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Working Paper

Education, lifelong learning, inequality and financial access: Evidence from African countries

AGDI Working Paper, No. WP/18/003

Provided in Cooperation with:
African Governance and Development Institute (AGDI), Yaoundé, Cameroon

Suggested Citation: Tchamyou, Vanessa S. (2018) : Education, lifelong learning, inequality and financial access: Evidence from African countries, AGDI Working Paper, No. WP/18/003, African Governance and Development Institute (AGDI), Yaoundé

This Version is available at:
https://hdl.handle.net/10419/191326

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A G D I Working Paper

WP/18/003

Education, Lifelong learning, Inequality and Financial access: Evidence from African countries

Forthcoming: Contemporary Social Science

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Education, Lifelong learning, Inequality and Financial access: Evidence from African countries

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January 2018

Abstract

This study investigates the role of financial access in modulating the effect of education and lifelong learning on inequality in 48 African countries for the period 1996 to 2014. Lifelong learning is conceived and measured as the combined knowledge gained from primary through tertiary education while the three educational indicators are: primary school enrolment; secondary school enrolment and tertiary school enrolment. Financial development dynamics are measured with financial system *deposits* (liquid liabilities), financial system *activity* (credit) and financial system *efficiency* (deposits/credit). Three measures of inequality are employed notably: the Gini coefficient; the Atkinson index and the Palma ratio. The estimation strategy is based on Generalised Method of Moments. The following findings are established. First, primary school enrolment interacts with all financial channels to exert negative effects on the Gini index. Second, lifelong learning has negative net effects on the Gini index through financial deposit and efficiency channels. Third, for the most part, the other educational levels do not significantly influence inequality through financial access channels. Policy implications are discussed.

JEL Classification: I28; I20; I30; O16; O55.

Keywords: Education; Lifelong Learning; Inequality; Financial development; Africa.

1. Introduction

The positioning of this inquiry is motivated by four important trends in academic and policy circles, notably: increasing interest in knowledge economy for development; growing inequality; limited financial access in Africa and gaps in the literature. These points are chronologically discussed.

First, over the past decades, the economies of developed countries which have increasingly moved towards the knowledge-based economies have relied less on traditional resources for wealth creation like labour and capital (Dahlman, 2007; Chavula, 2010; Chandra & Yokoyama, 2011; Asongu, 2017). Moreover, these attractive economies have heavily relied on essential factors such as highly skilled labour; high technology industries and investment in new technologies, which are essential components of the development of a knowledge-based economy (AfDB, 2007). In addition to investing in high-end technologies, the creation and dissemination of knowledge are also essential via universities (and research institutes) in various fields and disciplines. Knowledge economy can be understood as a policy syndrome in Africa because, compared to other regions of the world, the overall knowledge index of the continent has been decreasing since the year 2000 (Anyanwu, 2012; Tchamyou, 2017a).

Second, despite two decades of economic prosperity, the number of people living in extreme poverty has increased by more than 100 million between 1990 and 2012 in Africa. This is why exclusive development remains a growing concern in Africa (Beegle et al., 2015). According to the authors, it is projected that the concentration of the world's poorest people will be in Africa. In addition, the Sustainable Development Goals (SDGs) or the post-2015 development program is in line with the thesis that a region with a good understanding of inequalities will best articulate the policy agenda. Inequality is also an important policy syndrome because though Africa has experienced more than 20 years of renewed economic prosperity, the number of extremely poor people has been steadily increasing (Asongu & Le Roux, 2017).

Third, when Africa is compared with other regions of the world, the continent is considerably lagging behind in terms of financial development (World Bank, 2016). This is despite the consensus that an expansion of financial access could provide investment opportunities for companies and households which in the long run result in concrete development externalities (Odhiambo, 2010, 2013). However, financial services can be facilitated by the improvement

of institutional infrastructure, market liberalization, and encouragement of innovation and usage of technology (Claessens, 2006; Amavilah et al., 2017; Asongu et al., 2017).

Fourth, as far as we have reviewed, a study closest to our line of investigation is Asongu and Tchamyou (2017) who have examined the impact of foreign aid on education and lifelong learning in Africa. The authors have derived lifelong learning from a principal component analysis of primary school enrolment, secondary school enrolment and tertiary school enrolment. In addition, after exploring the existing literature on lifelong learning, we notice that a comprehensive measure of lifelong learning in the African context is missing. Moreover, "*To date only two macro level studies, i.e. the European Lifelong Learning Indicators (ELLI) instrument developed by the EU (2010) and the Composite Learning Index (CLI) instrument developed by the Canadian Council on Learning (undated.), have dealt with this issue*" (Luo, 2015, p.19). The drawbacks of these two indicators in relation to the African context are that: (i) the CLI is a Canadian indicator for progress in lifelong learning and the ELLI refers exclusively to European countries. Hence, consistent with Asongu and Tchamyou (2017), we use principal component analysis in order to measure of lifelong learning as the combined knowledge acquired during the three stages of education.

The positioning of the study complements the existing literature which for the most part has largely focused on the relationship between knowledge economy for development (Dahlman, 2007; Suh & Chen, 2007; World Bank, 2007; Chavula, 2010; Weber, 2011; Tchamyou, 2017a) and the finance-development nexus (for instance: Claessens, 2006; Beck et al., 2007; Odhiambo, 2010, 2013).

In the light of the above, this inquiry contributes to the sparse literature on lifelong learning (see fourth strand) by assessing how financial access (covered in the third strand) can modulate the effect of education and lifelong learning (discussed in the first strand) in order to reduce inequality (engaged in the second strand). To make this assessment, we use interactive Generalized Method of Moments in which financial development is considered as a policy or complementary variable. The policy relevance of financial development as opposed to educational enrolment builds the fact that financial access has a higher likelihood of being increased (given its current low rate), when compared with educational level which are reaching the maximum limit in some specific education levels like primary school enrolment.

The remaining of the study is structured as follows. Section 2 covers data and methodology. The empirical results and corresponding discussion are presented in Section 3 whereas Section 4 concludes with implications and future research directions.

2. Data description and Estimation technique

2.1. Data description

We investigate a sample of 48 African countries for the period 1996 to 2014 in order to assess the role of financial access in modulating the effect of education and lifelong learning on income inequality. To fulfil this objective, we merge data from five main sources, namely: (i) World Development Indicators (WDI) of the World Bank for education variables; (ii) World Governance Indicators (WGI) of the World Bank for governance variables; (iii) the Financial Development and Structure Database (FDSD) of the World Bank for financial access variables; (iv) the Global Consumption and Income Project (GCIP) for inclusive variables and (v) Principal Component Analysis for the lifelong learning index (Educatex). Governance indicators are only available from the year 1996 and 2014 is the ending date due to constraints in data availability.

Building on recent knowledge economy literature (Asongu & Tchamyou, 2017; Tchamyou, 2017a), lifelong learning is conceived and measured as the combined knowledge gained during three main levels of education, namely: primary education, secondary education and tertiary education. Hence, we use principal component analysis to reduce these variables to a single composite indicator. These results in the derivation of a principal component are (named "*Educatex*") based on the underlying levels of formal education. Principal Component Analysis (PCA) is a statistical method which consists of transforming a large set of correlated variables into a small set of uncorrelated variables. These new variables account for the most information contained in the original dataset. The information criteria used to determine the number of common factors to keep, are from Jolliffe (2002) and Kaiser (1974). Their recommendation is to retain factors with an eigen value higher than one. As shown in Table 1, the retained first principal component meets these criteria. The corresponding lifelong index (or Educatex) consists of more than 78% of information contained in primary, secondary and tertiary school enrolment.

Table 1: Principal Component Analysis (PCA) for Lifelong Learning

Education dimensions		Component Matrix (Loadings)			First PC	Eigen Value	Indexes
		PSE	SSE	TSE			
Education	School	0.552	0.625	0.552	0.782	2.347	Educatex
	Enrolment	-0.706	-0.002	0.708	0.171	0.515	
		-0.443	0.781	-0.440	0.045	0.137	

"PC: Principal Component. PSE: Primary School Enrolment. SSE: Secondary School Enrolment. TSE: Tertiary School Enrolment. Educatex is the first principal component of primary, secondary and tertiary school enrolments.

Consistent with the financial development literature (Tchamyou & Asongu, 2017; Beck et al. 2007), financial system deposits, financial system credit and financial system intermediation efficiency are used as measures of financial access, with the third measurement being the ratio of the first-two: the ability of banks to fulfil their fundamental role of transforming mobilised deposits into credit for investors and households.

In accordance with the finance-inequality literature (Beck et al., 2007), the Gini index is used as an inclusive development variable. There is a growing interest of the usage of the Palma ratio in the literature as an alternative measure of inequality because the ratio captures the tails of the distribution while the Gini index is focused on the entire distribution (Cobham et al., 2015). The same advantage is attributed to the Atkinson index. The three measurements have been used in recent literature for robustness purposes (Tchamyou et al., 2017).

In accordance with recent literature, we control for factors that may have a potential impact on income inequality, namely: GDP per capita growth, remittances and political stability (Beck et al., 2007; Tchamyou, 2017b). GDP per capita is usually used as an indicator of the stage of development of an economy. Kuznets (1955) advocated that the shape of the finance-inequality relationship is an inverted U-shape, meaning that inequality rises at the beginning of the development process and decreases at a mature stage of development. Hence, GDP per capita could have a positive or negative sign depending on the development stage of a specific economy. We can therefore expect positive or negative signs as our sample consists of countries with varying levels of economic development. Remittances are supposed to decrease inequality given that their primary objective is to serve for consumption purposes (Ssozi & Asongu, 2016). However, the opposite sign can also be expected because most of the migrant population originate from middle- and high-income households and hence as argued by Anyanwu (2011), the impact of remittances on inequality could be positive. A decrease in inequality is also expected with political stability given that it provides a conducive atmosphere for economic prosperity and ultimately, the equitable distribution of fruits from economic prosperity.

Table 2: Definitions and sources of variables

Variables	Signs	Variable definitions	Sources
Panel A: Education			
Primary School Enrolment	PSE	School enrolment, primary (% of gross)	World Bank (WDI)
Secondary School Enrolment	SSE	School enrolment, secondary (% of gross)	World Bank (WDI)
Tertiary School Enrolment	TSE	School enrolment, tertiary (% of gross)	World Bank (WDI)
Lifelong Learning	Educatex	First PC of PSE, SSE & TSE	PCA
Panel B: Financial development			
Financial System Depth	Fdgdp	Liquid Liabilities (% of GDP)	World Bank (FDSD)
Financial System Efficiency	FcFd	Financial credit on Financial deposits	World Bank (FDSD)
Financial System Activity	Pcrbof	Private domestic credit from financial institutions (% of GDP)	World Bank (FDSD)
Panel C: Income inequality			
Gini Index	Gini	"*The Gini index is a measurement of the income distribution of a country's residents*".	GCIP
Atkinson Index	Atkinson	"*The Atkinson index measures inequality by determining which end of the distribution contributed most to the observed inequality*".	GCIP
Palma ratio	Palma ratio	"*The Palma ratio is defined as the ratio of the richest 10% of the population's share of gross national income divided by the poorest 40%'s share*".	GCIP
Panel D: Control Variables			
GDP per capita	GDPpc	Logarithm of Gross Domestic Product per capita	World Bank (WDI)
Remittances	Remit.	Remittance inflows to GDP (%)	World Bank (WDI)
Political Stability	Pol.S	"*Political stability/no violence (estimate): measured as the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional and violent means, including domestic violence and terrorism*".	World Bank (WGI)

"WDI: World Bank Development Indicators. PC: Principal Component. PCA: Principal Component Analysis. Educatex is the first principal component of primary, secondary and tertiary school enrolments. FDSD: Financial Development and Structure Database. WGI: World Bank Governance Indicators. GCIP: Global Consumption and Income Project. WGI: World Bank Governance Indicators.

The definitions and sources of variables are disclosed in Table 2. The summary statistics and the sample of countries are presented in Table 3. The motivation for the descriptive statistics is twofold: (i) it is apparent from the mean that variables can be compared and (ii) a significant variability in the variables is apparent from the standard deviations. Hence, some expected reasonable linkages could be derived from the estimations. Table 4 presents the correlation matrix. The aim of this matrix is to check the degree of substitutions among variables and then avoid issues of multicollinearity. The concern is visible in financial

development and inequality indicators. In order to avoid misspecification, inequality indicators and financial development variables are distinctly applied in the estimation processes.

Table 3: Summary statistics and Presentation of countries

	Variables	Mean	S.D.	Min.	Max.	Obs.
Income inequality	Gini index	0.587	0.041	0.488	0.868	911
	Atkinson index	0.701	0.060	0.509	0.895	911
	Palma ratio	6.454	1.749	3.016	21.790	911
Financial Development	Financial System Depth or Deposits (Fdgdp)	26.272	20.610	1.690	97.823	862
	Financial System Efficiency (FcFd)	0.756	0.391	0.137	2.606	862
	Financial System Activity or Credit (Pcrbof)	20.707	23.575	0.551	150.21	862
Education	Primary School Enrolment (PSE)	0.901	0.114	0.497	1.139	754
	Secondary School Enrolment (SSE)	0.848	0.226	0.249	1.555	554
	Tertiary School Enrolment (TSE)	0.719	0.421	0.064	3.295	466
Lifelong learning	Educatex	0.026	1.742	-0.499	6.247	503
Control variables	GDP per capita	6.706	1.098	4.286	9.660	907
	Political Stability	-0.511	0.904	-2.988	1.188	768
	Remittances	4.011	7.248	0.000	61.988	773

Presentation of countries : Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Chad, Central African Republic, Comoros, Congo Democratic Republic, Congo Republic, Côte d'Ivoire, Djibouti, Egypt, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tomé & Principe, Senegal, Sierra Leone, Seychelles, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia.

S.D: Standard Deviation. Min: Minimum. Max: Maximum. Obs.: Observations.

Table 4: Correlation matrix (Uniform sample size)

Income Inequality			L.L.	Education levels			Financial development			Control variables			
Gini	Atkinson	Palma r	Educatex	PSE	SSE	TSE	Deposit Fdgdp	Credit FcFd	efficiency Pcrbof	GDPpc	Remit	Pol.S	
1.000	0.886	0.928	-0.023	0.127	0.123	0.025	-0.195	0.156	-0.051	0.030	0.134	0.439	Gini
	1.000	0.943	0.005	0.174	0.243	0.133	-0.102	0.011	-0.052	0.080	0.294	0.430	Atkinson
		1.000	0.024	0.171	0.246	0.088	-0.140	0.025	-0.081	0.043	0.198	0.475	Palma ratio
			1.000	0.391	0.421	0.299	0.191	0.022	0.158	-0.034	0.109	0.133	Educatex
				1.000	0.682	0.541	0.307	-0.115	0.287	0.012	0.222	0.283	PSE
					1.000	0.738	0.408	-0.040	0.395	0.063	0.459	0.415	SSE
						1.000	0.309	-0.109	0.294	0.110	0.255	0.331	TSE
							1.000	-0.015	0.835	0.019	0.120	0.404	Fdgdp
								1.000	0.466	0.025	-0.158	0.079	FcFd
									1.000	0.026	0.029	0.424	Pcrbof
										1.000	0.031	0.026	GDPpc
											1.000	0.172	Remit
												1.000	Pol.S

Gini: Gini of Income Inequality. Atkinson: Atkinson of Income Inequality. Palma r: Palma ratio of Income Inequality. Fdgdp: Financial deposits (liquid liabilities). FcFd: Financial credit on Financial deposits. Pcrbof: Private domestic credit from deposit banks and other financial institutions. Educatex: Lifelong learning (L.L.). GDPpc: GDP per capita. Remit.: Remittances. Pol.S.: Political Stability.

2.2. Estimation technique: Generalised Method of Moments

The estimation strategy adopted in this study is the *two-step* Generalised Method of Moments (GMM); an empirical strategy based on Roodman (2009a, 2009b) which is an extension of Arellano and Bover (1995). There are four main arguments justifying the choice of this empirical strategy. First, the baseline requirement for the implementation of the GMM is fulfilled, notably: the number of cross-sections (N = 48) is greater than the number of time series (T = 19). Second, the dependent variables are persistent because their correlation coefficients with their corresponding first lags are higher than the threshold or rule of thumb (i.e. 0.800) that is essential for the establishment of persistence. Third, the technique is also robust in the sense that it accounts for endogeneity by controlling simultaneity (by means of instrumentation) and time invariant omitted variables. Moreover, it controls for cross-sectional dependence and restricts the proliferation of instruments (or over-identification) (see Love & Zicchino, 2006; Baltagi, 2008). In accordance with Brambor et al. (2006), all constitutive elements have been incorporated in the specifications. Fourth, the usage of a panel data structure is consistent with the GMM and hence the approach does not eliminate cross-country variations. The preference of the *two-step* is because it controls for heteroscedasticity while the *one-step* only controls for homoscedasticity.

The estimation procedure is summarized with the following equations in levels (1) and first difference (2).

$$INE_{i,t} = \sigma_0 + \sigma_1 INE_{i,t-\tau} + \sigma_2 EDU_{i,t} + \sigma_3 FIN_{i,t} + \sigma_4 Inter_{i,t} + \sum_{h=1}^{5} \delta_j W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (1)$$

$$INE_{i,t} - INE_{i,t-\tau} = \sigma_1 (INE_{i,t-\tau} - INE_{i,t-2\tau}) + \sigma_2 (EDU_{i,t} - EDU_{i,t-\tau}) + \sigma_3 (FIN_{i,t} - FIN_{i,t-\tau})$$
$$+ \sigma_4 (Inter_{i,t} - Inter_{i,t-\tau}) + \sum_{h=1}^{5} \delta_j (W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + \varepsilon_{i,t-\tau} \quad (2)$$

where, $INE_{i,t}$ is the income inequality of country i at period t; σ_0 is a constant; τ represents the coefficient of autoregression (it is equal to one for the present specification because of issues in degrees of freedom); EDU is education (primary, secondary and tertiary schoolings) and lifelong learning (*Educatex*); FIN is a financial access indicator (deposits, credit and efficiency); $Inter$ is the interaction between education and financial access on the on hand and on the other hand, lifelong learning and financial access ($EDU \times FIN$); W is the vector of control variables (*GDP per capita; remittances and political stability*), η_i is the country-specific effect, ξ_t is the time-specific constant and $\varepsilon_{i,t}$ is the error term.

We devote space to briefly engage identification, simultaneity and exclusion restrictions. Recent literature has acknowledged that all explanatory variables are assumed to be predetermined (or suspected endogeneous) while only time invariant variables (or years) are supposed to be strictly exogenous (see Asongu & Nwachukwu, 2016). The reason is because it is not feasible for years to be endogenous in first difference (see Roodman, 2009b). Hence, the method used to deal with *ivstyle* (years) is '*iv (years, eq(diff))*' and the procedure for treating the predetermined variables is *gmmstyle*. In the light of the above, the time invariant variables (or years) affect the dependent variable (or inclusive indicators) just via the suspected endogenous variables (or financial access, education and lifelong learning).

Moreover, to evaluate the validity of the exclusion restriction for instrument exogeneity, the required statistical test is the Difference in Hansen Test. As result, the null hypothesis of the mentioned test should not be rejected for years to elicit inequality exclusively through financial access; education and lifelong learning. It is essential to articulate that in the GMM estimation strategy, the Difference in Hansen Test is the needed information criterion employed to investigate if time invariant variables are strictly exogenous. Furthermore, rejecting the null hypothesis of the Sargan Over-identifying Restrictions test in the standard instrumental variable procedure is an indication that instruments do not exclusively explain the dependent variable via the suspected endogenous variables (see Beck et al., 2003).

3. Empirical results and discussion

Tables 5, 6, 7 and 8 respectively present results corresponding to: primary school enrolment; secondary school enrolment; tertiary school enrolment and lifelong learning. For all tables, (i) the computation of the net effect is done to evaluate the complementary role of financial access in the effect of education levels and lifelong learning and (ii) the estimated models are overwhelmingly valid based on the information criteria used to assess their validity[1]. For instance, in the fourth column of Table 5, the net effect obtained from the interaction between deposits and primary school enrolment is -0.010 ([0.085× 0.756] + [-0.075]), where: 0.085 is the unconditional effect of primary school enrolment; 0.756 is the mean value of financial efficiency and -0.075 is the conditional effect from the interaction between primary school enrolment and financial efficiency.

The following results can be established on the nexus between education levels, financial access and inclusive variables. First, in Table 5, (i) the net effect of financial deposit (financial credit) on primary school is positive for the Gini index (the Atkinson index). (ii) The net effect of financial efficiency on primary school is negative for the Gini index. As for the Palma ratio, the conditional effects are not significant. Third, with regards to the secondary school (Table 6), positive marginal effects are apparent only for the Gini index. Given that the unconditional effects and conditional effects corresponding of all inclusive variables are not jointly significant; the computation of net effects is not feasible. Fourth, there is a positive net effect of financial efficiency on tertiary school for the Atkinson index in Table 7. Fifth, in Table 8 on lifelong learning: (i) the marginal effects are consistently negative; (ii) the net effects of financial deposits and financial efficiency are negative for the Gini index and (iii) the net effect of financial efficiency is positive for the Palma ratio. Sixth, overall, the significant control variables have the expected signs. Moreover, some positive significant values which are associated with remittances can be explained by the fact that majority of the migrant population originate from middle- and high-income households (see Anyanwu, 2011).

[1] The post estimation diagnostic tests overwhelmingly reveal the absence of autocorrelation in the residuals and validity of the instruments. The interested reader can find more insights in Asongu and De Moor (2017, p. 200).

Table 5: Primary School Enrolment (PSE), Finance and Inequality

	Dependent variable: Inequality								
	The GINI Coefficient (GINI)			The Atkinson Index(Atkinson)			The Palma Ratio(Palma)		
	Deposits	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**
Constant	**0.0540*** **	(omitted)	**-0.052***	(omitted)	**-0.075*** **	**-0.095***	**-1.468***	-0.673	(omitted)
	(0.000)		**(0.079)**		**(0.005)**	**(0.094)**	**(0.099)**	(0.218)	
GINI (-1)	**0.861*** **	**0.898*** **	**0.939*** **	---	---	---	---	---	---
	(0.000)	**(0.000)**	**(0.000)**						
Atkinson(-1)	---	---	---	**1.082*** **	**1.040*** **	**1.056*** **	---	---	---
				(0.000)	**(0.000)**	**(0.000)**			
Palma (-1)	---	---	---	---	---	---	**0.917*** **	**0.908*** **	**0.908*** **
							(0.000)	**(0.000)**	**(0.000)**
PSE	**0.027*** **	0.010	**0.085*** **	**0.073*** **	**0.040****	0.058	**2.178*** **	**1.366****	0.769
	(0.003)	(0.186)	**(0.001)**	**(0.005)**	**(0.023)**	(0.275)	**(0.016)**	**(0.012)**	(0.352)
Deposit	**0.0008***	---	---	0.001	---	---	0.043	---	---
	(0.053)			(0.132)			(0.237)		
Credit	---	**0.0009****	---	---	**0.001***	---	---	0.011	---
		(0.018)			**(0.096)**			(0.691)	
Efficiency	---	---	**0.077****	---	---	0.030	---	---	-0.386
			(0.022)			(0.605)			(0.703)
Deposit × PSE	**-0.0009****	---	---	-0.001	---	---	-0.047	---	---
	(0.048)			(0.117)			(0.216)		
Credit × PSE	---	**-0.0009****	---	---	**-0.001***	---	---	-0.012	---
		(0.013)			**(0.098)**			(0.663)	
Efficiency × PSE	---	---	**-0.075****	---	---	-0.033	---	---	0.460
			(0.025)			(0.585)			(0.646)
GDP pc	-0.00008	0.00002	-0.00001	0.00007	0.0001	**0.0001****	-0.0001	0.003	0.004
	(0.205)	(0.646)	(0.818)	(0.599)	(0.116)	**(0.030)**	(0.973)	(0.274)	(0.177)
Political Stability	0.001	**0.001****	-0.0006	**-0.008****	-0.002	**-0.005*** **	0.001	0.017	0.001
	(0.147)	**(0.044)**	(0.585)	**(0.010)**	(0.140)	**(0.009)**	(0.983)	(0.706)	(0977)
Remittances	-0.000002	**-0.0001*** **	**-0.0002*** **	0.000002	-0.0001	**-0.0002*** **	-0.002	**-0.009*** **	**-0.009*** **
	(0.969)	**(0.005)**	**(0.002)**	(0.992)	(0.154)	**(0.000)**	(0.514)	**(0.000)**	**(0.000)**
Net effects	0.708	n.a.	-0.010	n.a.	0.827	n.a.	n.a.	n.a.	n.a.
AR(1)	**(0.230)**	**(0.232)**	**(0.232)**	(0.054)	(0.048)	**(0.057)**	**(0.102)**	**(0.110)**	**(0.119)**
AR(2)	**(0.281)**	**(0.261)**	**(0.310)**	**(0.143)**	**(0.440)**	**(0.200)**	**(0.316)**	**(0.298)**	**(0.303)**
Sargan OIR	**(0.132)**	(0.006)	(0.020)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen OIR	**(0.349)**	**(0.396)**	**(0.204)**	**(0.401)**	**(0.302)**	**(0.177)**	**(0.672)**	**(0.500)**	**(0.648)**
DHT for instruments									
(a) GMM Instruments for levels									
H excluding group	(0.033)	(0.013)	(0.025)	(0.046)	(0.102)	(0.078)	(0.011)	(0.094)	(0.022)

Dif(null, H=exogenous)	(0.620)	(0.802)	(0.445)	(0.638)	(0.409)	(0.272)	(0.981)	(0.649)	(0.936)
(b) gmm (lagged values)	---	---	---	---	---	---	---	---	---
H excluding group									
Dif(null, H=exogenous)									
(c) IV (Years, eq (diff))									
H excluding group	---	---	---	---	---	---	---	---	---
Dif(null, H=exogenous)	(0.754)	(0.775)	(0.534)	(0.782)	(0.713)	(0.672)	(0.991)	(0.921)	(0.996)
Fisher	**6736.46*** **	**475543.44*** **	**3393.18*** **	**650009.30*** **	**3100.21*** **	**2309.13*** **	**2495.99*** **	**2388.53*** **	**42741.20*** **
Instruments	41	41	41	41	41	41	41	41	41
Countries	45	45	45	45	45	45	45	45	45

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests . Deposits: Financial System Deposits. Credit: Financial System Credit. Efficiency: Deposit/Credit. Mean value of Deposit: 26.272; Mean value of Credit: 20.707; Mean value of Efficiency: 0.756. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of financial access. nsa: not specifically applicable because the information criteria does not validate the model.

Table 6: Secondary School Enrolment (SSE), Finance and Inequality

	Dependent variable: Inequality								
	The GINI Coefficient (GINI)			The Atkinson Index(Atkinson)			The Palma Ratio(Palma)		
	Deposits	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**
Constant	**0.107*** **	**0.122*** **	**0.119*** **	(omitted)	0.016	-0.018	(omitted)	**1.254*** **	(omitted)
	(0.000)	**(0.000)**	**(0.000)**		(0.543)	(0.585)		**(0.000)**	
GINI (-1)	**0.824*** **	**0.808*** **	**0.843*** **	---	---	---	---	---	---
	(0.000)	**(0.000)**	**(0.000)**						
Atkinson(-1)	---	---	---	**1.025*** **	**0.960*** **	**1.039*** **	---	---	---
				(0.000)	**(0.000)**	**(0.000)**			
Palma (-1)	---	---	---	---	---	---	**0.728*** **	**0.753*** **	**0.836*** **
							(0.000)	**(0.000)**	**(0.000)**
SSE	**-0.010** **	**-0.014** **	**-0.035*** **	0.012	0.012	-0.013	0.493	0.368	-0.422
	(0.029)	**(0.010)**	**(0.000)**	(0.286)	(0.236)	(0.446)	(0.147)	(0.142)	(0.600)
Deposit	-0.00001	---	---	**0.0005***	---	---	-0.013	---	---
	(0.926)			**(0.077)**			(0.136)		
Credit	---	-0.0001	---	---	-0.00008	---	---	**-0.022** **	---
		(0.429)			(0.845)			**(0.029)**	
Efficiency	---	---	**-0.040*** **	---	---	-0.030	---	---	-1.539
			(0.000)			(0.246)			(0.120)
Deposit × SSE	0.00002	---	---	-0.0004	---	---	**0.015***	---	---
	(0.815)			(0.126)			**(0.094)**		
Credit × SSE	---	0.0001	---	---	0.00006	---	---	**0.022** **	---
		(0.415)			(0.892)			**(0.037)**	
Efficiency × SSE	---	---	**0.050*** **	---	---	0.033	---	---	1.683
			(0.000)			(0.272)			(0.139)
GDP per capita	0.00005	0.0001	0.00009	**0.0003*** **	**0.0003*** **	**0.0005*** **	**0.012*** **	**0.012*** **	**0.010*** **
	(0.466)	(0.144)	(0.213)	**(0.004)**	**(0.009)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.005)**
Political Stability	0.0003	**0.002***	**0.003*** **	**-0.003***	0.001	**-0.006*** **	0.066	0.049	0.061
	(0.824)	**(0.061)**	**(0.002)**	**(0.096)**	(0.453)	**(0.001)**	(0.343)	(0.547)	(0.372)
Remittances	**0.0002*** **	**0.002*** **	**0.0001*** **	0.0001	-0.00007	0.00002	-0.0003	-0.001	-0.005
	(0.001)	**(0.000)**	**(0.006)**	(0.453)	(0.615)	(0.845)	(0.936)	(0.592)	(0.102)
Net effects	n.s.a.	n.a.	n.s.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
AR(1)	**(0.234)**	**(0.232)**	**(0.239)**	(0.056)	(0.049)	(0.043)	(0.094)	**(0.102)**	**(0.109)**
AR(2)	**(0.276)**	**(0.281)**	**(0.303)**	**(0.818)**	**(0.877)**	**(0.965)**	**(0.355)**	**(0.350)**	**(0.353)**
Sargan OIR	**(0.401)**	(0.039)	**(0.404)**	(0.000)	(0.000)	(0.029)	(0.000)	(0.000)	(0.000)
Hansen OIR	(0.067)	**(0.120)**	(0.090)	**(0.552)**	**(0.440)**	**(0.301)**	**(0.433)**	**(0.633)**	**(0.603)**
DHT for instruments									
(a) GMM Instruments for levels									
H excluding group	(0.100)	(0.059)	(0.167)	(0.029)	(0.075)	(0.203)	(0.025)	(0.078)	(0.126)

Dif(null, H=exogenous)	(0.098)	(0.210)	(0.107)	(0.851)	(0.614)	(0.334)	(0.756)	(0.804)	(0.719)
(b) gmm (lagged values)	---	---	---	---	---	---	---	---	---
H excluding group									
Dif(null, H=exogenous)									
(c) IV (Years, eq (diff))									
H excluding group	---	---	---	---	---	---	---	---	---
Dif(null, H=exogenous)	(0.110)	(0.139)	(0.282)	(0.948)	(0.650)	(0.543)	(0.620)	(0.818)	(0.850)
Fisher	**5310.57*** **	**16914.13*** **	**78539.55*** **	**1.65e+08*** **	**11480.30*** **	**6860.24*** **	**7255.64*** **	**524.55*** **	**93286.18*** **
Instruments	41	41	41	41	41	41	41	41	41
Countries	43	43	43	43	43	43	43	43	43

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests . Deposits: Financial System Deposits. Credit: Financial System Credit. Efficiency: Deposit/Credit. Mean value of Deposit: 26.272; Mean value of Credit: 20.707; Mean value of Efficiency: 0.756. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of financial access. nsa: not specifically applicable because the information criteria does not validate the model.

Table 7: Tertiary School Enrolment (TSE), Finance and Inequality

	Dependent variable: Inequality								
	The GINI Coefficient (GINI)			The Atkinson Index(Atkinson)			The Palma Ratio(Palma)		
	Deposits	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**
Constant	**0.149*** **	**0.145*** **	**0.134*** **	0.006	(omitted)	(omitted)	(omitted)	(omitted)	**0.839*** **
	(0.000)	**(0.000)**	**(0.000)**	(0.839)					**(0.004)**
GINI (-1)	**0.743*** **	**0.755*** **	**0.776*** **	---	---	---	---	---	---
	(0.000)	**(0.000)**	**(0.000)**						
Atkinson(-1)	---	---	---	**0.975*** **	**0.934*** **	**0.989*** **	---	---	---
				(0.000)	**(0.000)**	**(0.000)**			
Palma (-1)	---	---	---	---	---	---	**0.754*** **	**0.695*** **	**0.839*** **
							(0.000)	**(0.000)**	**(0.000)**
TSE	0.002	**0.003***	-0.005	0.003	-0.0009	**-0.009***	0.016	**0.241** **	0.108
	(0.201)	**(0.056)**	(0.150)	(0.445)	(0.746)	**(0.096)**	(0.916)	**(0.034)**	(0.570)
Deposit	0.00007)	---	---	**0.0003*** **	---	---	**0.006***	---	---
	(0.407)			**(0.004)**			**(0.090)**		
Credit	---	-0.00006	---	---	-0.0001	---	---	0.004	---
		(0.272)			(0.32)			(0.260)	
Efficiency	---	---	**-0.015*** **	---	---	**-0.015** **	---	---	0.072
			(0.009)			**(0.014)**			(0.683)
Deposit × TSE	-0.0001	---	---	-0.0001	---	---	-0.001	---	---
	(0.102)			(0.202)			(0.475)		
Credit × TSE	---	0.00001	---	---	0.0001	---	---	-0.002	---
		(0.844)			(0.236)			(0.303)	
Efficiency × TSE	---	---	**0.019*** **	---	---	**0.014***	---	---	0.067
			(0.008)			**(0.071)**			(0.765)
GDP per capita	**-0.0002*** **	**-0.0001*** **	-0.00008	0.00002	0.00005	0.0001	-0.001	-0.003	-0.0008
	(0.000)	**(0.003)**	(0.280)	(0.885)	(0.698)	(0.239)	(0.659)	(0.271)	(0.812)
Political Stability	**0.002** **	**0.002** **	**0.003*** **	**-0.006*** **	-0.0001	-0.0006	-0.042	0.004	-0.003
	(0.028)	**(0.013)**	**(0.002)**	**(0.000)**	(0.937)	(0.612)	(0.433)	(0.934)	(0.952)
Remittances	0.00007	0.00007	**0.0001***	0.0001	**0.0001***	0.00006	**0.011*** **	**0.009*** **	0.004
	(0.246)	(0.173)	**(0.094)**	(0.216)	**(0.077)**	(0.327)	**(0.000)**	**(0.007)**	(0.144)
Net effects	n.a.	n.a.	n.a.	n.s.a.	n.s.a.	0.007	n.a.	n.a.	n.a.
AR(1)	**(0.184)**	**(0.198)**	**(0.218)**	**(0.287)**	**(0.303)**	**(0.286)**	**(0.284)**	**(0.361)**	**(0.313)**
AR(2)	(0.041)	(0.047)	**(0.185)**	**(0.224)**	**(0.400)**	**(0.349)**	**(0.551)**	**(0.170)**	**(0.188)**
Sargan OIR	(0.001)	(0.000)	(0.024)	(0.074)	(0.008)	**(0.349)**	(0.000)	(0.000)	(0.000)
Hansen OIR	**(0.372)**	**(0.565)**	**(0.222)**	(0.081)	(0.053)	**(0.282)**	**(0.324)**	**(0.199)**	**(0.399)**
DHT for instruments									
(a) GMM Instruments for levels									
H excluding group	(0.009)	(0.017)	(0.034)	(0.021)	(0.010)	(0.037)	(0.019)	(0.031)	(0.047)

Dif(null, H=exogenous)	(0.821)	(0.910)	(0.432)	(0.221)	(0.207)	(0.514)	(0.668)	(0.409)	(0.633)
(b) gmm (lagged values)	---	---	---	---	---	---	---	----	---
H excluding group									
Dif(null, H=exogenous)									
(c) IV (Years, eq (diff))									
H excluding group	---	---	---	---	---	---	---	---	---
Dif(null, H=exogenous)	(0.554)	(0.971)	(0.488)	(0.174)	(0.954)	(0.700)	(0.420)	(0.979)	(0.951)
Fisher	**271.34*** **	**13087.04*** **	**3740.60*** **	**1199.72*** **	**6.18e+06*** **	**5.24e+06*** **	**7460.21*** **	**70027.58*** **	**1008.51*** **
Instruments	41	41	41	41	41	41	41	41	41
Countries	43	43	43	43	43	43	43	43	43

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests . Deposits: Financial System Deposits. Credit: Financial System Credit. Efficiency: Deposit/Credit. Mean value of Deposit: 26.272; Mean value of Credit: 20.707; Mean value of Efficiency: 0.756. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of financial access. nsa: not specifically applicable because the information criteria does not validate the model.

Table 8: Lifelong Learning (LL), Finance and Inequality

	Dependent variable: Inequality								
	The GINI Coefficient (GINI)			The Atkinson Index(Atkinson)			The Palma Ratio(Palma)		
	Deposits	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**	**Deposits**	**Credit**	**Efficiency**
Constant	**0.078*** **	**0.115*** **	**0.043*** **	-0.016	0.029	**0.020** **	(omitted)	(omitted)	(omitted)
	(0.000)	**(0.000)**	**(0.000)**	(0.148)	(0.160)	**(0.036)**			
GINI (-1)	**0.876*** **	**0.811*** **	**0.930*** **	---	---	---	---	---	---
	(0.000)	**(0.000)**	**(0.000)**						
Atkinson(-1)	---	---	---	**1.023*** **	**0.964*** **	**0.990*** **	---	---	---
				(0.000)	**(0.000)**	**(0.000)**			
Palma (-1)	---	---	---	---	---	---	**1.028*** **	**0.975*** **	**1.016*** **
							(0.000)	**(0.000)**	**(0.000)**
Educatex	**-0.0006*** **	**-0.0003*** **	**-0.0005*** **	-0.0003	-0.00008	**-0.001*** **	-0.005	-0.002	**-0.016** *
	(0.003)	**(0.003)**	**(0.005)**	(0.584)	(0.712)	**(0.000)**	(0.543)	(0.481)	**(0.059)**
Deposit	**-0.00008** **	---	---	-0.0001	---	---	**-0.006*** **	---	---
	(0.027)			(0.128)			**(0.000)**		
Credit	---	-0.00002	---	---	**-0.00008*** **	---	---	**-0.001** **	---
		(0.285)			**(0.000)**			**(0.025)**	
Efficiency	---	---	-0.003	---	---	**-0.014*** **	---	---	**-0.238*** **
			(0.143)			**(0.000)**			**(0.000)**
Deposit × LL	**0.00001*** **	---	---	0.00001	---	---	0.0001	---	---
	(0.004)			(0.227)			(0.474)		
Credit × LL	---	0.0000005	---	---	-0.000002	---	---	**-0.00006** **	---
		(0.750)			(0.228)			**(0.031)**	
Efficiency × LL	---	---	**0.0003** **	---	---	**0.0008*** **	---	---	**0.016*** **
			(0.030)			**(0.000)**			**(0.005)**
GDP per capita	**-0.0001** *	**-0.0001*** **	-0.00002	0.0001	**0.0001** **	**0.0003*** **	0.0003	**0.002*** **	**0.004*** **
	(0.069)	**(0.009)**	(0.786)	(0.149)	**(0.022)**	**(0.000)**	(0.880)	**(0.008)**	**(0.008)**
Political Stability	0.0006	**0.004*** **	**0.001** *	**-0.006*** **	**0.004** *	0.001	**-0.127*** **	**0.050** *	**-0.106*** **
	(0.520)	**(0.007)**	**(0.076)**	**(0.003)**	**(0.053)**	(0.283)	**(0.003)**	**(0.077)**	**(0.001)**
Remittances	0.00005	**-0.0001** **	**-0.0003*** **	0.0001	0.0001	-0.00006	0.004	0.001	-0.0001
	(0.295)	**(0.036)**	**(0.000)**	(0.166)	(0.113)	(0.656)	(0.161)	(0.203)	(0.955)
Net effects	-0.015	n.a.	-0.00007	n.a.	n.a.	n.s.a.	n.a.	n.a.	0.003
AR(1)	**(0.185)**	**(0.185)**	**(0.192)**	**(0.245)**	**(0.235)**	**(0.242)**	**(0.178)**	**(0.175)**	**(0.183)**
AR(2)	**(0.284)**	**(0.235)**	**(0.258)**	**(0.165)**	**(0.626)**	**(0.442)**	**(0.298)**	**(0.322)**	**(0.316)**
Sargan OIR	(0.010)	(0.001)	(0.088)	(0.000)	(0.000)	(0.060)	(0.000)	(0.000)	(0.001)
Hansen OIR	**(0.399)**	**(0.533)**	**(0.365)**	**(0.573)**	**(0.419)**	(0.097)	**(0.251)**	**(0.409)**	**(0.203)**
DHT for instruments									
(a) GMM Instruments for levels									
H excluding group	(0.025)	(0.069)	(0.065)	(0.061)	(0.036)	(0.064)	(0.092)	(0.057)	(0.062)

Dif(null, H=exogenous)	(0.720)	(0.726)	(0.546)	(0.781)	(0.692)	(0.167)	(0.355)	(0.616)	(0.335)
(b) gmm (lagged values)	---	---	---	---	---	---	---	---	---
H excluding group									
Dif(null, H=exogenous)									
(c) IV (Years, eq (diff))									
H excluding group	---	---	---	---	---	---	---	---	---
Dif(null, H=exogenous)	(0.802)	(0.863)	(0.614)	(0.882)	(0.822)	(0.432)	(0.653)	(0.757)	(0.617)
Fisher	**59903.56*** **	**1828.20*** **	**112519.53*** **	**319577.23*** **	**83695.78*** **	**154038.94*** **	**1.51e+06*** **	**818307.58*** **	**3.30e+06*** **
Instruments	41	41	41	41	41	41	41	41	41
Countries	42	42	42	42	42	42	42	42	42

***,**,*: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) & AR(2) tests and; b) the validity of the instruments in the Sargan and Hansen OIR tests . Deposits: Financial System Deposits. Credit: Financial System Credit. Efficiency: Deposit/Credit. Mean value of Deposit: 26.272; Mean value of Credit: 20.707; Mean value of Efficiency: 0.756. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of financial access. nsa: not specifically applicable because the information criteria does not validate the model.

4. Concluding implications and future research directions

The purpose of this study has been to examine how financial access (by means of credit, deposit and efficiency channels) modulates the effect of education and lifelong learning on income inequality. The empirical evidence has been based on Generalised Method of Moments with a sample of 48 African countries for the period 1996 to 2014. Three indicators of inequality (the Gini coefficient, the Atkinson index and the Palma ratio) are used while lifelong learning is conceived and measured as the combined knowledge gained from primary to tertiary education. Hence, the corresponding educational indicators are: primary school enrolment; secondary school enrolment and tertiary school enrolment.

The following main findings have been established. First, primary school enrolment interacts with all financial channels to exert negative effects on the Gini index. Second, lifelong learning has negative net effects on the Gini index through financial deposit and efficiency channels. Third, for the most part, the other educational levels do not significantly influence inequality through financial access channels. In what follows, we substantiate the main findings.

First, the fact that compared to other levels of education, primary education provides enabling conditions for more positive income redistribution is consistent with the literature (see Petrakis & Stamatakis, 2002; Asiedu, 2014) on the comparative advantage of primary education in social returns when economies are less industrialised. This is essentially because primary (e.g. agriculture) and informal sectors on which most economies in Africa depend, do not require an economic agent to be so much educated. As a policy implication, investing in quality primary education will go a long way to reducing inequality in Africa in the post-2015 development agenda.

Second, the relevance of lifelong learning in reducing inequality translates the notion of synergy from education. This implies that whereas independent knowledge gained in either tertiary schooling or secondary schooling may not significantly affect inequality, the combined knowledge acquired through the three levels of education is more relevant in mitigating inequality. This is consistent with the study of Coady and Dizioli (2017) who have found that income inequality reduces with the expansion of education which in turn contributes to the decrease in inequality of education. Hence, the process of developing skills is important to promote economic growth but can also be of help in breaking the intergenerational transmission of poverty and thus mitigate inequality, particularly inequality

of opportunity (Coady & Dizioli, 2017). As a policy implication, primary education is essential in the relevance of higher educational levels in the effect of education on inequality. This implication builds on the logic that the redistributive effect of lifelong learning is driven fundamentally by primary school enrolment. In essence, the United Nations Sustainable Development Goal 4 on "*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*" (UNESCO, 2015) has emphasised the need of expanding early childhood education (goal 4.2.1) and enhancing learning results in early primary education (goal 4.1.1(a)), despite the high rate of enrolment in primary school in Sub-Saharan African which has nearly caught-up with those of developed countries (Gove, 2017).

Future studies can investigate whether the established findings withstand empirical scrutiny from country-specific frameworks. Such is necessary to account for country-specific effects (which are eliminated by the GMM) in order to provide findings with more targeted policy implications.

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