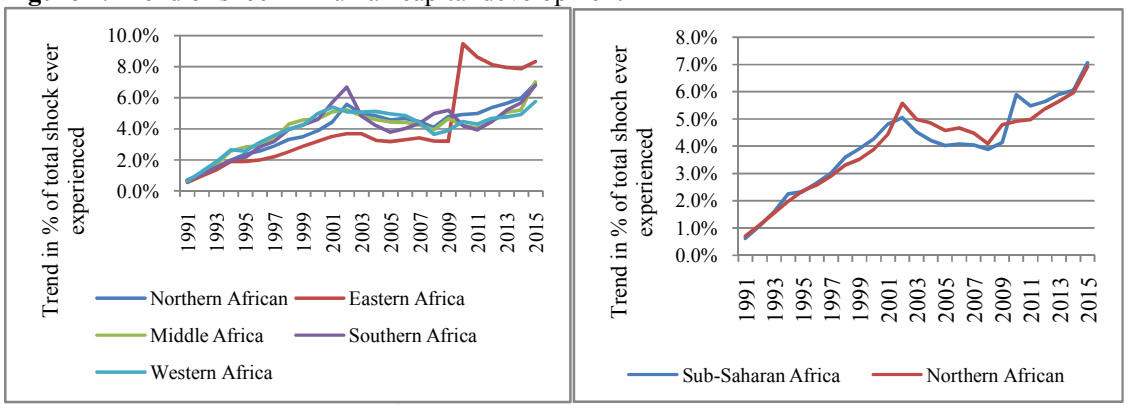
In this paper we estimate the inverse of growth in cumulated government expenditure on education to uncover the effect of a shock in human capital development on economic growth and development in Africa. We also use physical capital, K, proxied by gross fixed capital formation; Labor force, L; a shock in human capital development, H_{it}^{c*}, proxied by inverse of growth in cumulated government expenditure on education; growth proxied by GDP growth and development proxied by income per capita growth.

3. Empirical results

As stated in the methodology, the association between a shock in human capital development and growth and development suggests that a high shock in human capital development correspond to the deteriorations while a low shock correspond to improvements in growth and development. This may be the results of different factors, which among other things include: decline in human capital development may, in one way or another, lead to a decline in science and technology, innovations and creativity, and researches and development. This may also be caused by the fact that, shirking human capital development slow-down domestic technological progress and limit the economy's capacity to adopt and/ or imitate new technologies developed in other economies. Therefore, as human capital development reacts as an absorption capacity to attain efficient productivity and sustainable growth and development, any shock in it results in negative effects on growth and development.

Figure 1, shows that departing from a low shock in human capital development, all analyzed African regions had experienced an increasing human capital shock over 1991-2015 which peaked around 2000-2001 in all regions. For the East Africa, for which a shock in human capital development was below that of all other regions over 1991-2008, from 2010 to 2015 a shock in human capital development in this region over exceeded that of other regions. This sharp increase may had been caused by different civil wars and political instability which were aggravated since 2009 in this region. For instance, this can be explained by situation in Somalia, 2008 presidential election in Kenya, situation in South Sudan, situation in Zimbabwe and Burundi among others. This confirm what is suggested in the methodology, that a region for which countries had experienced enormous civil wars and political instabilities, is subjected to higher shock in human capital development which may significantly deteriorate growth and development in that region compared to a region for which countries had not experienced enormous civil wars and political instabilities.

Figure 1: Trend of shock in human capital development



3.1. Effect of human capital shock on growth and development

In this section, we investigate the effect of a shock in human capital development on growth and development in Africa. The estimated coefficients are presented in Table 1 and Table 2. Table 1 and Table 2 reveal that there is a negative relationship between a shock in human capital development and growth and development in all analyzed African regions. While results in Table 1 demonstrate that this negative relationship is statistically significant at 10% level on growth in all models, but Table 2 shows that this negative relationship is not statistically significant at 10% level on development only in model3 that represent middle African countries. Our empirical findings suggest that, a one percent of increase in a shock in human capital development results in decreasing growth in Northern, Eastern, Middle, Southern, Western and Sub-Saharan African countries, respectively by 1.4%, 0.5%, 0.1%, 1.1%, 1.3% and 0.1%. While results in Table 2 suggest that a one percent of increase in a shock in human capital development results in decreasing development in Northern, Eastern, Southern, Western and Sub-Saharan African countries, respectively by 0.4%, 0.3%, 0.6%, 0.6% and 0.03% and 0.1%. Our findings show that the uncovered negative effect of shock in human capital development is more reverberated in growth when compared to development. This is explained by the fact that the estimated elasticity for a shock in human capital development on growth in Northern, Eastern, Southern and Western African regions are greater that those estimated on development in the same regions. This may recall us the important role that human capital development play in growth when compared to development. In addition to this the level of growth in any economy depends of its production capacity and economic efficiency. In most of the cases, these two, production capacity and economic efficiency, are function of level of human capital development in an economy. Therefore, any shock affecting human capital development is highly reverberated in growth than it can be reverberated in development.

Region by region results demonstrate that, when Northern Africa is compared with Sub-Saharan Africa, a shock in human capital development results in more decline in growth among Northern African countries than among Sub-Saharan African countries. This is the same when we also compare these two regions using the effect of a shock in human capital development on development. A number of explanations can be given to this: As northern African countries are more developed than the Sub-Saharan African countries any shock in human capital development would results in sharp distortion of economic sectors when compared to Sub-Saharan African countries; as Sub-Saharan African countries are less developed, the negative impact of a shock in human capital development on growth and development is very minor. In addition, when Sub-Saharan regions are compared, growth and development in Southern and Western African countries is more sensitive to a shock in human capital development when compared to Eastern and Middle African countries. The same explanation given when comparing Northern and Sub-Saharan African countries, can hold for cross comparison of Sub-Saharan African regions. Taking into consideration the level of growth and development in each

Sub-Saharan African region, Easter and Middle African regions are still lagging behind Western and Southern regions.

Table 1: Human capital shock and growth

	Model1	Model2	Model3	Model4	Model5	Model6
Capital	0.292***	0.099***	0.177***	0.275***	0.174***	0.184***
	(0.001)***	(-0.0001)***	(-0.0003)***	(-0.001)	(-0.0004)***	(-0.0004)***
Labor Force	0.207	-1.993	-1.676	-3.314	-1.918	-2.161**
	(0.000)	(-0.0002)	(-0.0003)	(-0.0000)	(-0.000)	(-0.0001)**
Shock Hc	-0.011***	-0.005***	-0.0003*	-0.007***	-0.013***	-0.001***
	(-0.014)***	(-0.005)***	(-0.001)*	(-0.011)***	(-0.013)***	(-0.001)***
Constant	0.013***	0.004	0.0001	0.009	0.009**	-0.001
Obs.	120	384	192	96	384	1056
LR chi2 (3)	85.18***	67.23***	28.38***	63.39***	204.64***	218.88***
Likelihood	197.295	490.366	156.168	119.631	397.282	1051.449
Likelihood-ratio test of sigma_u=0	0.00	0.00	0.00	0.00	0.00	0.00

***, **, * denote statistical significance at 1%, 5% and 10%. Figures in ( ) are elasticities; Model1, Model2, Model3, Model4, Model5 and Model6 are respectively for Northern, Eastern, Middle, Southern, Western and Sub-Saharan African countries.

Table 2: Human capital shock and development

	Model1	Model2	Model3	Model4	Model5	Model6
Capital	0.097***	0.022*	0.085***	0.136***	0.006	0.041***
	(0.0002)***	(-0.00004)*	(-0.0001)***	(-0.001)***	(-0.00001)	(-0.0001)***
Labor Force	-0.009	-2.006**	-0.626	5.903	-0.553	-0.853
	(0.000)	(-0.0001)**	(-0.0001)	(0.0001)	(0.0000)	(-0.0001)
Shock Hc	-0.003***	-0.003***	-0.000	-0.004***	-0.006***	-0.0002**
	-0.004***	(-0.003)***	(-0.0001)	(-0.006)***	(-0.006)***	(-0.0003)**
Constant	0.004	0.003	-0.001	0.006	0.003	-0.0001
Obs.	120	384	192	96	384	1056
LR chi2 (3)	27.49***	41.08***	12.97***	38.96***	45.58***	32.09***
Likelihood	260.324	665.836	235.265	153.597	510.349	1470.234
Likelihood-ratio test of sigma_u=0	0.00	0.00	0.00	0.00	0.00	0.00

***, **, * denote statistical significance at 1%, 5% and 10%. Figures in ( ) are elasticities; Model1, Model2, Model3, Model4, Model5 and Model6 are respectively for Northern, Eastern, Middle, Southern, Western and Sub-Saharan African countries.

4. Discussion

Nowadays, human capital development is a determining factor for an economy's capacity to invent new technologies and adopt or imitate technologies developed in other economies that may include economies which are the world leader in terms of technological progress. This demonstrates a direct effect that human capital development has on an economy's productivity capacity and efficiency. On one hand, the more the economy's human capital development is getting better the more its ability to adopt and imitate new technology from abroad getting higher and that economy is stepping toward high and efficient productivity capacity and then stimulating growth and development. On the other hand, the more the economy's human capital development is shrinking, the more its production capacity is getting worst and then hampering growth and development. Results in the Table 1 and Table 2 confirm how a shock in human capital development negatively impacted on growth and development. Mostly, negative effects of a shock in human capital development results from the fact that this shock slow-down technological progress and catch-up and technological diffusion among countries with human development shock. Our results demonstrate that the impact of a shock in human capital development on growth and development may differ depending on the level of growth

and development already attained by each economy/ or region: First, when a region has attained a high level of growth and development compared to its neighboring regions, any shock in human capital development would results in high negative effect on growth when compared to those neighboring regions. Second, when a region is lagging behind its neighboring economies in terms of growth and development, any shock in human capital would results in limited catch-up to approach growth and development already attained by its neighboring regions and will always lag behind those regions. Third, a region with a shock in human capital development increasing over time, will always have a lower ability to catch-up with other regions in terms of growth and development.

5. Conclusions

This paper departs from Cobb-Douglas production function and Benhabib and Spiegel (1994)' s alternative model for growth accounting and applies Random-effects ML regression technique to uncover the possible effect that a shock in human capital development has on growth and development. The main findings of this paper uncover that African regions for which countries had experienced enormous civil wars and political instabilities, compared to other regions, were subjected to a high shock in human capital development which had been the cause of a low growth and development in those regions.

As policy implications, our results demonstrate that the impact of a shock in human capital development on growth and development may differ depending on the level of growth and development already attained by each economy/ or region. Therefore, this paper suggests that taking strategies for stopping civil wars and persistent political instability and mitigating their negative consequences on economic sectors would lead to a sustainable growth and development in Africa.

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