

Institutional quality and human capital formation in Africa

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Abstract

This study investigates the role of institutional quality in human capital development in Africa. Thereby, the authors incorporated institutional quality measures into an educational production model. The dynamic panel estimation of the model, based on data from the World Bank for the period 1996-2016 revealed that improving the institutional quality promotes access to primary, secondary and higher education in Africa. Particularly, improving government effectiveness, voice and accountability, rule of law, political stability, as well as reducing violence, promotes access to primary education. In addition, improving government effectiveness and regulatory quality also promote access to secondary education. Access to higher education is more sensitive to voice and accountability. As a result, political authorities must improve the institutional quality to enable African citizens to acquire and increase the level of education they wish to have.

Keywords: Institutional quality, human capital, education, panel data, Africa

Classification JEL : C33, I21, O15, 055

1. Introduction

Human capital is one of the factors that can explain the Asian miracle, as compared to the failure of development in the vast majority of African countries (Berthélemy, 2006). This means that the ability of African countries to reduce poverty and inequality is essentially based on an educated, well-trained and resilient population (World Bank, 2018c). In particular, a skilled and empowered workforce is a valuable asset that can help African economies accelerate the pace of their structural transformation and economic development,

to better reap the benefits of the fourth industrial revolution and globalization. However, this is only possible when Africans have the opportunity to acquire and increase the level of education they desire. In addition, comparative analyses of developing regions with World Bank (2018b) data also indicate that Africa faces a "human capital deficit" more than any other region in the world (Kim, 2018).

The crucial importance of human capital formation in the development process of countries led social scientists and policy makers to study its determinants. At least five working groups seek to explain human capital development in countries.

The first group focuses on the role of public policies in overcoming market failures such as credit constraints in financing human capital development (Rajan, 2009; Galor and Moav, 2006; Lindert, 2005). The second group focuses on inequalities and ethnolinguistic fragmentation as barriers to human capital accumulation when they are very pronounced (Galor et al, 2009; Easterly, 2007; Engerman and Sokoloff, 1997; Perotti, 1996). The third group highlights demographic, historical, religious and cultural factors as determinants of human capital formation (Becker and Woessmann, 2009; Engerman and Sokoloff, 1997; Meyer et al, 1992). The fourth group of microeconomic research examining the effects of different education systems on educational outcomes shows that giving schools more managerial autonomy produces positive effects on educational outcomes, while the centralized allocation of financial resources has a positive impact on the quality of education (Fuchs and Woessman, 2007). The fifth group insists that human capital accumulation depends on the quality of institutions. For example, Gallego (2010) argues that public spending on education is explained by political participation. Similarly, less centralized governments tend to provide their populations with better quality education (Engerman and Sokoloff, 1997; Inman and Rubinfeld, 1997; Oates, 1972). However, decentralization can create inefficient educational provision in the absence of checks and balances at the local level because it could allow local elites to concentrate power between their hands and block the provision of public goods or channel spending to their members or supporters (Gennaioli and Rainer, 2003; Bardhan, 2002; Kremer et al, 2002).

This study follows the work of the fifth group, which focuses on the role of institutional quality on human capital development. Indeed, since North's (1990) seminal work, there has been an ever-increasing interest in taking into account the quality of institutions in explaining countries' economic performance. Moreover, very few studies have sought to analyse the role of institutional quality on access to education in Africa. In most cases, existing works focus on developing countries in general. Those who studied the role of institutional quality have often limited themselves to a single dimension of these institutions.

For example, Seka (2013) examines the relationship between corruption and tertiary education in Africa. Harding and Stasavage (2014), Brown (2000) study the role of democracy on primary school enrollment and basic services such as school fees and school inputs. Poirier (2012) analyses the effect of armed conflict on schooling in Sub Saharan Africa.

The objective of this study is to analyze the role of institutional quality in human capital formation using several dimensions of institutional quality. To this end, this study incorporates institutional quality measures into an education production model. This model is based on Uzawa (1965)-Lucas (1988) works. Its assumption is that improving the institutional quality increases the return on investment in education, which motivates individuals to invest more in their education. The model is estimated using the Generalized of Method of Moment system on 52 African countries over the period 1996-2016. The results obtained indicate that improving the institutional quality promotes access to education in Africa, in particular through the pursuit of reforms linked to democracy and government effectiveness.

The rest of this study is divided into four sections. The second section provides a brief review of the literature. The third section presents the methodology used and the data. The fourth section presents and discusses the main results obtained. The fifth and final section concludes.

2. Literature review

Since North's (1990) seminal work, there has been an ever-increasing interest in taking into account the quality of institutions in explaining countries' economic performance. On the role of institutional quality in human capital formation, social scientists often limit themselves to a single dimension of these institutions. Analyses included the role of corruption, protection of property rights, political system, rule of law and political instability and violence in explaining human capital formation. This brief literature review is therefore thematic.

Regarding the role of corruption, Seka (2013), Shleifer and Vishny (1993) explain how corruption is detrimental to education. Shleifer and Vishny (1993) show that corruption reduces the demand and supply of education through "corruption without theft" and "corruption with theft ". In the first case, the public official sets the school fees of the pupils above the normal price, to which he adds a bribe. He pockets the bribe and transfers the official school fees into government department in charge of public finance. The bribe requested increases school fees and prevents students' parents who cannot afford the bribes from obtaining space for their children. In the second case, the public official does transfer official school fees into government department in charge of public finance. The bribe paid by students' parents may be less than the official tuition fee. The official "under-invoices" the

school fees and pockets all the money without paying anything back to the State. Corruption with theft leads to a higher loss of income for the State, which will be unable to increase the supply and quality of education in the long term (building of new classrooms, library, computer centre, recruitment of new teachers) since the money received by the bureaucrat is not transferred to the State accounts. Seka (2013) explains how in a corrupt environment characterized by the lure of easy gain, students lose all enthusiasm for pursuing long studies. He shows that talented students who initially like to pursue long studies find them hastily too long, when they compare the standard of living of those who have already done so with those who have not but are rich through corruption. However, according to Theobald (1990), Lui (1985), Huntington (1968) and Leff (1964), bribes can overcome excessively centralized bureaucracy, red tape and long delays in the provision of public goods such as education.

With regard to the protection of property rights, it can motivate individuals to educate and train themselves. According to Romer (1990), patents can serve as a driving force for knowledge creation because they encourage Research and Development (R&D) actors to make the investments necessary to create knowledge. To Tebaldi and Elmslie (2008), this process is highly dependent on the quality of institutions because good institutions contribute to facilitate the process of registering new patents, to disseminate ideas and to promoting cooperation among researchers, to accelerate the dissemination of scientific knowledge, to reduce the uncertainty associated with new projects, all of which stimulate R&D activities. Women's land ownership also contributes to strengthening their income-generating capacities through long-term investments, access to credit, protection from economic shocks and the possibility of earning income from land, all of which enable them to invest in their children's education (Menon et al., 2014; Do & Iyer, 2008).

On the political system, democracy exposes political decision-makers to popular demands and promotes access to education (Acemoglu et al., 2015; Ansell, 2010; Gallego, 2010; Bueno de Mesquita et al., 2005; Lindert, 2005; Lake & Baum, 2001; Brown, 1999). According to these authors, electoral competition, political participation, media freedom, respect for human rights, protection of property rights and the desire for sustained economic growth features of democratic regimes can explain this relationship. This means that the democratic regime, unlike the autocratic regime, promotes access to education. However, while democracy seems to have a positive effect on the quantity of education, its effect on the quality of education is uncertain (Dahlum and Knutsen, 2017), in particular because the improvement in the educational quality is difficult to perceive by the median voter (Harding and Stasavage, 2014), while the increase in access to school or the abolition of school fees seems to be quite visible.

Work on the link between the rule of law education focuses on studying the relationship between the rule of law and educational choices (Nifo et al., 2017). According to Nifo et al. (2017), respect for the rule of law reduces the resources that can be expropriated by rents seekers, thereby reducing incentives to choose a career dedicated to protecting producers from rent seeking. The institutional quality affects the compensation structure and shapes differences in the relative profitability expected from careers. Poor institutional quality encourages rent-seeking, thus pushing talent into rent-seeking activities or professions to defend themselves against rent-seeking behaviour. However, when the institutional quality is good, careers devoted to protection against rent-seeking are less necessary and less profitable, because a smaller share of production is at stake and rent-seeking is less likely to succeed.

Civil wars have a long-lasting effect on the level and access to education of civilians and combatants affected by violence (Justino, 2011). The phenomenon of child soldiers, changing household labour allocation decisions, declining educational performance, fear, targeting of schools, teachers, students and population displacement prevent people from investing in their education during and after conflicts. Swee (2015), Merrouche (2011) and Shemyakina (2011) note that poor personal health and the loss of family members can create serious restrictions on access to school.

This study contributes to the existing literature by (i) using six institutional quality measures to analyse the role of institutional quality on access to education; (ii) using an aggregate institutional quality measure calculated by the Principal component analysis (ACP); (iii) adopting a specification based on an endogenous theoretical model and an estimation method that takes into account the associated endogeneity of institutional quality and education: the endogenous Uzawa (1965)-Lucas (1988) model is used and is estimated by the Generalized method of moments system ; (iv) covering a large sample of 52 African countries observed over a relatively long period from 1996 to 2016.

3. Methodology and data

In this section, we successively present the model specification, data and estimation techniques.

3.1. Model specification

The model emphasizes the importance of education as proposed by Uzawa (1965). It derives from a function of human capital accumulation, similar to that introduced by Lucas (1988), based on microeconomic foundations. The process of increasing education is the result of a decision by individuals who weigh the intertemporal rewards of education against its costs. Institutions play a crucial role in this process because they affect the rate of return on

education, thereby promoting the accumulation of human capital. Institutions that provide a well-functioning education and training market increase the efficiency of education, thus stimulating the education sector: the quantity and quality of education available in the economy depend on the institutional quality.

The model assumes that the population is composed of skilled (h) and unskilled (n) workers who grow at a constant rate η . The education sector uses a skilled and unskilled workforce to educate and train more workers. The workforce employed in the education sector is rewarded according to its social performance. The final goods sector produces final goods and requires a skilled and unskilled labour force. It rewards workers based on their marginal productivity. The incentive for unskilled individuals to educate themselves results from productivity differentials that are rewarded by higher wages. The reduced production function of education and the individual decision to accumulate human capital are described in sub sections (3.1.1.) and (3.1.2.).

3.1.1. Educational production function

Since unskilled workers can be trained and receive knowledge from skilled workers, the production function of education is given by:

$$y(e) = \gamma[(1-a)n]^{1-\beta}[(1-a)h] \quad (1)$$

With $0 \leq \gamma \leq 1$, the measure of the institutional quality; (β) the participation of human capital in the economy; $0 < a < 1$ is the proportion of skilled and unskilled labour allocated to the goods-producing sector. A higher γ is associated with better institutional quality. This specification implies that poor institutional quality affect the productivity of skilled workers in the process of transferring their knowledge to unskilled workers: institutional arrangements that do not reward educators for their excellence in teaching and research may discourage highly skilled professionals from fully involving students in the learning process. The quality of institutions plays a fundamental role in the process of determining the social return of education. For example, a society with bad institutions, that is low γ , also gives low importance to educational development. This leads to a decrease in the effective wage of skilled workers employed in the education sector.

Mobility in the labour market implies that wages for similar work should be equal. The model shows that improving the quality of institutions increases the productivity of the factors of production allocated to the education sector. This result is shown by equation 2:

$$y(e) = \left(\frac{\gamma\beta}{\gamma + \beta}\right) n^{1-\beta} h^\beta \quad (2)$$

with $\partial y(e)/\partial \gamma > 0$

This equation describes how societies invest in education. However, it does not provide the microeconomic basis for individual behaviour in the educational development process. Subsection (3.1.2.) develops a model linking the individual decision to invest in her education to market conditions.

3.1.2. Individual decision to accumulate human capital

An unqualified representative agent makes the decision to invest in his education by comparing the future earnings he will obtain after his training with the costs associated with that training. Future wage flows obtained by skilled workers in the economy generate an endogenous incentive to education. The present value of the gains obtained from investment in education is the weighted sum of all future wages and is given by equation 3:

$$W = \int_t^{\infty} w_h^g e^{-(r/\gamma)(s-t)} ds = \int_t^{\infty} (\gamma\beta/\gamma + \beta)n^{1-\beta}h^{\beta-1}e^{-(r/\gamma)(s-t)} ds \quad (3)$$

With r the market discount rate; the ratio r/γ is the effective discount rate by institutional inefficiencies and inefficiencies caused by poor *institutional arrangements*. Good institutional quality increases the return of education. The ratio r/γ discounts the investment made in education, and therefore its *inverse* γ/r can be interpreted as the effective rate of return on investment in education.

The opportunity cost of unskilled workers to acquire knowledge is the sum of the income they forego during the time they acquire formal knowledge and the average social cost incurred for unskilled workers to develop their human capital. The average social cost is obtained by dividing equation (2) by n the number of uneducated people. The opportunity cost is also affected by time, which is $(t-T)$ necessary for unskilled people n to become qualified h . Assuming that costs (C) are discounted over time by a rate φ , we obtain equation 4:

$$C = \int_T^t (\gamma/\gamma + \beta)(1-\beta)n^{-\beta}h^{\beta} + (\gamma\beta/\gamma + \beta)n^{-\beta}h^{\beta}e^{\varphi/(s-t)} ds = \int_T^t [(\gamma/\gamma + \beta)n^{-\beta}h^{\beta}]e^{\varphi/(s-t)} ds \quad (4)$$

An individual will choose to invest in her education himself if the future discounted return on investment flow of her income is equal to or greater than the costs incurred to accumulate human capital. Assuming that, at the margin, an unqualified person chooses to acquire the necessary knowledge to be qualified, and then we get equation 5:

$$\int_t^{\infty} (\gamma\beta/\gamma + \beta)n^{1-\beta}h^{\beta-1}e^{-(r/\gamma)(s-t)} ds = \int_T^t [(\gamma/\gamma + \beta)n^{-\beta}h^{\beta}]e^{\varphi/(s-t)} ds \quad (5)$$

By integrating both sides in relation to s and assuming that $T \rightarrow \infty$, the solution obtain is given by equation 6:

$$(h/n) = (\varphi\beta\gamma/r) \quad (6)$$

Equation (6) implies that the optimal ratio of educated and non-educated workers in the economy (h/n) depends essentially on the institutional quality (γ) , the participation of human capital in the economy (β) , the discount rate of return on investment in education (r) and the opportunity cost of education (φ) . Good institutional quality is associated with a high ratio of skilled and unskilled workers and, consequently, a higher proportion of skilled labour in the economy.

Finally, the dynamic process of human capital accumulation can be obtained by solving equation (6) for n and substituting it in the ratio of the wages of skilled and unskilled workers give equation 7:

$$\dot{h} = y(e) = [(\gamma\beta/\gamma + \beta)] (r/\phi)^{1-\beta} h \quad (7)$$

Equation (7) shows that this is indeed an endogenous process of human capital accumulation that depends on the institutional quality. It can be compared to the one proposed by Lucas (1988), which is given by $\dot{h} = (1 - \mu)\delta^* h$ which μ represents the effort devoted to education and the acquisition of knowledge, δ^* is the maximum rate of education and acquired knowledge. The maximum rate of education and acquired knowledge in equation (7) is given by $(r/\phi)^{1-\beta}$ while $(1 - \mu)$ is represented by the remaining parameters. Introducing institutional quality measures into equation (7) will allow us to determine the role of institutional quality in human capital formation in Africa.

We have seen in the introduction that in addition to institutional quality (IQ), education can be affected by other factors. Factors related to educational policy (EP), demographic factors (DF), and education market structure factors (EMS), health factors (S) and geographic factors (GEO) are those that we add to the model. Thus the education function is given by equation 8:

$$EDUC_{it} = f(EDUC_{it-1}, IQ_{it}, PE_{it}, FD_{it}, SME_{it}, GEO_{it}, S_{it}) \quad (8)$$

The econometric equation resulting from this function is given by equation 9:

$$EDUC_{it} = \beta_0 + \beta_1 EDUC_{it-1} + \beta_2 IQ_{it} + \beta_3 PE_{it} + \beta_4 FD_{it} + \beta_5 GEO_{it} + \beta_6 S_{it} + \eta_i + \varepsilon_{it} \quad (9)$$

With i , an African country; t , the year, η_i represents the country specific effects, ε_{it} is the error term, β_0, \dots, β_6 are the parameters of the model. The inclusion of the autoregressive term

AR (1) ($EDUC_{it-1}$) is justified by the fact that human capital accumulation is dynamic. The previous level of education influences its present level (Manuelli and Seshadri, 2014; Cunha et al., 2010).

3.2 Data

This study uses on five-year data (1995, 2000, 2005, 2005, 2010, and 2015) cylindrical panel data from 52 African countries (see list of countries in appendixes table 1) observed over the period 1996-2016. The choice of the study period 1996 to 2016 is mainly justified by the availability of data on World Bank institutional quality indicators. The data are five-year because it is not clear that major changes in the institutional quality in a country is observed each year (Williams and Siddique, 2008). Therefore, it seems preferable to analyse the quality of institutions at intervals of at least 5 years in order to better understand its effect on African countries over time.

These data come mainly from the Worldwide Governance Indicators (*WGI*) database and World Development Indicators (*WDI*) of the World Bank. These databases are used because, on the one hand, they cover all African countries. On the other hand, other databases such as those of the International country risk guide (*ICRG*) of the Political risk services group (*PRS*) cover a few African countries (only 33 countries). However, we are also aware that the World Bank's institutional quality database has limitations. Williams and Siddique (2008) propose two limits to this database. The first criticism is that data on the institutional quality do not cover a sufficiently long period and therefore limit the possibilities of time-series studies or the possibility of obtaining a sufficiently large amount of information related to these data. The second criticism is that the individual data sets used to create the indicators may be unduly influenced by some of the other individual data sets used by Kaufmann et al (2013). For example, the "country experts" consulted to determine an institutional score for a country in a given indicator may already know the country's scores from, for example, the *ICRG* Institutional Quality Index; scores that others have given. Although "more information is better than less", if these experts copy all the documents they use and react to each other", the potential measurement error could then be extremely important.

In this analysis, the dependent variables are primary, secondary and tertiary enrolment rates. The variables of interest are the six institutional quality measures from the World Bank's (2018a) worldwide Governance Indicators. These are: (i) control of corruption (*Corr*), (ii) government effectiveness (*GE*); (iii) regulatory quality (*RQ*); (iv) voice and accountability (*VA*), (v) rule of law (*RL*) and; (vi) political stability and absence of violence including terrorism (*PSAV*). These indicators of institutional quality are strongly correlated with each other (see table 2 in appendixes). Using these indicators simultaneously in the same regression

can generate multi-collinearity problems. Therefore, these six indicators are introduced into equation (9) in an alternative way. In addition, a synthetic institutional quality index is calculated using a Principal component analysis (PCA). The PCA allows a set of observed variables to be summarized into a number of components that are linear combinations of these variables. Thus, the composite index of institutional quality that we call the institutional quality index is a linear combination of the six institutional quality indicators. The coefficients present represent the contribution of each indicator to the construction of the institutional quality index (IQI) and are calculated with STATA 14. The formula for this institutional quality index is given, after the various preliminary operations by equation 10:

$$IQI_{it} = 0,1614Corr_{it} + 0,1759GE_{it} + 0,1729RQ_{it} + 0,1642VA_{it} + 0,1801RL_{it} + 0,1455PSABV_{it} \quad (10)$$

The control variables used are educational policy factors, demographic factors, and factors related to the structure of the education market, health factors and geographical factors. Education policy factors are per pupil expenditure on primary education as a percentage of Gross domestic product (GDP) per capita, per student expenditure on higher education as a percentage of GDP per capita and per student expenditure on secondary education as a percentage of public expenditure on education. The demographic factors used are population density and population growth rate.

The factors affecting the structure of the education market are private primary school enrolment as a percentage of total primary school enrolment and private secondary school enrolment as a percentage of total secondary school enrolment. These variables measure the size of the private market for primary and secondary education. In the case of a competitive education market (Friedman, 1980), parents have the opportunity to enrol their children in a public or private school. This situation becomes a reality when the private sector satisfies a large part of the demand in the education market. The health factor is life expectancy at birth in years. The geographically related factor used is the total benefits from natural resources as a percentage of GDP.

The instruments used are internal: they are the endogenous lagged variables (primary school enrolment rate, secondary school enrolment rate, tertiary enrolment rate) in order 1 and 2. These types of instruments are generally used in dynamic models. The definitions of the variables, the sources of the data used and the expected signs are presented in the appendices, table 3.

The descriptive statistics in table 3 indicate that the mean of the overall institutional quality over the period 1996-2016 in Africa is 0.000, showing that it is moderate. Taken individually, all institutional quality indicators are negative and have not reached at least the

average of 0 on the scale of assessment of these indicators. Weaker are the government effectiveness with an average of (-0.699), the regulatory quality with an average of (-0.660) and the rule of law with an average value of (-0.656). The control of corruption has a mean of (-0.597) while political stability and absence of violence has a mean of (-0.508) being closer to zero than the three previous indicators. This situation seems to challenge African governments to take concrete actions to significantly improve not only the overall institutional and also the different dimensions of these institutions.

Descriptive statistics also show that primary education is not yet universal in Africa. Moreover despite the significant efforts that have been made over the past two decades to increase access to education, less than 50% and less than 10% of populations in Africa have access to secondary and tertiary education respectively (See supplementary material 1 indicating the ranking of African countries according to their primary, secondary and tertiary enrolment rates over the period 1996-2016).

Primary education has increased dramatically since 1996 (see supplementary material 2). From 2005 onwards, the enrolment rate even exceeds 100%, indicating that people under six years of age or over 14 years of age have even enrolled at this level at certain times. However, in many African countries, access to primary education is not yet universal. Over the period 1996-2016, on average, 53.85% of African governments have not yet achieved universal primary education in their countries. In addition, 57.69% of African countries have not reached the average primary school enrolment rate on the continent, which is around 96.28% over the period of study. These results indicate that, despite the efforts made, there is still a significant number of children not enrolled in primary school.

Table 3: *Descriptive statistics of the selected variables*

Variable	Observations	Mean	Std-deviation	Min	Max
Primary school enrolment rate	240	95,897	23,361	29,150	145,570
Secondary school enrolment rate	204	42,674	24,486	5,210	105,740
Tertiary school enrolment rate	197	8,599	9,766	0,250	55,300
Control of corruption	260	-0,597	0,601	-1,790	1,030
Government effectiveness	260	-0,699	0,592	-1,810	1,000
Quality of regulation	260	-0,660	0,591	-2,250	1,060
Voice and accountability	260	-0,619	0,717	-2,190	0,990
Rule of law	260	-0,656	0,627	-2,010	1,030
Political stability and absence of violence	260	-0,508	0,866	-2,340	1,090
Institutional quality index	260	0,000	1,000	-1,876	2,868
Government expenditure per student,primary	133	12,884	5,906	2,790	41,820
Government expenditure on secondary education	137	30,061	10,675	0,000	71,590
Government expenditure per student,tertiary	112	275,013	392,611	0,000	2525,710
Population density	259	85,291	112,724	2,170	622,190
Natural resource rents (%GDP)	256	12,930	12,695	0,000	64,150
School enrolment, primary, private	213	13,156	14,622	0,000	88,840

School enrolment, secondary, private	160	18,784	17,638	0,000	77,410
Life expectancy at birth	260	58,275	8,142	36,820	75,970

Source: Authors, based on World Bank WGI and WDI data (2018a, b)

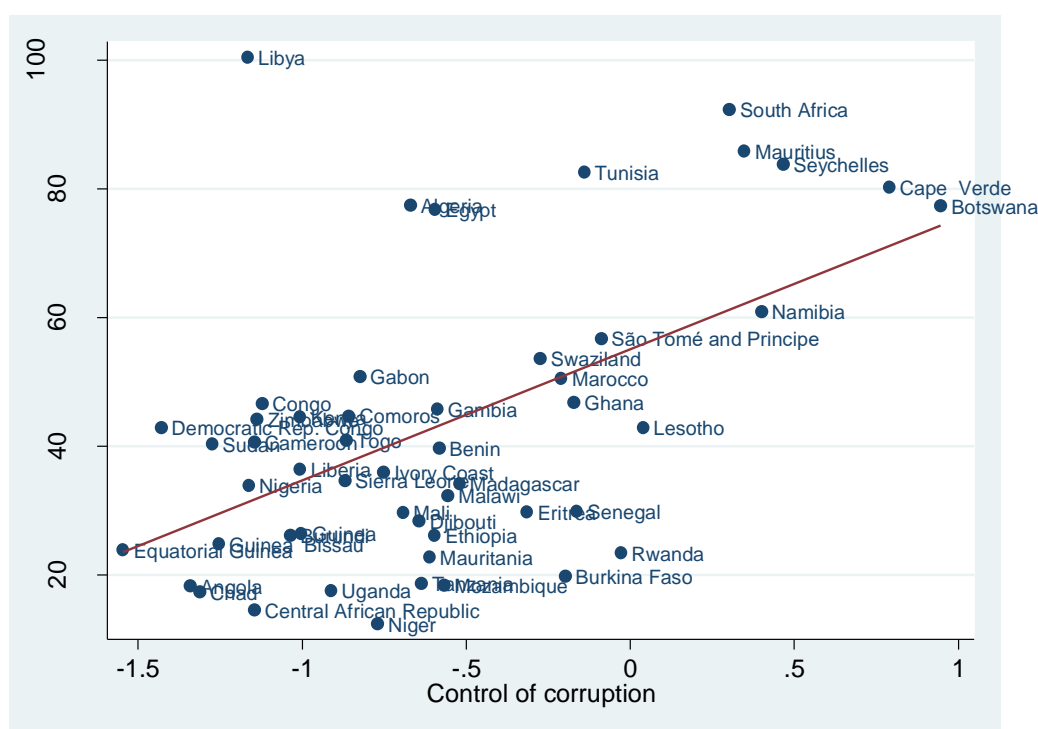
Secondary education has also increased significantly in Africa over the past two decades. This reflects the efforts that have been made to increase enrolment rates. However, considerable efforts are still needed, as secondary education remains inaccessible to many people in African countries: only 42.90% of children are enrolled in secondary education in Africa. In addition, 57.69% of countries did not reach this African average. Worse, in 71.15% of African countries, less than 50% of children are enrolled in secondary school. On average, over the period 1996-2016, in Niger, Central African Republic, Chad, Uganda, Angola, Mozambique, Tanzania, Burkina Faso, Mauritania, Rwanda, Equatorial Guinea and Guinea Bissau, less than a quarter of children are enrolled in secondary education.

Tertiary education remains the least accessible in Africa, although it has also increased significantly over the period 1996-2016 (see supplementary material 2). Despite this, on average 69.23% of countries have not reached the African average in tertiary enrolment rate which is around 8.55%. In addition, in more than 48% of countries, less than 5% African populations have access to higher education.

The evolution of the six World Bank institutional quality indicators (2018b) in Africa has not been uniform. The control of corruption, the quality of regulation, the government effectiveness, as well as political stability and the absence of violence declined over the period 1996-2016 (see supplementary materials 3 and 4). The rule of law has improved slightly. It is the voice and accountability that has significantly improved.

The correlational analysis shows that African countries with good institutional quality tend to have higher enrolment rates. Corruption control is positively correlated, in Pearson's sense, with access to secondary education in Africa (see figure 1 and supplementary material 1). This correlation is high ($R^2 = 0.52$) and is significant at the 10% threshold. Thus, in African countries that have good control of corruption, people tend to enrol more in secondary school than in African countries with a poor control of corruption. For example, enrolment rates are higher in Botswana, Cape Verde, Seychelles, Mauritius, South Africa, countries that have good control of corruption. In contrast, enrolment rates are lower in Angola, Chad, Central African Republic, Niger, Sudan and Guinea, countries which have poor control of corruption.

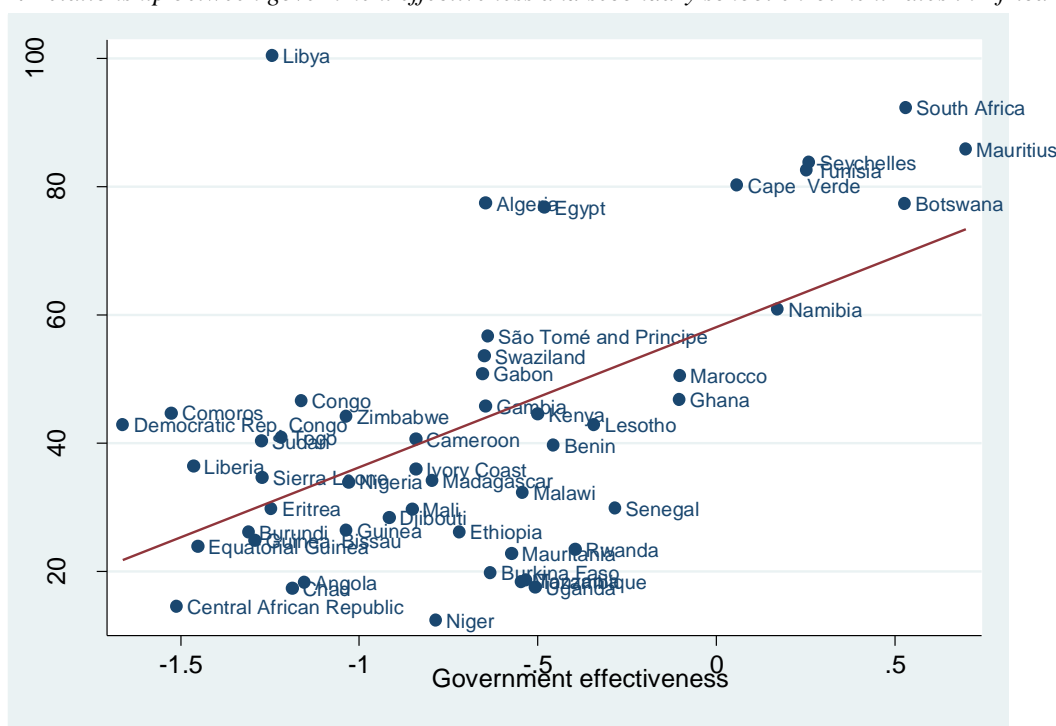
Figure 1: Relationship between control of corruption and secondary school enrolment rates in Africa



Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

Government effectiveness is also positively correlated with secondary school enrolment rates in Africa (see figure 2). This correlation is also high ($R^2 = 0.55$) and significant at the 10% (see table 2 in appendices). This means that in African countries with more government effectiveness people tend to have more access to secondary education. In contrast, in countries with less government effectiveness, people tend to have the lowest enrolment rates. For examples, countries with relatively more government effectiveness such as Mauritius, Botswana, Cape Verde, Seychelles, South Africa, and Tunisia have the highest enrolment rates. On the other hand, in countries with relatively less government effectiveness such as Djibouti, Chad, Niger, Eritrea, Sudan, Guinea, people have less access to primary, secondary and tertiary education.

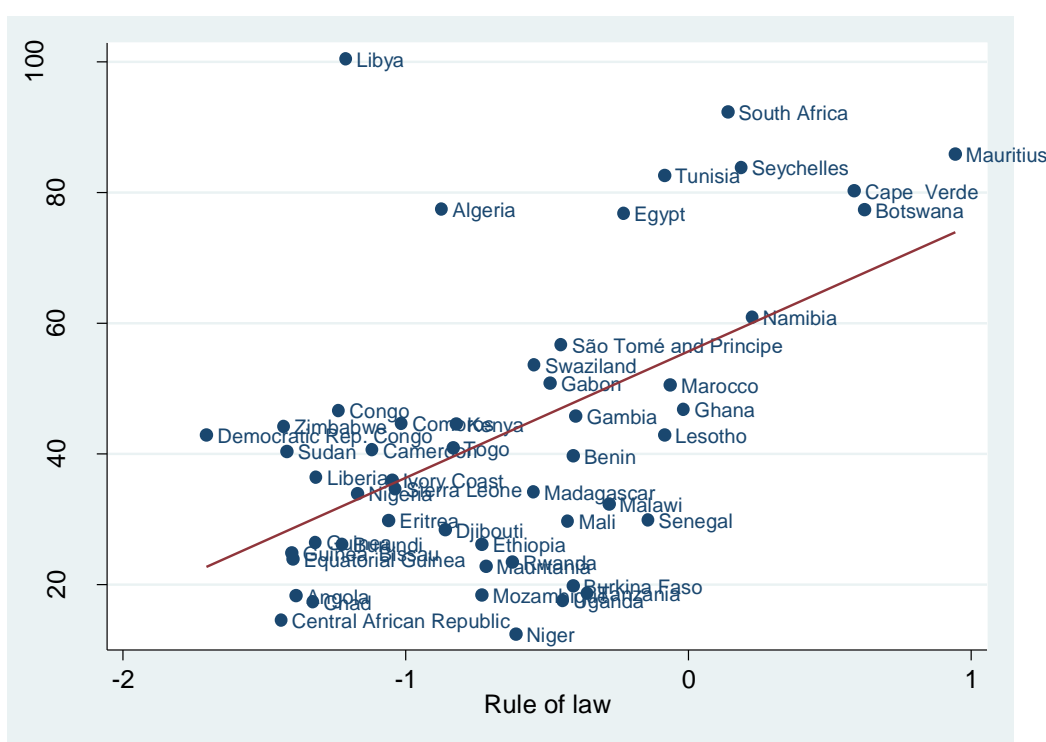
Figure 2: Relationship between government effectiveness and secondary school enrolment rates in Africa



Source: Author, based on WGI and WDI data (World Bank, 2018a, b)

The correlation between the rule of law and secondary school enrolment rates is also positive (see figure 3) and high ($R^2 = 0.52$) (see appendixes tables 2). In African countries where the rule of law is paramount, people tend to have more access to secondary education. For example, countries such as Mauritius, Botswana, Cape Verde, Seychelles, South Africa, Tunisia, Namibia that have a relatively good level of rule of law have high enrolment rates. On the contrary, countries in which respect for the law is not the most widely thing shared tend to have low enrolment rates. Central African Republic, Angola, Chad, Niger, Mozambique, Burkina Faso, Uganda, Equatorial Guinea are some examples. Others correlational analyses yield the same findings.

Figure 3: Relationship between the rule of law and secondary school enrolment rates in Africa



Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

Based on the correlational analyses, differences in access to education in Africa seem to be correlated with differences in institutional quality. However, since correlation is not causal, the econometric estimates in subsection (3.3.) propose to study the causal effects of institutional quality on education in order to better understand the links.

3.3. Estimation techniques

The existence of endogenous variables such as institutional quality and educational (Acemoglu et al., 2014), as well as the presence of the autoregressive term AR (1) as an explanatory variable, inevitably leads to endogeneity problems usually encountered in macroeconomic studies. Furthermore, endogeneity may also result from the measurement

error of the explanatory variables. According to Williams and Siddique (2008) and Acemoglu et al (2001), variables on institutional quality are derived from expert opinions and survey data and are therefore potentially subject to measurement errors. For example, this could happen if experts tend to observe better good institutional quality in countries with an educated and well-trained population. Another source of endogeneity is the existence of an omitted variable: indicators of institutional quality and education could be correlated with unobserved country-specific variables. Another source of endogeneity is reverse causality. According to Seka (2013), Shleifer and Vishny (1993) corruption can be an obstacle to the development of the education sector. Education can also affect corruption. According to Gupta et al. (2001), low levels of education could also create an environment conducive to corruption. More educated population could also indicate a greater likelihood of better control of corruption. It is generally accepted that the most educated citizens are less tolerant toward corruption (Truex, 2011; Swamy et al., 2001). Also, in the theory of modernization, Lipset (1959) argues that education can also foster the emergence of a democratic society, thus showing that the causality between democracy and education can also go both ways. The sources of endogeneity indicated make standard estimation techniques such as Ordinary least squares (OLS) inappropriate: OLS do not provide efficient estimates (Sevestre, 2002). The most appropriate method to take into account the endogeneity problems seems to be the generalized method of moments (GMM).

GMM was initially proposed by Arellano and Bond (1991) and Holtz-Eakin et al. (1988). It generates two types of estimators: the Blundell and Bond (1998) estimator or GMM system and the Arellano and Bond estimator (1991) or GMM in difference. For GMM in differences, the strategy to avoid the endogeneity biases is to differentiate the level equations into primary differences. Although it provides more accurate estimates than OLS, the use of autoregressive terms as instruments is not always appropriate and does not identify the effect of invariant factors over time. Using Monte Carlo simulations, Blundell and Bond (1998) show that the GMM system estimator is more efficient than the first difference estimator. Indeed, the latter gives biased coefficients on small samples when the instruments are weak. The bias is all the more important when the variables are persistent over time, when the specific effects are significant and when the time dimension of the panel is small. Blundell and Bond (1998) and Arellano and Bover (1995) then complete the strategy of estimating the GMM on the difference equation with a GMM on the reference equation taken at level with lagged explanatory variables considered difference instruments. For difference equations, additional moment conditions are used assuming that the explanatory variables are stationary: there is no correlation between the country-specific effect and the explanatory variables taken

considered in differences. The combination of the equations in difference with those in level estimated simultaneously significantly increases the accuracy of the estimators when the explanatory variables are sufficiently auto correlated (Blundell and Bond, 1998).

Roodman (2009a, b) recently elaborated on the technical conditions of use of GMM. He points out that the GMM is suitable for panel data in which the study period (T) is short and the sample size (N) is large ($N > T$). As part of this work, $N = 52 > T = 5$. The existence of an autoregressive term making the model dynamic may also justify the use of the GMM. Thus, the dynamic nature of our model also allows the use of GMM. We now come to the main findings got by using the GMM system.

4. Results and discussions

The objective of this section is to present the main results, discuss them and present sensitivity analysis by using girls' school enrolments at the primary, secondary and tertiary as alternatives dependent variables.

4.1. Main results

The model we used is globally valid. Hansen's tests indicate that the internal instruments used are generally satisfactory. Moreover the Arellano and Bond first-order and second-order autocorrelation tests do not reject the hypotheses of no first-order and second-order autocorrelation, respectively. In addition, the auto-regressive terms are generally positive and significant (1% or 5%), which justifies the use of a dynamic model. This confirms one of the hypotheses of Lucas (1988) and Uzawa (1965) that the process of human capital accumulation is dynamic. Investment in education affects the increase in later education levels (Manuelli and Seshadri, 2014; Cunha *et al.*, 2010).

The findings indicate that improving the overall institutional quality has a positive and significant effect at the 5 or 10% threshold on primary, secondary and tertiary school enrolment rates (see tables 4, 5 and 6). The implication of this result is that improving the overall institutional quality of in Africa countries can foster primary, secondary and tertiary school enrolment rates. Dias and Tebaldi (2012) find similar results when studying the effect of institutional quality on education on a panel of 61 developed and developing countries observed on five-year data over the period 1965-2005. They estimate their model also GMM system. Nifo *et al* (2017) study the relationship between institutional quality in Italian regions and 80,996 students who graduated in 2004 and 2007 from post-secondary 'choices of field of study. They use the logit and multinomial logit models. Their findings indicate that higher institutional quality in the students' home region is associated with higher proportions of

graduates with productive technical and general skills, suggesting that institutions play an important role in determining educational choices.

Our findings also indicate that control of corruption has a positive but non significant effect on primary, secondary and tertiary school enrolment rates. Duerrenberger and Warning (2018), Dridi (2014) and Seka (2013) find a positive and significant effect of control of corruption on education. Seka (2013) analyses in cross sectional data of a sample of 38 developed and developing countries observed in 1998 the effect of corruption control on higher education enrolment rates. He uses OLS and finds control of corruption foster school enrolment rates in higher education. But, he does not control for potential endogeneity. Using OLS and two stage least squares (2SLS), Dridi (2014) finds that control of corruption also fosters secondary school enrolment rates in a panel of 85 countries over the period 1980-2002. Duerrenberger and Warning (2018) more recently study the effect of control of corruption on the average year of schooling in higher education in a sample of 88 developing countries over the period 2005-2012. They use Pool least squares (PLS) and the Prais-Winsten estimator. They find that in countries with high levels of corruption, the number of years of schooling in higher education is low which is similar to our findings although they don't control for potential endogeneity.

Government effectiveness has a positive and significant effect on primary and secondary school enrolment. Nevertheless, it has a positive but not significant effect on tertiary school enrolment. Sen (2014) studies in cross-section the effect of institutional quality on development in Asia using OLS and 2SLS in 2010. He finds that improving government effectiveness increase the average years of schooling for children who are at least five years old. Similarly, in a cross country study of 64 developed and developing countries observed in 2000, Adams-Kane and Lim (2016), use GMM system, and find that government effectiveness also fosters school attainment of adult population aged 15 years or younger.

Table 4: *Estimated effects of institutional quality on primary school enrolment rates in Africa*

GMM system							
Variables	Primary school enrolment rates (%)						
Primary school enrolment rates , AR(1)	0,435*** (0,086)	0,430*** (0,085)	0,439*** (0,087)	0,422*** (0,087)	0,418*** (0,086)	0,434*** (0,087)	0,430*** (0,085)
Control of corruption	0,050 (0,036)						
Government effectiveness		0,062** (0,028)					
Regulatory quality			0,042 (0,028)				
Voice and accountability				0,045* (0,024)			
Rule of law					0,069** (0,032)		

Political stability and absence of violence					0,047**	(0,018)	
Institutional quality index							0,037**
Government expenditure per student	-0,089***	-0,091***	-0,089***	-0,101***	-0,099***	-0,089***	-0,091***
,primary	(0,028)	(0,028)	(0,027)	(0,030)	(0,029)	(0,024)	(0,028)
	0,038**	0,040**	0,039**	0,041**	0,040**	0,040**	0,040**
Population density	(0,016)	(0,017)	(0,016)	(0,018)	(0,017)	(0,017)	(0,0167)
Natural resources rents (%GDP)	0,021**	0,024**	0,018*	0,020*	0,027**	0,025**	0,024**
	(0,009)	(0,010)	(0,009)	(0,011)	(0,012)	(0,011)	(0,010)
School enrolment, primary, private	-0,015*	-0,015*	-0,019**	-0,020**	-0,016**	-0,017**	-0,015*
	(0,008)	(0,007)	(0,008)	(0,008)	(0,008)	(0,007)	(0,007)
Constant	2,708***	2,738***	2,698***	2,795***	2,808***	2,695***	2,694***
	(0,403)	(0,397)	(0,406)	(0,417)	(0,402)	(0,390)	(0,388)
Number of observations	101	101	101	101	101	101	101
Number of countries	41	41	41	41	41	41	41
Number of countries	17	17	17	17	17	17	17
Test AR(1) (p-value)	0,512	0,512	0,374	0,622	0,596	0,737	0,512
Test AR(2) (p-value)	0,161	0,161	0,152	0,183	0,155	0,159	0,161
Test Hansen (p-value)	0,343	0,343	0,307	0,335	0,374	0,269	0,343

Note: the robust standard errors of the estimated coefficients in brackets. *, **, *** represent the significance at 10%.5% and 1% (* p<0.1, ** p<0.05, *** p<0.01).

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

The quality of regulation has a positive but not significant effect on primary and tertiary school enrolment rates. It has a positive and significant effect (at 1%) for secondary school enrolment. The implication of this finding is that improving the quality of regulation fosters secondary school enrolment rates. However, Sen (2014) also finds that the quality of regulation has no significant effect on the number of years of schooling of children aged 15 years or younger in Asia.

Voice and accountability, considered as a proxy of democracy, a meta-institution, that is an institution from which other institutions in a country are born or strengthened (Acemoglu et al., 2005; Rodrik, 2000) has a positive and significant effect (at 10%) on primary school enrolment rates. We also find that it has a positive and significant effect (at 5%) on tertiary school enrolment rate. For secondary education, although the effect is positive, it is not significant. These findings imply that improving voice and accountability can foster primary and tertiary school enrolment rates in Africa. In studying the comparative effect of democracy on primary school enrolment in Africa with other developing regions and using OLS from an unbalanced panel data of 94-136 countries over five year data(1960, 1965, 1970) and 1975-1987, Brown (2000) find that unlike other developing regions where democracy foster primary school enrolment, it has no effect on education in Africa. Their findings indicate that the type of political regime does not explain primary school enrolment

in Africa. In Asia, a more recent study by Sen (2014) also finds no effect of voice and accountability on the average years of schooling of children aged 15 or under. Harding and Stasavage (2014), on the other hand, find that democratic regimes do promote access and primary school enrolment in a panel of 29 African countries. Dahlum and Knutsen (2017) study the effect of democracy on the average years of schooling for 25 years old people on a sample of 120 countries over the period 2005 -2009. They use OLS and 2SLS and find that democratic regimes foster school enrolment and the average years of schooling.

Table 5: *Estimated effects of institutional quality on secondary school enrolment rates in Africa*

Variables	GMM system						
	Secondary school enrolment rates						
Secondary school enrolment rates , AR(1)	0,702** * (0,081)	0,690** * (0,083)	0,674** * (0,086)	0,697** * (0,095)	0,685** * (0,086)	0,691** * (0,082)	0,690** * (0,083)
Control of corruption	0,044 (0,047)						
Government effectiveness		0,074* (0,043)					
Regulatory quality			0,123** * (0,042)				
Voice and accountability				0,036 (0,044)			
Rule of Law					0,060 (0,050)		
Political stability and absence of violence						0,028 (0,034)	
Institutional quality index							0,044* (0,025)
Government expenditure on secondary education	0,088** (0,043)	0,084** (0,041)	0,086** (0,041)	0,097* (0,054)	0,090** (0,042)	0,098** (0,047)	0,084** (0,041)
Population density	0,027* (0,015)	0,027* (0,015)	0,033** (0,015)	0,030** (0,013)	0,027* (0,015)	0,028* (0,014)	0,027* (0,015)
Natural resource rents (%GDP)	-0,007 (0,015)	-0,004 (0,015)	-0,002 (0,017)	-0,009 (0,014)	-0,005 (0,015)	-0,010 (0,015)	-0,004 (0,015)
School enrolment , secondary, private	-0,001 (0,019)	-0,001 (0,020)	-0,009 (0,022)	-0,008 (0,023)	-0,005 (0,021)	-0,005 (0,019)	-0,001 (0,020)
Constant	0,874** * (0,290)	0,946** * (0,310)	1,008** * (0,353)	0,870** * (0,291)	0,944** * (0,320)	0,887** * (0,284)	0,895** * (0,292)
Number of observations	72	72	72	72	72	72	72
Number of countries	38	38	38	38	38	38	38
Number of instruments	17	17	17	17	17	17	17
Test AR(1) (p-value)	0,758	0,766	0,813	0,646	0,703	0,575	0,766

Test AR(2) (p-value)	0,305	0,300	0,297	0,301	0,303	0,302	0,300
Test Hansen (p-value)	0,141	0,164	0,125	0,135	0,151	0,159	0,164

Note: The data used are five-yearly. The numbers in brackets represent the robust standard errors of the estimated coefficients. *, **, *** represent the significance at 10%.5% and 1% (* p<0.1, ** p<0.05, *** p<0.01).

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

The rule of law has a positive and significant effect on primary school enrolment (at 5%) (see table 3). Although its effect is positive on secondary and tertiary school enrolment, it is not significant (see tables 5 and 6). Improving the rule of law in Africa can also foster primary school enrolment rate. In Asia, Sen (2014) finds, on the contrary, that the rule of law has no effect on the number of children aged 15 or under attending school. In Italy, Nifo et al (2017) find that the improvement of the rule of law in the students' home region is associated with higher proportions of graduates with productive technical and general skills, suggesting that the rule of law plays an important role in determining educational choices.

Table 6: *Estimated effects of institutional quality on tertiary school enrolment rates*

Variables	GMM system						
	Tertiary school enrolment rates						
Tertiary school enrolment rates , AR(1)	0,269** (0,114)	0,305** (0,121)	0,271** (0,120)	0,302** (0,118)	0,290** (0,115)	0,280** (0,118)	-0,0541 (0,280)
Control of corruption	0,001 (0,152)						
Government effectiveness		0,072 (0,126)					
Quality of regulation			0,079 (0,139)				
Voice and accountability				0,146** (0,068)			
Rule of law					0,0235 (0,164)		
Political stability and absence of violence						0,0282 (0,0774)	
Institutional quality index							1,504** (0,676)
Government expenditure per student, tertiary	-0,304*** (0,112)	-0,292*** (0,097)	-0,302*** (0,098)	-0,294*** (0,106)	-0,296*** (0,102)	-0,299*** (0,0987)	-0,0295 (0,126)
Life expectancy at birth	2,114*** (0,616)	1,925*** (0,598)	2,064*** (0,561)	1,840*** (0,547)	2,023*** (0,634)	2,057*** (0,563)	-3,436 (2,058)
Natural resources rents	0,075 (0,047)	0,081** (0,036)	0,088** (0,043)	0,108** (0,042)	0,077 (0,051)	0,082** (0,038)	-0,025 (0,044)
Population growth rate	-0,260** (0,101)	-0,238** (0,101)	-0,261*** (0,095)	-0,267*** (0,0923)	-0,251** (0,0956)	-0,256** (0,0950)	0,051 (0,102)
Constant	-5,273* (2,716)	-4,630* (2,520)	-5,064** (2,402)	-4,223* (2,354)	-4,985* (2,740)	-5,090** (2,387)	6,748 (4,336)
Number of observations	84	84	84	84	84	84	84

Number of countries	37	37	37	37	37	37	37
Number of instruments	17	17	17	17	17	17	17
Test AR(1) (p-value)	0,390	0,399	0,325	0,741	0,414	0,463	0,485
Test AR(2) (p-value)	0,247	0,286	0,265	0,265	0,254	0,276	0,410
Test Hansen (p-value)	0,480	0,451	0,557	0,303	0,443	0,620	0,393

Note: The data used are five-yearly. The numbers in brackets represent the robust standard errors of the estimated coefficients. *, **, *** represent the significance at 10%, 5% and 1% (* p<0.1, ** p<0.05, *** p<0.01).

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

Political stability and the absence of violence have a positive and significant effect (at 5%) on primary school enrolment rates. This finding implies that it fosters primary school enrolment in Africa. For secondary and tertiary education, the signs obtained are those expected, even if the coefficients obtained are not significant. Shemyakina (2011) and Swee (2015) find that violent conflicts affect secondary education more than primary education. Poirier (2012) also studies the effect of armed conflict on a sample of 43 African countries over the years 1950-2010. He uses OLS to estimate his model and finds that civil wars have negative consequences on educational performance. In addition, he finds that the ratio of students who do not go to school and secondary school enrolment rates are particularly sensitive to periods of conflict. But in general, it seems to be established by the literature that violent conflicts negatively affect school enrolment both in the long and short term (Justino, 2011).

In summary, our findings related to the role of institutional quality in school enrolment are presented in table 7.

Table 7: Summary of the role of institutional quality in school enrolment in Africa

Level of education	Dimensions of institutional quality
Primary education	<ul style="list-style-type: none"> • Government effectiveness • Voice and accountability • Rule of Law • Political stability and absence of violence • Institutional quality index
Secondary education	<ul style="list-style-type: none"> • Government effectiveness • Quality of regulation • Index of institutional quality
Tertiary education	<ul style="list-style-type: none"> • Voice and accountability • Institutional quality index

Source: Authors

In addition to the institutional quality, other factors can affect school enrolment in Africa. School enrolment can be affected by other factors related to educational policy,

demographic factors, the structure of the education market, health factors and geographical factors. We briefly present these findings.

With regard to educational policy, public expenditure per primary school pupil as a percentage of GDP per capita has a negative and significant effect (at 1%) for all institutional quality measures including the institutional quality index. Public expenditure per student in tertiary education as a percentage of GDP per capita has also a negative and significant effect (at 1%) for all institutional quality dimensions. But they have a negative effect and are 'and are not significant for the overall institutional quality. These findings suggest that public spending per student does not necessarily foster primary and tertiary school enrolment rates. It raises the issue related to the effectiveness of these types of spending. Low institutional quality such as government ineffectiveness or lack of control of corruption could explain the poor quality of public expenditure.

Secondary education expenditure as a percentage of public expenditure on education has a positive and significant sign (at 5% or 10%). The increase in these expenditures seems to be more to secondary school enrolment. Castello-Climent and Hidalgo-Cabrallana (2012) find a positive effect of public expenditure on education on the secondary school enrolment rate. Atangana Ondo (2011) also finds in a study on the identification factors that influence of secondary school performance in Cameroon that the most efficient schools are those with relatively better resources. However, Papagapitos and Riley (2009) do not find any statistically significant effect of public education spending on secondary school enrolment rates.

Demographic factors such as population density and population growth rate can positively affect the supply and/or demand for education. Indeed population density has a positive and significant effect (at 5% level) on primary school enrolment rates and 10% or 5% on secondary school enrolment rates. Primary and secondary school enrolment rates are higher in countries with a high population density. In contrast to population density, high population growth seems to hinder access to tertiary education: population growth rate has an overall negative and significant effect on tertiary school enrolment rate in Africa. Countries with high population growth rates tend to have lower school enrolment rates. This is consistent with the trade-off between "quantity and quality of children" and the effect of larger families (Hanushek, 1992; Becker and Lewis, 1973; Willis, 1973). Conversely, Boix (1997) and Dahlum and Knutsen (2017) argue that a country with high population growth tends to spend more on education than another country with a more mature demographic profile, thereby increasing school enrolment rates.

Factors related to the structure of the education market such as private primary school enrolment as a percentage of total primary school enrolment have a negative and significant effect (at the 5 or 10%) (see table 4) on overall primary school enrolment. For secondary education, private secondary school enrolment as a percentage of total secondary school enrolment also has a negative but insignificant effect on secondary school enrolment rates (see table 5). The public primary education sector continues to satisfy most of the demand for primary education in Africa. There is also little competition between private primary schools in order to improve the quality of public service. As reported by Atangana Ondo (2011), competition could drive a shift in demand from public schools to private ones. This transfer could lead to progress to the number of pupils per class, pupil-teacher ratio and the average expenditure per pupil. But the overall effect is likely to be zero, since there is only a transfer from the public to the private sector.

The geographical factor such as the endowment of natural resources is captured by the income derived from these resources. Natural resources rents seem to affect positively the primary school enrolment rate in Africa (see table 4). It also seems to foster tertiary school enrolment rates (see table 6). On the other hand, they have a negative and insignificant effect on secondary education (see table 5). The effect of the benefits derived from natural resources rents depends on level of education. African governments may allocate the natural resources rents differently to different levels of education with unequal effectiveness. Davis (1995) also finds that dependence on natural resources foster primary enrolment. He uses comparative descriptive statistics on a panel of 57 mineral-resource-poor countries and 22 mineral-rich countries over 1970-1991. He asserts that resource curse hypothesis is not verified for all mineral economies and applies, where applicable, only on a case-by-case basis, depending on domestic economic factors. Stijns (2006) also finds that natural resources abundance contribute to increase the average years of schooling, the average years of schooling for girls, the net secondary school enrolment rate, the adult literacy rate and public expenditure on education as a percentage of GDP. He uses Pearson-style correlational analysis on a panel of 70 developing and developed countries using five-year data from 1975 to 2000 and cross-sectional data of 1994. Stijns (2009) find also, on a sample of countries ranging from 69 -77 over 1995 -1999, that countries with significant natural resources invest more in human capital formation for men and women. However, Blanco and Grier (2012) find no significant overall effect of natural resource dependence on the average years of primary school enrolment in a panel of 17 Latin American countries over 1975-2004. More recently, Sun *et al* (2018) study the relationship between natural resource dependence, public investment in education and human capital formation in a panel of 31 Chinese provinces over 1999-2015. They use OLS

and find that dependence on natural resources is negatively and significantly correlated with the share of higher education enrolment in the total population.

The health factor measured by life expectancy has a positive and significant effect on tertiary education (at the 1% threshold). This effect suggests that the possibility of a long and healthy life encourages people to acquire higher levels of education by enrolling in tertiary schools. A similar explanation could be that people who live longer tend to acquire a higher level of education. This result is consistent with those found by Cervellati and Sunde (2005) and Soares (2005) for whom improving life expectancy at birth or reducing mortality can encourage citizens to invest in their education.

4.2. Sensitivity analysis: taking into consideration girls' education

The inclusion of female education is explained by the fact that girls' education has traditionally been neglected in many African countries. Inequalities in education between men and women remain, although there has been a significant reduction in the gap. Girls still represent a high proportion of out-of-school children. The average gap between men and women is 1.4 years of schooling: women receive an average of 4.3 years of schooling, compared to 5.7 years for men (UNECA, 2017).

Sperling and Winthrop (2016) generously show in eight points why governments must massively invest in girls' education. African policy makers must invest in girls' education because : (i) investing in girls' education increases labour productivity and promotes economic growth; (ii) investing in girls' education also saves lives; (iii) investing in girls' education leads to smaller and healthier families; (iv) investing in girls' education mitigates the effects of climate change; (v) investing in girls' education leads to healthier, more educated and better educated children; (vi) investing in girls' education reduces the risks of child marriage;(vii) investing in girls' education leads to greater empowerment of women; and (viii) investing in girls' education reduces the consequences of natural disasters.

While allowing us to test the sensitivity of our results to education without gender distinction, taking girls' education into account allows us to know and understand the role of institutional quality on female school enrolment rates in Africa. Overall, our findings (see supplementary material 5, 6 and 7) are consistent with the baseline results (tables 4, 5 and 6). Table 8 compares the institutional quality dimensions that foster overall school enrolment rates with those that foster especially girls' school enrolment rates. Although the overall institutional quality and regulatory quality are not significant with girls 'enrolment, they have the expected sign: they are positive.

Table 8: *Role of institutional quality in education in Africa: overall school enrolment versus girl school enrolment*

School enrolment rates	Role of institutional quality on overall school enrolment rates	Role of institutional quality on girls school enrolment rates
Primary education	<ul style="list-style-type: none"> • Government effectiveness • Voice and accountability • Rule of law • Political stability and absence of violence • Institutional quality index 	<ul style="list-style-type: none"> • Government effectiveness • Voice and accountability • Rule of law • Political stability and absence of violence • Regulatory quality
Secondary education	<ul style="list-style-type: none"> • Government effectiveness • Regulatory quality • Institutional of quality index 	<ul style="list-style-type: none"> • Government effectiveness • Regulatory quality • Institutional of quality index
Tertiary education	<ul style="list-style-type: none"> • Voice and accountability • Institutional quality index 	<ul style="list-style-type: none"> • Voice and accountability

Source: Authors

5. Conclusion

This study examines the role of institutional quality in primary, secondary and tertiary school enrolment in Africa. We incorporated institutional quality measures into an educational production model. The model estimated by the Generalized method of moments based on World Bank data over 1996-2016 highlights four main results. First, improvement of overall institutional quality foster primary, secondary and tertiary school enrolment in Africa. Second improving government effectiveness, voice and accountability, rule of law political stability and absence of violence foster more specifically primary school enrolment. Third, government effectiveness and regulatory quality also foster secondary school enrolment. Finally, voice and accountability is more sensitive to tertiary school enrolment. These findings also show that differences in school enrolment rates in Africa seem to be explained by differences in the institutional quality.

Our findings suggest that public authorities' should improve the institutional quality in their countries in order to foster school enrolment. It is one powerful instrument that they have to use to achieve universal primary education and even motivates their population to acquire higher level of education. African political authorities, who often have limited resources and yet wish to offer their populations the opportunity to have the educational level they want, can improve the overall institutional quality or focus on a few key institutional dimensions.

While the results of this study provide a preliminary understanding of the role of institutional quality in human capital formation in Africa, further studies using more

available data and taking into consideration heterogeneity are needed to parse out in more detail the role of institutional quality on human capital development in Africa.

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Appendices

Table 1: List of countries

Algeria	Djibouti	Madagascar	Central African Republic	Guinea
Angola	Egypt	Malawi	Republic Democratic of Congo	Ghana
Benin	Eritrea	Mali	Rwanda	Zambia
Botswana	Ethiopia	Morocco	Sao Tome and Principe	Zimbabwe
Burkina Faso	Gabon	Mauritius	Senegal	
Burundi	Gambia	Mauritania	Seychelles	
Cameroon	Equatorial Guinea	Mozambique	Sierra Leone	
Cape Verde	Guinea Bissau	Namibia	Sudan	
Chad	Kenya	Niger	Swaziland	
Comoros	Lesotho	Nigeria	Tanzania	
Congo	Liberia	South Africa	Togo	
Côte d'Ivoire	Libya	Uganda	Tunisia	

Source: Authors

Table 2 : Correlation between variables

	Primary school enrolment rate	Secondary school enrolment rate	Tertiary school enrolment rate	Control of corruption	Government effectiveness	Political stability and absence of violence	Regulatory quality	Rule of law	Voice and accountability
Primary school enrolment rate	1,000								
Secondary school enrolment rate	0,431***	1,000							
Tertiary school enrolment rate	0,268***	0,806***	1,000						
Control of corruption	0,222***	0,502***	0,214***	1,000					
Government effectiveness	0,267***	0,541***	0,351***	0,837**	1,000				
Political stability and absence of violence	0,247***	0,375***	0,108	0,669**	0,641**	1,000			
Regulatory quality	0,239***	0,390***	0,162*	0,742**	0,870**	0,623***	1,000		
Rule of law	0,263***	0,522***	0,275***	0,878**	0,895**	0,761***	0,864**	1,000	
Voice and accountability	0,262***	0,378***	0,095	0,691**	0,690**	0,6289***	0,724**	0,773**	1,000

Note: *, **, *** represent the significance at 10%.5% and 1% (* p<0.1, ** p<0.05, *** p<0.01)

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

Table 3: Definitions, sources of selected variables and expected signs

Variable	Definition	Source	Expected Sign
Primary school enrolment rate (%)	Ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	WDI, World Bank (2018)	
Secondary school enrolment rate (%)	Ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown	WDI, World Bank (2018)	
Tertiary school enrolment rate (%)	Ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown	WDI, World Bank (2018)	
Control of corruption	Perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests	WGI, World Bank (2018)	Positif
Government effectiveness	Perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	WGI, World Bank (2018)	Positif
Regulatory quality	Perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	WGI, World Bank (2018)	Positif
Voice and accountability	Perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	WGI, World Bank (2018)	Positif
Rule of law	Perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	WGI, World Bank (2018)	Positif
Political stability and absence of violence	Perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.	WGI, World Bank (2018)	Positif
Institutional index	We calculated it using principale component analysis	WGI, World Bank (2018)	Positif
Government expenditure per student, primary (% of GDP per capita)	Government expenditure per student is the average general government expenditure per student in the given level of education, expressed as a percentage of GDP per capita	WDI, World Bank (2018)	Positif
Government expenditure per student, secondary (% of GDP per capita)	Government expenditure per student is the average general government expenditure per student in the given level of education, expressed as a percentage of GDP per capita.	WDI, World Bank (2018)	Positif
Government expenditure per student, tertiary (% of GDP per capita)	Government expenditure per student is the average general government expenditure per student in the given level of education, expressed as a percentage of GDP per capita.	WDI, World Bank (2018)	Positif

Population density (people per sq. km of land area)	Population density is midyear population divided by land area in square kilometers	WDI, World Bank (2018)	Positif
Population growth (annual %)	Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage	WDI, World Bank (2018)	Negatif
School enrollment, primary, private (% of total primary)	Private enrollment refers to pupils or students enrolled in institutions that are not operated by a public authority but controlled and managed,by a private body.	WDI , World Bank (2018)	Negatif
School enrollment, secondary, private (% of total secondary)	Private enrollment refers to pupils or students enrolled in institutions that are not operated by a public authority but controlled and managedby a private body .	WDI, World Bank (2018)	Négatif
Total natural resources rents (% of GDP)	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents , mineral rents, and forest rents...	WDI, World bank (2018)	Positif
Life expectancy at birth, total (years)	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	WDI, World Bank (2018)	Positif

Note: The indicators of institutional quality take values from -2.5 to +2.5 with a higher level indicating more effort of to get good institutional quality.

Source : Authors

Supplementary materials

Material 1

Table: Ranking of African countries according to their primary, secondary and tertiary school enrolment rates, 1996-2016

Countries	Ran k	Primary school enrolment rates(%)	Countries	Ran k	Secondary school enrolment rates	Countries	Ran k	Tertiary school enrolment rates
Gabon	1	140.423	Libya	1	100.460	Libya	1	53.720
Malawi	2	134.600	South Africa	2	92.328	Egypt	2	30.264
Rwanda	3	128.888	Mauritius	3	85.888	Tunisia	3	28.152
Madagascar	4	126.966	Seychelles	4	83.876	Algeria	4	25.180
Togo	5	118.432	Tunisia	5	82.650	Mauritius	5	24.814
São Tome and Principe	6	118.296	Cape Verde	6	80.340	South Africa	6	19.800
Uganda	7	113.938	Algeria	7	77.528	Marocco	7	16.620
Namibia	8	112.360	Botswana	8	77.423	Botswana	8	14.926
Tunisia	9	111.958	Egypt	9	76.842	Liberia	9	12.757
Lesotho	10	110.312	Namibia	10	60.987	Ghana	10	12.293
Cape Verde	11	109.738	São Tome and Principe	11	56.733	Cape Verde	11	11.798
Algeria	12	109.384	Swaziland	12	53.710	Sudan	12	11.495
Seychelles	13	108.642	Gabon	13	50.895	Seychelles	13	11.015
Botswana	14	108.460	Marocco	14	50.565	Cameroon	14	9.778
Libya	15	105.827	Ghana	15	46.840	Nigeria	15	9.073
Comoros	16	105.555	Congo	16	46.673	Benin	16	8.688
Cameroon	17	104.030	Gambia	17	45.783	São Tome and Principe	17	8.070
South Africa	18	103.476	Comoros	18	44.750	Ivory Coast	18	7.883
Swaziland	19	103.444	Kenya	19	44.577	Gabon	19	7.700
Mauritius	20	103.426	Zimbabwe	20	44.263	Togo	20	7.500
Zimbabwe	21	102.200	Lesotho	21	42.936	Zimbabwe	21	7.240

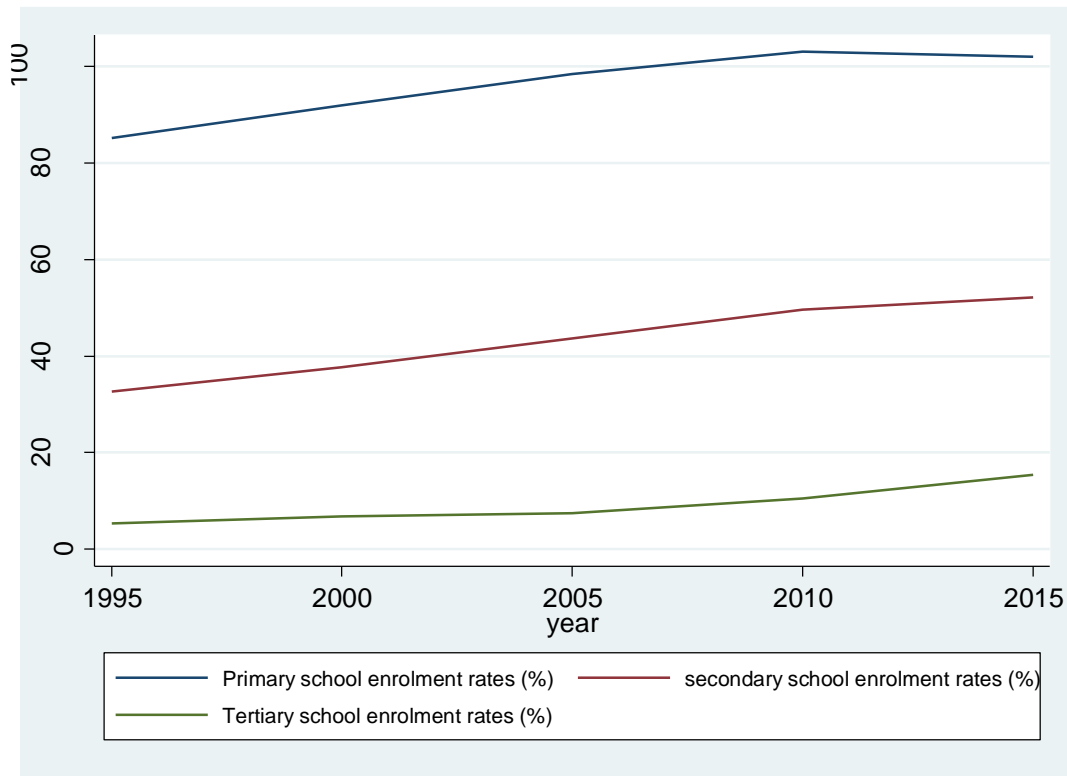
Morocco	22	101.544	Democratic Republic of Congo	22	42.887	Senegal	22	6.928
Kenya	23	101.490	Zambia	23	42.850	Namibia	23	6.507
Congo	24	100.725	Togo	24	40.990	Congo	24	5.828
Burundi	25	99.968	Cameroon	25	40.664	Lesotho	25	5.644
Egypt	26	98.356	Sudan	26	40.445	Guinea	26	5.180
Sierra Leone	27	97.957	Benin	27	39.763	Swaziland	27	5.143
Liberia	28	97.532	Liberia	28	36.475	Democratic republic of Congo	28	4.867
Benin	29	96.790	Ivory Coast	29	36.053	Comoros	29	4.598
Guinea Bissau	30	95.920	Sierra Leone	30	34.680	Rwanda	30	4.310
Zambia	31	95.258	Madagascar	31	34.220	Angola	31	4.172
Angola	32	95.007	Nigeria	32	34.005	Mali	32	4.168
Ghana	33	94.950	Malawi	33	32.382	Mauritania	33	4.154
Mozambique	34	93.070	Senegal	34	29.980	Ethiopia	34	3.583
Nigeria	35	92.150	Erytrea	35	29.884	Madagascar	35	3.294
Mauritania	36	89.768	Mali	36	29.752	Mozambique	36	3.294
Democratic Republic of Congo	37	87.554	Djibouti	37	28.408	Uganda	37	3.273
Gambia	38	86.742	Guinea	38	26.438	Kenya	38	3.160
Tanzania	39	85.036	Ethiopia	39	26.248	Zamba	39	3.155
Central African Republic	40	84.373	Burundi	40	26.190	Burkina Faso	40	2.992
Equatorial Guinea	41	83.046	Guinea Bissau	41	24.865	Guinea Bissau	41	2.420
Ivory Coast	42	78.922	Equatorial Guinea	42	23.957	Burundi	42	2.378
Ethiopia	43	78.184	Rwanda	43	23.524	Central African Republic	43	2.118
Senegal	44	76.944	Mauritania	44	22.800	Djibouti	44	2.050
Chad	45	76.792	Burkina Faso	45	19.832	Tanzanie	45	2.012
Guinea	46	72.638	Tanzania	46	18.710	Erythrée	46	1.924
Mali	47	69.932	Mozambique	47	18.410	Equatorial Guinea	47	1.840

Sudan	48	68.633	Angola	48	18.368	Sierra Leone	48	1.800
Burkina Faso	49	66.414	Uganda	49	17.600	Gambia	49	1.697
Eritrea	50	58.892	Chad	50	17.446	Chad	50	1.490
Niger	51	52.236	Central African Republic	51	14.578	Niger	51	1.200
Djibouti	52	49.662	Niger	52	12.472	Malawi	52	0.518
Africa		96.285	Africa		42.902	Africa		8.547

Source: Authors, based on WGI and WDI data (World Bank, 2018a)

Material 2

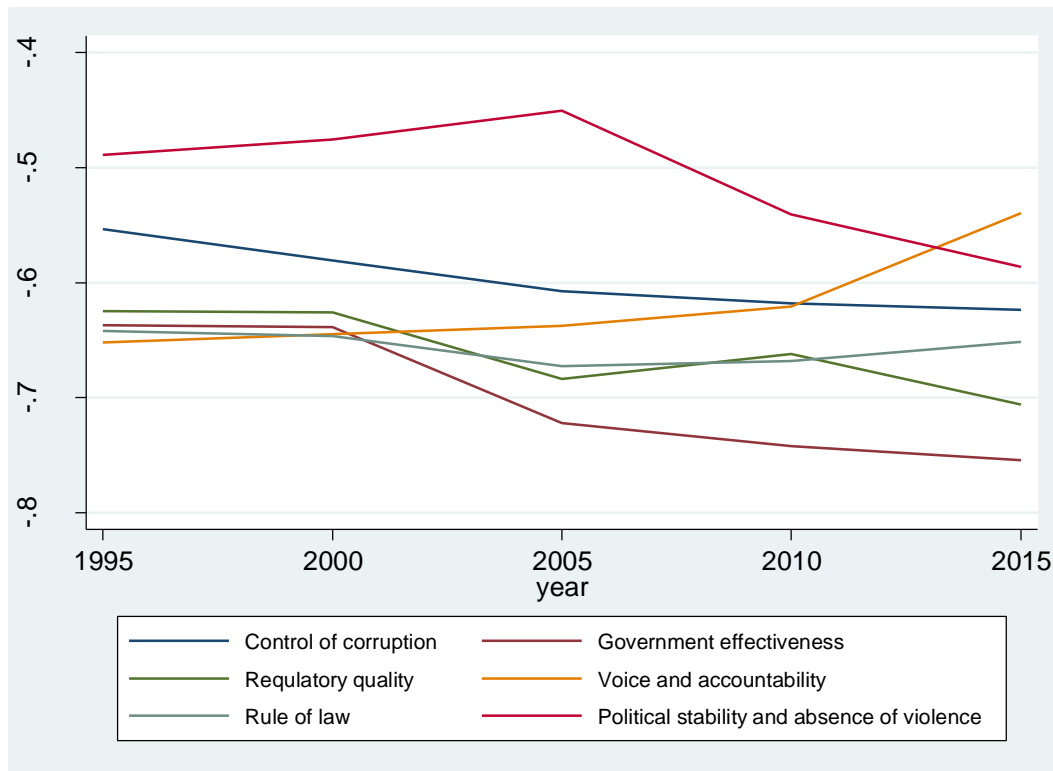
Figure 1 : Trends in primary, secondary and tertiary enrolment rates in Africa



Source: Authors, based on World Bank WDI data (2018a)

Material 3

Figure 2: Trends in institutional quality in Africa



Source: Authors, based on World Bank WGI data (2018b)

Supplementary material 5

Table 8 : Estimate of the role of institutional quality on girls' primary school enrolment rates in Africa

GMM system							
Variables	Girls' primary school enrolment rates (%)						
Primary school enrolment rates , AR(1)	0,450*** (0,077)	0,453*** (0,075)	0,456*** (0,078)	0,443*** (0,081)	0,434*** (0,076)	0,452*** (0,078)	0,376** (0,149)
Control of corruption	0,064 (0,040)						
Government effectiveness		0,084** (0,032)					
Regulatory quality			0,064* (0,032)				
Voice and accountability				0,059** (0,029)			
Rule of law					0,100** (0,038)		
Political stability and absence of violence						0,061*** (0,021)	
Institutional quality index							0,044 (0,050)
Government expenditure per student, primary	-0,082** (0,031)	-0,083** (0,031)	-0,083*** (0,030)	-0,098*** (0,034)	-0,095*** (0,032)	-0,082*** (0,027)	-0,045 (0,041)
Population density	0,045** (0,017)	0,046** (0,018)	0,045** (0,018)	0,047** (0,020)	0,046** (0,018)	0,046** (0,018)	0,042** (0,017)
Total natural resources	0,025** (0,010)	0,030** (0,011)	0,022** (0,010)	0,024** (0,012)	0,035** (0,013)	0,030** (0,013)	0,020 (0,012)
School enrollment, primary, private	-0,011 (0,009)	-0,010 (0,008)	-0,016* (0,008)	-0,018** (0,009)	-0,013 (0,008)	-0,014* (0,007)	-0,020 (0,015)
Constant	2,573*** (0,356)	2,569*** (0,345)	2,564*** (0,362)	2,648*** (0,379)	2,679*** (0,351)	2,551*** (0,344)	2,580*** (0,506)
Number of observations	100	100	100	100	100	100	74
Number of countries	40	40	40	40	40	40	35
Number of instruments	17	17	17	17	17	17	17
Test AR(1) (p-value)	0,603	0,345	0,254	0,500	0,511	0,603	0,831
Test AR(2) (p-value)	0,178	0,194	0,183	0,229	0,176	0,198	0,313
Test Sargan (p-value)	0,526	0,488	0,529	0,668	0,551	0,516	0,815
Test Hansen (p-value)	0,378	0,354	0,336	0,421	0,436	0,348	0,402

Note: The data used are five-yearly. The numbers in brackets represent the robust standard errors of the estimated coefficients. *, **, *** represent the significance at 10%.5% and 1% (* p<0.1, ** p<0.05, *** p<0.01).

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

Material 6

Table 9: Estimate of the role of institutional quality on girls' secondary school enrolment rates in Africa

GMM system							
Variables	Girls secondary school enrolment rates (%)						
Girls secondary school enrolment rates , AR(1)	0,685*** (0,090)	0,679*** (0,093)	0,658*** (0,094)	0,688*** (0,108)	0,669*** (0,096)	0,694*** (0,082)	0,417* (0,214)
Control of corruption	0,086 (0,064)						
Government effectiveness		0,115* (0,058)					
Regularoty quality			0,169*** (0,055)				
Voice and accountability				0,050 (0,056)			
Rule of law					0,100 (0,069)		
Political stability and absence of violence						0,035 (0,040)	
Institutional quality index							0,318* (0,186)
Government expenditure per student, secondary	0,117** (0,055)	0,105* (0,057)	0,112* (0,056)	0,126 (0,075)	0,114** (0,056)	0,118* (0,059)	-0,017 (0,112)
Population density	0,0298* (0,017)	0,030* (0,016)	0,038** (0,017)	0,033* (0,017)	0,031* (0,017)	0,031* (0,016)	0,016 (0,034)
Total natural resources rents	-0,004 (0,017)	-0,001 (0,017)	-0,002 (0,020)	-0,011 (0,017)	-0,002 (0,018)	-0,011 (0,017)	-0,036 (0,030)
School enrolment , secondary, private	-0,003 (0,024)	-0,004 (0,027)	-0,0170 (0,031)	-0,014 (0,033)	-0,011 (0,029)	-0,007 (0,025)	-0,092 (0,061)
Constant	0,833** (0,313)	0,915*** (0,322)	0,984** (0,375)	0,801*** (0,287)	0,917** (0,342)	0,793*** (0,270)	0,537 (0,435)
Numbers of observations	71	71	71	71	71	71	58
Number of countries	38	38	38	38	38	38	32
Number of instruments	17	17	17	17	17	17	17
Test AR(1) (p-value)	0,666	0,604	0,915	0,506	0,579	0,457	0,589
Test AR(2) (p-value)	0,303	0,297	0,296	0,298	0,301	0,303	0,288
Test Hansen (p-value)	0,194	0,208	0,149	0,175	0,220	0,211	0,284

Note: The data used are five-yearly. The numbers in brackets represent the robust standard errors of the estimated coefficients. *, **, *** represent the significance at 10%.5% and 1% (* p<0.1, ** p<0.05, *** p<0.01).

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)

Material 7

Table 10 : Estimate of the role of institutional quality on girls' tertiary school enrolment rates in Africa

GMM system							
Variables	Girls tertiary school enrolment rates (%)						
Girls tertiary school enrolment rates , AR(1)	0,334*** (0,121)	0,340*** (0,118)	0,281** (0,117)	0,346*** (0,116)	0,337*** (0,114)	0,272** (0,117)	0,204 (0,280)
Control of corruption	0,034 (0,150)						
Government effectiveness		0,175 (0,135)					
Regulatory quality			0,186 (0,170)				
Voice and accountability				0,212** (0,093)			
Rule of law					0,128 (0,160)		
Political stability and absence of violence						0,104 (0,085)	
Institutional quality index							1,227 (0,758)
Government expenditure per student, tertiary	-0,303** (0,128)	-0,310** (0,123)	-0,325** (0,125)	-0,302** (0,119)	-0,309** (0,126)	-0,335** (0,124)	-0,028 (0,135)
Life expectancy	2,395*** (0,804)	2,180*** (0,789)	2,528*** (0,794)	2,162*** (0,734)	2,244*** (0,782)	2,572*** (0,800)	-2,474 (2,521)
Total natural resources rents	0,073 (0,052)	0,094** (0,046)	0,107* (0,056)	0,121* (0,062)	0,098* (0,055)	0,110* (0,054)	-0,030 (0,057)
Population growth	-0,338** (0,160)	-0,324** (0,149)	-0,380** (0,149)	-0,369** (0,145)	-0,341** (0,142)	-0,387** (0,152)	-0,051 (0,136)
Constant	-6,496* (3,485)	-5,574 (3,376)	-6,763* (3,488)	-5,485* (3,199)	-5,838* (3,449)	-6,917* (3,455)	4,165 (5,848)
Number of observations	78	78	78	78	78	78	78
Number of countries	36	36	36	36	36	36	36
Number of instruments	17	17	17	17	17	17	17
Test AR(1) (p-value)	0,192	0,193	0,189	0,229	0,202	0,226	0,158
Test AR(2) (p-value)	0,310	0,317	0,343	0,283	0,304	0,352	0,338
Test Hansen (p-value)	0,084	0,091	0,084	0,110	0,125	0,058	0,163

Note: The data used are five-yearly. The numbers in brackets represent the robust standard errors of the estimated coefficients. *, **, *** represent the significance at 10%, 5% and 1% (* p<0.1, ** p<0.05, *** p<0.01).

Source: Authors, based on WGI and WDI data (World Bank, 2018a, b)