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Finance, inequality and inclusive education in Sub-Saharan Africa [1]

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Finance, inequality and inclusive education in Sub-Saharan Africa

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Abstract

This research complements the extant literature by establishing inequality critical masses that should not be exceeded in order for financial access to promote gender parity inclusive education in Sub-Saharan Africa. The focus is on 42 countries in the sub-region and the data is for the period 2004-2014. The estimation approach is the Generalized Method of Moments. When remittances are involved in the conditioning information set, the Palma ratio should not exceed 6.000 in order for financial access to promote gender parity inclusive "primary and secondary education" and the Atkinson index should not exceed 0.695 in order for financial access to promote inclusive tertiary education. However, when the internet is involved in the conditioning information set, it is established that in order for financial access to promote inclusive primary and secondary education, the: (i) Gini coefficient should not exceed 0.571; (ii) Atkinson index should not be above 0.750 and (iii) Palma ratio should be maintained below 8.000. Irrespective of variable in the conditioning information set, what is apparent is that inequality decreases the incidence of financial access on inclusive education. Hence, a common policy measure is to reduce inequality in order to promote inclusive education using the financial access mechanism. Policy implications are discussed in the light of Sustainable Development Goals.

JEL Classification: G20; I10; I32; O40; O55
Keywords: Africa; Finance; Gender; Inclusive development

1. Introduction

Financial access has been documented to reduce income inequality (Tchamyou, Erreygers & Cassimon, 2019a; Tchamyou, 2019, 2020) and income inequality affects the relevance of financial access in development outcomes (Kim, Yu & Hassan, 2020) such as education[2]. This is essentially because the lack of finance, can severely constraint opportunities of students and pupils from enrolling into schools and learning to improve their avenues to employment and social mobility (Asongu & Nwachukwu, 2018a). Girls are among the least educated in Africa partly due to income inequality (Elu, 2018) and policy makers should be concerned about the levels of income inequality that should not be tolerated if financial access is to promote female education. The problem statement motivating this study which is summarized with this background information can be articulated with the following research question: what levels of income inequality should not be exceeded in order for access to finance to promote inclusive education in sub-Saharan Africa (SSA)? This research question is closely related to two main Sustainable Development Goals (SDGs), namely: (i) SDG-4 (i.e. "*ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*") and (ii) (i) SDG-5 (i.e. "*achieve gender equality and empower all women and girls*"). In addition to these motivational insights, three particular factors underpin the study, notably: (i) the paramount place of women in SSA for the achievement of SDGs, in the light of high income inequalities prevalent in the sub-region; (ii) financial access as a crucial driver of inclusive development and (iii) gaps in the inclusive development literature. These three main angles are expanded in the following passages in the same order as they have been highlighted.

First, in the post-2015 development era, a fundamental constraint to socio-economic development is income inequality and women are at the heart of it. A recent report from the World Bank estimates the loss linked to the exclusion of women from economic participation in SSA to represent approximately 2.5 trillion USD (World Bank, 2018; Nkurunziza, 2018). The sub-region is host to the highest poverty rate among the female gender in the world (Hazel, 2010; Efobi, Tanankem, Asongu, 2018). More than half of the countries in SSA did not achieve the Millennium Development Goals (MDGs) extreme poverty target because of income inequality (Asongu, 2018a; Tchamyou, 2020) and it is projected that unless income inequality is addressed, the SDG target of limiting extreme poverty to a benchmark ofbelow 3% will not be achieved (Bicaba, Brixiova & Ncube, 2017). Financial access has been

[2] "Inequality" and "Income inequality" are used interchangeably throughout the study.

documented to address the policy syndrome of income inequality and improve female economic participation (Asongu & Odhiambo, 2018a; Tchamyou, 2019).

Second, there is a substantial body of literature that supports the importance of financial access in driving economic growth and socio-economic development. The bulk of contemporary studies providing credence to this thesis on the relevance of finance in development outcomes include, *inter alia*: Odhiambo (2010, 2013, 2014); Iyke and Odhiambo (2017); Boadi, Dana, Mertens and Mensah (2017); Chapoto and Aboagye (2017); Oben and Sakyi (2017); Wale and Makina (2017); Ofori-Sasu, Abor and Osei (2017); Bocher, Alemu and Kelbore (2017); Osah and Kyobe (2017); Chikalipah (2017); Daniel (2017) and Kim, Yu and Hassan (2018). The positioning of this study builds on this attendant literature by employing the financial channel as a mechanism by which inclusive education can be enhanced. Such a positioning also builds on a gap in the extant literature[3].

Third, the existing literature on inclusive development can be discussed in three main strands, namely: (i) inequality and inclusive development; (ii) gender economic inclusion and (iii) gender-oriented education inclusion. In the first strand, Kaulihowa and Adjasi (2018) focused on income inequality and external financial flows while information technology has motivated a recent stream of literature on the crucial role of information and communication technology (ICT) in driving inclusive human wellbeing and socio-economic development (Gosavi, 2018; Minkoua Nzie, Bidogeza & Ngum, 2018; Asongu & Nwachukwu, 2018b;Issahaku, Abu & Nkegbe, 2018; Humbani & Wiese, 2018; Abor, Amidu & Issahaku, 2018; Asongu & Odhiambo, 2019a). De Magalhães and Santaeulàlia-Llopis (2018) were concerned with nexuses between income levels and consumption within the poorest elements of society while a branch of the literature investigated the causes of Africa's inequality and poverty from perspectives of genetics(Asongu & Kodika-Tedika, 2017) and emerging paradigms of economic development (Asongu & le Roux, 2019). Page and Söderbom (2015), Jones and Tarp (2015) and Asongu (2016) were among authors whose work advanced literature on the need to rethink policies of development assistance in order to achieve SDGs. Sulemana and Kpienbaareh (2018) focused on the nexus between uneven distribution of

[3]This research is also motivated by the fact that, the extant financial development literature has not directly or indirectly focused on the positioning of this research (Gevorkyan & Kvangraven, 2016; Danquah, Quartey & Iddrisu, 2017; Asongu, Nwachukwu & Tchamyou, 2017; Kusi, Agbloyor, Ansah-Adu & Gyeke-Dako, 2017;Boamah, 2017; Amponsah, 2017; Kusi & Opoku-Mensah, 2018; Boateng, Asongu, Akamavi & Tchamyou, 2018;Bayraktar & Fofack, 2018; Asongu, Batuo, Nwachukwu & Tchamyou, 2018a; Senga, Cassimon & Essers, 2018; Gyeke-Dako, Agbloyor, Turkson & Baffour, 2018; Asongu, Raheem & Tchamyou, 2018b; Bokpin, Ackah & Kunawotor, 2018; Senga & Cassimon, 2019; Dafe, Essers & Volz, 2018).

income and occupation whereas Asongu and Odhiambo (2019b) examined how the degradation of the environment influences inclusive human development.

In the second school of thought on gender economic inclusion, Efobi *et al*. (2018) investigated the importance of ICT in gender inclusion while Elu (2018) supports the need to take more women on board in the scientific field of education. Mannah-Blankson (2018) was concerned with gender inclusion and financial access from the microfinance sector whereas Bayraktar and Fofack (2018) modelled the relevance of gender in informal and financial sectors. Bongomin, Ntayi, Munene and Malinga (2018) focused on the nexus between mobile telephony and access to finance while another body of the literature has been concerned with the importance of corporate social responsibility, ICT and engagement of the female gender in agricultural projects (Uduji & Okolo-Obasi, 2018, 2019, 2020; Uduji, Okolo-Obasi & Asongu, 2019).

The third perspective on inclusive education involves, among others: Hui, Vickery, Njelesani and Cameron (2018) who were concerned with gender-specific experiences pertaining to inclusive schooling for children that are disabled in West and East Africa whereas Clouder *et al*. (2019) engaged the importance of technology in facilitating learning among handicapped students in institutions in North Africa. Magumise and Sefotho (2020) focused on the perception of teachers and parents. In this stream on disability, Mutanga (2018) examined the engagement of students with disabilities in institutions of higher learning in South Africa while Carew, Deluca, Groce and Kett (2019) investigated the impact of inclusive intervention on the readiness of teachers to instill knowledge into children that are victims of physical impairments. Tlale and Romm (2018) were engaged in the systematic thinking and practice which can provide the ground work for inclusive education while Majoko (2018) examined how special and inclusive teaching can be instrumental in early education.

Noticeably, the engaged contemporary literature has not focused on nexuses between income inequality, financial access and inclusive education in the light of extant challenges to SDGs in SSA. This study fills the gap by providing inequality levels that should not be exceeded if financial access is to promote inclusive education. It is relevant to also note that the closest study in the literature to this study is one by Asongu, Nnanna and Acha-Anyi (2020) which has focused on nexuses between inequality, financial access and gender economic inclusion. Using the generalized method of moments and fixed effects regressions, the authors have largely found unexpected net negative effects from the role of financial access in modulating the effect of inequality on gender economic participation. This study

departs from the underlying study by focusing on gender inclusive education and establishing inequality critical masses that should not be exceeded in order for financial access to promote gender parity inclusive education in Sub-Saharan Africa.

The rest of the research is structured as follows. The theoretical underpinnings relevant to the empirical framework are covered in section 2 while section 3 provides the discussion on the data and methodology. The empirical results are disclosed in section 4 and the concluding implications and future research suggestions are covered in section 5.

2. Theoretical underpinnings: inequality, financial access and inclusive education

This section provides the intuition and theoretical foundations motivating nexuses among financial access, inequality and inclusive education. Following Tchamyou *et al*. (2019a), there are two principal views on the relationship between access to finance and economic development. In the first positioning, financial access is instrumental in reducing income inequality and promoting economic growth. However, with regards to the second school of thought, access to finance can be limited to poor sections of the population owing to concerns of asymmetric information, transaction costs and collateral requirements when negotiating access to loans (Asongu & Odhiambo, 2018b). Of these two strands, the former is more consistent with the problem statement being addressed in this study because financial access is considered as a mechanism by which inclusive education can be promoted. Moreover, the former strand also maintains that income inequalities can severely constrain the effectiveness of financial access in opportunities of investment and socio-economic development (Galor & Zeira, 1993; Galor & Moav, 2004; Aghion & Bolton, 2005). Inclusive education is an aspect of socio-economic development; hence, it isreasonable to expect financial access to promote gender inclusion in education.

Conversely, as documented in Asongu, Nwachukwu and Tchamyou (2016), a contending branch of the literature maintains that the rewards from access to finance are skewed towards wealthier elements of society since; they can more easily fulfill the requirements related to information asymmetry discussed in the preceding paragraph. According to the narrative, owing to financial access constraints, poorer segments of society fundamentally rely on the informal financial sector as well as on remittances for their livelihoods and investment projects (Beck, Demirgüç-Kunt & Levine, 2007; Ssozi & Asongu, 2016).

Between the two contending strands is a reconciliatory stance that supports the view that is partially sympathetic to both strands because it opines that there is a non-linear nexus

between financial access and income inequality (Greenwood & Jovanovic, 1990; Asongu & Tchamyou, 2014). This non-linear dimension of the debate aligns with this research in the perspective that the study is based on interactive regressions which involve the establishment of critical limits of income inequality at which the positive relevance of financial access to inclusive education is no longer apparent.

Still in accordance with Tchamyou *et al*. (2019a), the contending positions on the relationship between financial access and income inequality can be further articulated with two main theories underlying channels through which access to finance affects the distribution of income in society. There is first of all, an intensive margin theory which posits that financial access affects income inequality through direct and indirect mechanisms as well as via the improvement of services received by existing clients of financial institutions (Chipote, Mgxekwa & Godza, 2014). On the other hand, the extensive margin theory maintains that the rewards of financial access can equally be extended to the previously unbanked population. Hence, the fraction of the population that did not previously have access to the formal financial system can equally benefit from policies designed to promote formal financial development (Odhiambo, 2014; Orji, Aguegboh & Anthony-Orji, 2015; Chiwira, Bakwena, Mupimpila & Tlhalefang, 2016). Otherpositions in this theoretical view maintain that inequality concerns such as persistence in intergenerational inequality can be mitigated with the provision of financial access services to poor elements of society, including girls previously excluded from formal education opportunities (Evans & Jovanovic, 1989; Holtz-Eakin, Joulfaian & Rosen, 1994; Black & Lynch, 1996; Bae, Han & Sohn, 2012; Batabyal & Chowdhury, 2015).

In summary, the basis of this research that access to finance can influence inclusive education, contingent on income inequality levels is broadly in line with the discussed theoretical insights. Accordingly, both the intensive and extensive margin theories can be used to justify the empirical framework for at least two main reasons. On the one hand, the intensive margin theory is relevant because in this research, financial access affects inclusive education both directly and indirectly. In the interactive regressions, the unconditional effect of financial access on inclusive education is the direct mechanism whereas the conditional effect (i.e. from the interaction between financial access and income inequality) is the indirect mechanism. In order to avoid the pitfalls of interactive regressions documented in Brambor et al. (2006), both conditional and unconditional effects are taken on board in the computation of net effects or associated thresholds. The present study focuses on thresholds that should not be exceeded for financial access to promote inclusive education.

On the other hand, the mere fact that the modeling exercise is tailored to determine thresholds of income inequality that are detrimental to the positive role of financial access on inclusive education, is evidence of the need to involve poorer sections of society in the formal financial sector in order to ultimately engender positive ramifications on inclusive education. This narrative is consistent with a plethora of contemporary inclusive development literature, notably: (i) Tchamyou et al. (2019a) who have assessed linkages between information technology, financial access and income inequality and (ii) Asongu, Nnanna and Acha-Anyi (2020) who have examined nexuses between inequality, financial access and gender economic participation. This next section is designed to assess whether the projected interactions yield the anticipated effects on inclusive education.

3. Data and methodology

3.1 Data

Consistent with the motivation for this study, the focus of the research is on SSA. Owing to constraints in data availability at the time of the study, forty-two countries were sampled with annual data from 2004 to 2014[4]. The data is from three main sources. First of all, the inequality indicators are obtained from the Global Consumption and Income Project (GCIP), namely: the Gini coefficient, the Atkinson index and the Palma ratio. The adoption of three indicators of inequality is motivated by a stream of recent income inequality literature which posits that for robust empirical analyses, it is worthwhile to use different measurements of inequality (Tchamyou *et al*., 2019a, 2019b; Meniago & Asongu, 2018). Building from the attendant supportive literature, the Gini coefficient has the shortcoming of not capturing tails of the inequality distribution. Hence, it is in view of addressing this setback that two complementary indicators (i.e. the Atkinson index and the Palma ratio) are taken on board.

The Financial Development and Structure Database (FDSD) of the World Bank is the source of the financial access variable which is private domestic credit from deposit banks and other financial institutions. The choice of the credit mechanism as opposed to the deposit channel is motivated by the fact that the selected channel is intuitively more relevant in access to credit facilities. In other words, the deposit channel is a necessary, but not a sufficient

[4]The 42 countries include: "Angola, Benin, Botswana, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo Republic, Côte d'Ivoire, Djibouti, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda and Zambia".

condition for access to finance because mobilized deposits have to be transformed into credit and overdrafts before access to finance can be feasible.

It is important to clarify that the measure of financial access used in this study also incorporates the poor. Two main points are worth discussing. On the one hand, domestic credit from the banks and other financial institutions is a measurement of financial activity and such a conception is consistent with the FDSD of the World Bank and contemporary financial access literature (Tchamyou, 2019, 2020) in which, liquid liabilities (i.e. financial system deposits) and money supply are considered as more appropriate measures of financial depth. On the other hand, of the two main measures of financial activity from the FDSD (i.e. banking system credit and financial system credit); the measurement used in this study to capture financial activity is financial system credit or credit from deposit money banks and other financial institutions. "Other financial institutions" are legally registered but not licensed as financial institutions by the government and central bank, namely: Credit Unions, Micro Finance and nongovernmental organization (NGOs) which encompass microenterprises and the entrepreneurial poor (Asongu & Acha-Anyi, 2017). The decomposition of the financial system to articulate the underlying measurement of financial access is provided in Appendix 1. Hence, a conception of financial access in this study incorporates the poor.

A third source of the data is the World Development Indicators of the World Bank from which the inclusive education and control variables are obtained. The adopted two gender parity education indicators are "primary and secondary education" and tertiary education while the control variable is remittances. The motivation for adopting variables that articulate all three levels of education is consistent with contemporary African education, lifelong learning and knowledge economy literature on the imperative to adopt more holistic measures of education in order to provide more room for policy outcomes (Asiedu, 2014; Tchamyou, 2017; Asongu & Tchamyou, 2016, 2019, 2020).

The adopted control variable (i.e. remittances) is expected to negatively affect economic inclusion (Asongu et al., 2020) and by extension, inclusive education. It is both relevant to substantiate the restriction of the conditioning information set and anticipated sign. First of all, with regards to the latter, contemporary inclusive development literature is supportive of the role of remittances in driving exclusive development in Africa. As argued by Anyanwu (2011), Meniago and Asongu (2018) and Asongu and Odhiambo (2019c), remittances do not decrease income inequality in Africa because majority of Africans travelling abroad are from wealthier segments of African society. This has been recently confirmed in gender inclusive development literature (Asongu & Odhiambo, 2018a).

As concerns the limitation of elements in the conditioning information set to one variable, it is worthwhile to articulate that the GMM-centric tolerates the involvement of limited control variables, provided that the purpose for doing so is to restrict the proliferation of instruments, even when the instruments are collapsed in the estimation exercise. Some examples of studies that are in line with this narrative include: (i) Osabuohien and Efobi (2013) and Asongu and Nwachukwu (2017) who have used no control variable and Bruno, De Bonis and Silvestrini (2012) who have used two control variables[5]. The definitions of the variables are disclosed in Appendix 2 while the summary statistics is provided in Appendix 3. Appendix 4 shows that corresponding correlation matrix.

3.2 Methodology

The methodology section of this study is presented in two main sub-sections, notably, a section on the GMM specification and another section on "identification, exclusion restrictions and simultaneity". In the attendant sections, the concern of endogeneity is discussed. Accordingly, the unobserved heterogeneity dimension of endogeneity is discussed in Section 3.2.1 while the reverse causality or simultaneity dimension is engaged in Section 3.2.2.

3.2.1 GMM: Specification

The choice of the empirical strategy is motivated by contemporary studies on the consistency between an estimation technique and data behavior (Kou, Chao, Peng & Alsaadi, 2019a; Kou, Yang, Xiao, Chen & Alsaadi, 2019b; Kou, Lu, Peng & Shi, 2012; Kou, Ergu, Chen, Lin, 2016; Kou, Peng & Wang, 2014). Five main justifications underpin the choice of the GMM

[5]While we acknowledge that there are many potential control variables underlying the investigated nexuses, not all can be taken on board in the light of the adopted estimation strategy, (i.e. the Generalized Method of Moments). Accordingly, a criterion for the validity of estimated models is that, instruments should not be proliferated. For instruments not to be proliferated, in the post-estimation diagnostics tests, for each specification, the number of instruments should be less than the corresponding number of countries, even when the option of collapsing instruments is taken on board. For instance, when two control variables are adopted as it is the case in Tables 3-4, the concern of exact identification is apparent (i.e. the number of instruments becomes equal to the number of cross-sections). In summary, not all potential control variables can be taken on board because in Generalized Method of Moments estimations; there is a choice between (i) avoiding variable omission bias as much as possible and (ii) having robust estimated models that pass the post-estimation diagnostic test related to instrument proliferation. "*Our justification for employing two control variables in the GMM specification is very solid, because employing more than two variables will lead to findings that do not pass all post-estimation diagnostic tests owing to instrument proliferation, even when the option of collapsing instruments is taken on board in the estimation exercise. There is a choice here between having valid estimated models and avoiding variable omission bias*" (Asongu & Odhiambo, 2020, p. 679).

strategy employed in this study. These justifications are in line with recent GMM-centric literature (Asongu & Nwachukwu, 2016a; Tchamyou, 2019, 2020). (i) The number of cross sections is higher than the number of periods per cross section. Therefore, the N(i.e. 42 countries)> T(i.e. 11 years or 2004 to 2011) condition for the employment of the estimation approach is fulfilled. (ii) The inclusive development outcomes variables are persistent over time because the correlations between their first difference and level series' are higher than the threshold for establishing persistence in the scholarly literature (Tchamyou *et al*., 2019a). (iii) The estimation approach is tailored to account for endogeneity because: the unobserved heterogeneity is taken on board by controlling for time invariant omitted variables and reverse causality is accounted for with an instrumental variable process. (iv) Owing to the panel nature of the data, cross-country variations are involved in the regression exercise. (v) The choice of the GMM technique is also motivated by the difficulty of finding external instruments.

The GMM approach used in this study is the Roodman (2009a, 2009a) strategy, which is an extension of Arellano and Bover (1995). The motivation for this approach is that compared to more traditional *difference* and *system* GMM approaches, this option has been documented in the contemporary GMM-centric literature to provide more robust estimates (Boateng, Asongu, Akamavi & Tchamyou, 2018).

The following equations in level (1) and first difference (2) summarize the standard *system* GMM estimation procedure.

$$E_{i,t} = \sigma_0 + \sigma_1 E_{i,t-\tau} + \sigma_2 F_{i,t} + \sigma_3 I_{i,t} + \sigma_4 FI_{i,t} + \sigma_5 R_{i,t} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (1)$$

$$\begin{aligned} E_{i,t} - E_{i,t-\tau} = {} & \sigma_1 (E_{i,t-\tau} - E_{i,t-2\tau}) + \sigma_2 (F_{i,t} - F_{i,t-\tau}) + \sigma_3 (I_{i,t} - I_{i,t-\tau}) + \sigma_4 (FI_{i,t} - FI_{i,t-\tau}) \\ & + \sigma_5 (R_{i,t} - R_{i,t-\tau}) + (\xi_t - \xi_{t-\tau}) + (\varepsilon_{i,t} - \varepsilon_{i,t-\tau}) \end{aligned} \quad (2)$$

where, $E_{i,t}$ denotes a proxy for inclusive education (i.e. "primary and secondary education", and tertiary education) of country i in period t, σ_0 is a constant, F represents financial access (private domestic credit), I entails an income inequality indicator (i.e. the Gini coefficient, the Atkinson index and the Palma ratio), FI reflects interactions between financial access and inequality indicators ("financial access" × "the Gini coefficient"; "financial access" × "the Atkinson index"; "financial access" × "the Palma ratio"), R is remittances, τ is the coefficient of auto-regression which is one in this study because a one year lag appropriately captures past information, ξ_t is the time-specific constant, η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term.

3.2.2 Identification, exclusion restrictions and simultaneity

The GMM is robustly specified if the narratives surrounding its specification are supported with a discussion on the corresponding procedure of identification and exclusion restrictions. Put in other words, the process of identification consists of defining the endogenous, explaining and strictly exogenous variables in the specification exercise. This relevance is in accordance with contemporary GMM-centric literature (Asongu & Nwachukwu, 2016b; Tchamyou & Asongu, 2017; Boateng *et al*., 2018; Tchamyou *et al*., 2019b). Consistent with this attendant literature, the time or years are considered to be strictly exogenous whereas the independent variables of interest and the control variable are acknowledged to be endogenous explaining or predetermined. This identification approach is supported by Roodman (2009b) who argues that it is not feasible for years to be endogenous after a first difference[6].

Still borrowing from the strand of contemporary GMM-oriented studies, the criterion with which the assumption of exclusion restrictions is examined is the Difference in Hansen Test (DHT) for the validity of instruments. The null hypothesis for this test should not be rejected in order for the identified strictly exogenous variables to elucidate education exclusively through the exogenous components of the independent variables of interest (i.e. inequality, financial access and remittances). This information criterion required for the validity of strictly exogenous variables is not different from that used in less contemporary instrumental variable (IV) estimation approaches in which, failure to reject the null hypothesis of the Sargan/Hansen overidentifying restriction test is an indication that the instruments are valid (Demirgüç-Kunt & Levine, 2003; Asongu & Nwachukwu, 2016c; Amavilah, Asongu & Andrés, 2017). An interpretation of the failure to reject the null hypothesis is that the identified strictly exogenous variables are valid in that they elucidate the outcome variables exclusively through the identified predetermined variables.

On the concerns of endogeneity associated with the specification, how the unobserved heterogeneity is taken on board by controlling for time invariant omitted variables has been discussed in the previous section. However, simultaneity or reverse causality which is another cause of endogeneity is an obvious concern because *inter alia*, while inequality and financial access influence inclusive education, inequality in education can also affect income inequality and financial standings of families.

The underlying concern of simultaneity is tackled in this study by leveraging on lagged regressors which are employed as instruments for variables that are forward-

[6]Hence, the procedure for treating *ivstyle* (years) is 'iv (years, eq(diff))' whereas the *gmmstyle* is employed for predetermined variables.

differenced. Accordingly, fixed effects that are susceptible of affecting the assessed nexuses are purged with the employment of Helmert transformation in the regressions as in the attendant GMM-centric literature (Arellano & Bover, 1995; Love & Zicchino, 2006). These transformations engender forward mean-variations of the variables such that, all future observations are deducted from the variables, as opposed to subtracting past observations from present observations. These transformations reflect orthogonal or parallel conditions between forward-differenced variables and lagged observations. Regardless of lag numbers, in order to minimize data loss, the attendant transformations are engaged for all observations, with the exception of the last observation for each cross section. Moreover, "*because lagged observations do not enter the formula, they are valid as instruments*" (see Roodman, 2009b, p. 104; Asongu & De Moor, 2017).

The main drawback in applying the GMM technique is that country-fixed effects are not taken on board and hence, this could lead to some loss of efficiency. However, these country fixed effects should be removed from theoretically and practically standpoints in order to avoid the correlation between country-specific effects and the lagged dependent variables which is a cause of endogeneity. It follows that the non-involvement of country fixed effects is also a measured to address the concern of endogeneity.

4. Empirical results

4.1 Presentation of results

The empirical results are disclosed in this section in Tables 1-2. Table 1 focuses on inclusive "primary and secondary education" as outcome variable whereas Table 2 shows results of the corresponding findings pertaining to the dependent variable of inclusive "tertiary education". Each table is partitioned into three main sections, each pertaining to an inequality indicator. In each section corresponding to an inequality dynamic, two specifications are apparent: one without a conditioning information set and another with a conditioning information set. As clarified in the data section, control variables can be absent in a GMM specification if the purpose for such avoidance to is limit the proliferation of instruments. Four principal information criteria are used to assess the validity of estimated models[7]. In the light of these information criteria, all the models are valid.

[7] "*First, the null hypothesis of the second-order Arellano and Bond autocorrelation test (AR (2)) in difference for the absence of autocorrelation in the residuals should not be rejected. Second the Sargan and Hansen over-identification restrictions (OIR) tests should not be significant because their null hypotheses are the positions that instruments are valid or not correlated with the error terms. In essence, while the Sargan OIR test is not robust but not weakened by instruments, the Hansen OIR is robust but weakened by instruments. In order to restrict identification or limit the proliferation of instruments, we have ensured that instruments are lower than the number of cross-sections in most specifications. Third, the Difference in Hansen Test (DHT) for exogeneity of instruments is also employed to assess the validity of*

Contingent on the problem statement underlying this study, thresholds or critical masses at which inequality completely wipes-outs the expected positive incidence of financial access are established. Accordingly, the intuition for the research is consistent with positive unconditional effects of financial access on inclusive education and negative conditional impacts (i.e. from the interaction between financial access and inequality) on inclusive education. It follows that the research expects financial access to promote inclusive education while inequality should dampen the underlying positive nexus. Hence, with positive unconditional effects and corresponding negative conditional or interactive effects, at certain thresholds of inequality, the positive incidence of financial access on inclusive education is no longer apparent. It is the purpose of this research to establish such thresholds of income inequality above which, financial access no longer promotes inclusive education.

Following recent threshold literature (Asongu, 2018b), in the last column of Table 1, 6.000 (0.0006/0.0001) is the critical mass of the Palma ratio at which financial access no longer promotes inclusive "primary and secondary education". It is worthwhile to note that in this computation, 0.0006 represents the unconditional effect of financial access on inclusive "primary and secondary education", while 0.0001 is the conditional impact resulting from the interaction between the Palma ratio and financial access. The core interpretation is that policy makers should not allow the Palma ratio to exceed the established 6.000 if financial access is to promote gender parity inclusive education in the sampled countries.

Building on the same computational framework, in Table 2, the Akinson index should not exceed 0.695 in order for financial access to promote inclusive tertiary education. The significant control variables have the expected signs.

On potential concerns that can arise relating to the fact that findings are unstable and sensitive, this study argues that unstable and sensitive findings can still be robust and reported for three main reasons. First, on the unstable front: (i) different dependent outcome and inequality variables are used. The two outcome variables do not have a high degree of substitution as apparent from the correlation coefficient in the correlation matrix. Hence, it is normal to expect different tendencies from the findings. (ii) The inequality coefficients capture different tendencies. Accordingly, it is fundamentally because the Gini coefficient does not capture extreme points of the inequality distribution that the Atkinson index and Palma ratio are taken on board to capture tails of the inequality distributions (Tchamyou et al., 2019a).

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results from the Hansen OIR test. Fourth, a Fisher test for the joint validity of estimated coefficients is also provided" (Asongu& De Moor, 2017, p.200).

Second, with respect to sensitivity, a GMM regression in which a conditioning information set is involved (i.e. control variables are involved) is also a form of conditional convergence modeling in which, the findings are contingent on variables that are involved in the conditioning information set and empirically tested. Hence, consistent with the attendant GMM-centric literature, GMM results should be interpreted in the light of variables involved in the conditioning information set (Narayan, Mishra & Narayan, 2011). For instance, using the same example of convergence, catch-up is exclusively apparent within a GMM framework because of cross-country differences in variables involved in the conditioning information set (Narayan et al., 2011). Hence, the understanding of catch-up is contingent or conditional on variables involved in the conditioning information set (i.e. control variables). In summary, the modeling exercise is similar to conditional catch-up because, it: (i) involves control variables and (ii) employs an estimated lagged dependent variable. While this study does not specifically focus on catch-up (which is based on the estimated lagged outcome variables), the modeling exercise is the same though, a different problem statement is being examined.

Third, when a problem statement is soundly presented, the modeling approach is judged to be relatively consistent with data behavior and the post-estimation diagnostics tests are robust to the attendant estimations, even if the findings are not significant, they should be reported nonetheless in order to avoid the concern of publication bias in social sciences, where strong and significant results are preferred over weak and insignificant results (Rosenberg, 2005; Franco, Malhotra & Simonovits, 2014). The study therefore argues that significant results have as much economic significance as insignificant results in the light of contemporary literature on the relevance of publishing unexpected and insignificant findings (Ejemeyovwi & Osabuohien, 2020).

Table 1: Inequality, finance and inclusive "primary and secondary education"

	Dependent variable: Inclusive Primary and Secondary Education (PSSE)					
	The Gini Coefficient (Gini)		The Atkinson Index (Atkinson)		The Palma Ratio (Palma)	
PSSE (-1)	**0.946*** **	**0.970*** **	**0.976*** **	**0.947*** **	**0.970*** **	**0.956*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Domestic Credit (Credit)	0.002	0.003	0.002	0.001	0.0004	**0.0006** **
	(0.451)	(0.233)	(0.147)	(0.265)	(0.293)	**(0.025)**
The Gini Coefficient (Gini)	0.108	**0.194***	---	---	---	---
	(0.427)	**(0.078)**				
The Atkinson Index (Atkinson)	---	---	0.071	0.077	---	---
			(0.301)	(0.292)		
The Palma Ratio (Palma)	---	---	---	---	0.001	**0.002*** **
					(0.256)	**(0.006)**
Credit ×Gini	-0.004	-0.005	---	---	---	---
	(0.456)	(0.239)				
Credit ×Atkinson	---	---	-0.003	-0.002	---	---
			(0.134)	(0.277)		
Credit ×Palma	---	---	---	---	-0.00008	**-0.0001** **
					(0.254)	**(0.026)**
Remittances	---	-0.0003	---	0.00007	---	9.26e-06
		(0.110)		(0.725)		(0.922)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Thresholds	na	na	na	na	na	6.000
AR(1)	(0.025)	(0.027)	(0.032)	(0.024)	(0.033)	(0.025)
AR(2)	**(0.269)**	**(0.267)**	**(0.305)**	**(0.284)**	**(0.316)**	**(0.317)**
Sargan OIR	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Hansen OIR	**(0.162)**	**(0.112)**	**(0.532)**	**(0.457)**	**(0.325)**	**(0.148)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	(0.098)	**(0.146)**	**(0.298)**	**(0.214)**	**(0.113)**	**(0.114)**
Dif(null, H=exogenous)	**(0.251)**	**(0.162)**	**(0.545)**	**(0.559)**	**(0.462)**	**(0.244)**
(b) IV (years, eq(diff))						
H excluding group	---	(0.040)	---	(0.174)	---	(0.074)
Dif(null, H=exogenous)	---	**(0.318)**	---	**(0.603)**	---	**(0.303)**
Fisher	**354.51*** **	**1376.27*** **	**61171.35*** **	**5767.82*** **	**168045.42*** **	**6424.10*** **
Instruments	24	28	24	28	24	28
Countries	35	33	35	33	35	33
Observations	226	217	226	217	226	217

***,**,*: 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 Fisher 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.na: not applicable because at least one estimated coefficient needed for the computation of net effects is not significant. Constants are included in all regressions.

Table 2: Inequality, finance and inclusive tertiary education

	Dependent variable: Inclusive Tertiary Education (TSE)					
	The Gini Coefficient (Gini)		The Atkinson Index (Atkinson)		The Palma Ratio (Palma)	
TSE (-1)	**1.035*** **	**1.002*** **	**1.041*** **	**0.998*** **	**1.040*** **	**0.996*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Domestic Credit (Credit)	-0.001	0.009	**0.016** **	0.004	-0.0001	-0.001
	(0.851)	(0.207)	**(0.043)**	(0.392)	(0.960)	(0.329)
The Gini Coefficient (Gini)	-0.245	0.556	---	---	---	---
	(0.629)	(0.168)				
The Atkinson Index (Atkinson)	---	---	0.300	0.039	---	---
			(0.166)	(0.814)		
The Palma Ratio (Palma)	---	---	---	---	-0.013	-0.009
					(0.296)	(0.394)
Credit ×Gini	0.002	-0.016	---	---	---	---
	(0.856)	(0.211)				
Credit ×Atkinson	---	---	**-0.023** **	-0.006	---	---
			(0.049)	(0.418)		
Credit ×Palma	---	---	---	---	0.00005	0.0003
					(0.895)	(0.313)
Remittances	---	**-0.001*** **	---	-0.001	---	-0.002
		(0.005)		(0.222)		(0.175)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Thresholds	na	na	0.695	na	na	na
AR(1)	**(0.271)**	**(0.275)**	**(0.272)**	**(0.273)**	**(0.274)**	**(0.276)**
AR(2)	**(0.174)**	**(0.217)**	**(0.176)**	**(0.234)**	**(0.166)**	**(0.205)**
Sargan OIR	(0.037)	(0.070)	(0.032)	(0.061)	(0.032)	(0.067)
Hansen OIR	**(0.351)**	**(0.268)**	**(0.185)**	**(0.314)**	**(0.306)**	**(0.427)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	(0.062)	(0.091)	(0.068)	(0.025)	**(0.186)**	(0.063)
Dif(null, H=exogenous)	**(0.611)**	**(0.474)**	**(0.335)**	**(0.804)**	**(0.360)**	**(0.774)**
(b) IV (years, eq(diff))						
H excluding group	---	(0.044)	---	(0.061)	---	**(0.157)**
Dif(null, H=exogenous)	---	**(0.619)**	---	**(0.627)**	---	**(0.587)**
Fisher	**1058.83*** **	**3823.19*** **	**878.16*** **	**8688.13*** **	**1049.53*** **	**92384.57*** **
Instruments	24	28	24	28	24	28
Countries	35	32	35	32	35	32
Observations	154	146	154	146	154	146

***,**,*: 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 Fisher 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.na: not applicable because at least one estimated coefficient needed for the computation of net effects is not significant. Constants are included in all regressions.

4.2 Robustness checks: introducing other elements in the conditioning information set

Given the unstable and shaky nature of the findings, the study introduces alternative measures in the conditioning information set as a means of robustness check. The choice of internet penetration and government expenditure as determinants of inclusive education is consistent with contemporary inclusive education literature (Elu, 2018; Asongu, Orim & Nting, 2019). While these two variables are expected to positively affect inclusive education, the expected effect is also contingent on regional dynamics, initial conditions and the nature of the outcome variable. For instance, the internet could be more relevant in tertiary education than for primary and secondary education in countries at initial levels of industrialization where the internet is more used by students at the university than by students in secondary and primary schools. Moreover, a negative effect of information technology on development

outcomes as established by Ejemeyovwi and Osabuohien (2020) could also imply that the information technology penetration is not yet enough to generate the expected outcomes. Concerning government expenditure, they may be siphoned in one education level than in another, especially when: (i) such education levels are managed by different ministries and (ii) demands for management accountability differ from one level of education to another.

In the new estimations provided in Tables 3-4 in which additional control variables are involved, the inclusion of two control variables leads to post-estimation diagnostic tests in which the number of instruments is exactly the same as the number of countries, even when the option to collapse instruments is taken on board in the estimation exercise. This confirms why in the initial regressions (i.e. Tables 1-2), only one control variable is considered. Moreover, as justified in the data section, there is a strand of GMM-centric literature in which control variables are not involved in the estimation exercise in order to avoid instrument proliferation (Bruno et al., 2012; Osabuohien & Efobi, 2013). Hence, the concern of having a valid estimated model is prioritized over the concern of variable omission bias. Our best estimates are those in which, only one variable is involved in the conditioning information set because the corresponding regressions are not characterized by instrument proliferation given that number of instruments are less than attendant number of cross sections.

In the light of the information criteria for the validity of models (discussed in the previous section) and narrative on best estimators (discussed in the previous paragraph), while inequality thresholds cannot be computed in Table 4 because at least one estimated coefficient needed for such computation is not significant in all specifications, in Table 3, it is established that in order for financial access to promote inclusive primary and secondary education: (i) the Gini coefficient should not exceed 0.571; (ii) the Atkinson index should not be above 0.750 and (iii) the Palma ratio should be maintained below 8.000. For both tables, the control variables are significant and given the corresponding estimated signs, it is apparent that the internet is more useful for tertiary education and government expenditure is better managed and used to promote tertiary education. Justifications for the varying expected signs from control variables have been discussed above.

Table 3: Inequality, finance and inclusive "primary and secondary education"

	Dependent variable: Inclusive Primary and Secondary Education (PSSE)					
	The Gini Coefficient (Gini)		The Atkinson Index (Atkinson)		The Palma Ratio (Palma)	
PSSE (-1)	**0.942*** **	**1.035*** **	**0.893*** **	**0.941*** **	**0.955*** **	**1.013*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Domestic Credit (Credit)	**0.004***	0.002	**0.003****	**0.003****	**0.0008****	0.0004
	(0.089)	(0.183)	**(0.034)**	**(0.028)**	**(0.012)**	(0.296)
The Gini Coefficient (Gini)	0.167	0.033	---	---	---	---
	(0.141)	(0.593)				
The Atkinson Index (Atkinson)	---	---	**0.116***	**0.162*** **	---	---
			(0.076)	**(0.006)**		
The Palma Ratio (Palma)	---	---	---	---	**0.002***	**0.002***
					(0.059)	**(0.078)**
Credit × Gini	**-0.007***	-0.004	---	---	---	---
	(0.089)	(0.181)				
Credit × Atkinson	---	---	**-0.004****	**-0.005****	---	---
			(0.031)	**(0.026)**		
Credit × Palma	---	---	---	---	**-0.0001****	-0.00009
					(0.013)	(0.259)
Internet	**-0.0002*** **	**-0.0003*** **	0.00004	**-0.0001***	**-0.0002*** **	**-0.0003*** **
	(0.004)	**(0.001)**	(0.669)	**(0.085)**	**(0.005)**	**(0.004)**
Government Expenditure	---	**-0.001*** **	---	**-0.001*** **	---	**-0.001*** **
		(0.007)		**(0.000)**		**(0.000)**
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Thresholds	0.571	na	0.750	0.600	8.000	na
AR(1)	(0.026)	(0.080)	(0.030)	(0.092)	(0.026)	(0.086)
AR(2)	**(0.115)**	**(0.270)**	**(0.129)**	**(0.230)**	**(0.135)**	**(0.266)**
Sargan OIR	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Hansen OIR	**(0.201)**	**(0.710)**	**(0.382)**	**(0.502)**	**(0.321)**	**(0.581)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.078)**	**(0.180)**	**(0.267)**	**(0.224)**	**(0.148)**	**(0.164)**
Dif(null, H=exogenous)	**(0.392)**	**(0.886)**	**(0.427)**	**(0.627)**	**(0.459)**	**(0.783)**
(b) IV (years, eq(diff))						
H excluding group	**(0.126)**	**(0.299)**	**(0.235)**	**(0.663)**	(0.065)	**(0.375)**
Dif(null, H=exogenous)	**(0.314)**	**(0.866)**	**(0.450)**	**(0.344)**	**(0.625)**	**(0.640)**
Fisher	**1192.64*** **	**3896.81*** **	**1033.00*** **	**1.49e+09*** **	**936538.40*** **	**40632.29*** **
Instruments	28	32	28	32	28	32
Countries	35	32	35	32	35	32
Observations	221	187	221	187	221	187

***,**,*: 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 Fisher 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.na: not applicable because at least one estimated coefficient need for the computation of net effects is not significant. Constants are included in all regressions.

Table 4: Inequality, finance and inclusive tertiary education

	Dependent variable: Inclusive Tertiary Education					
	The Gini Coefficient (Gini)		The Atkinson Index (Atkinson)		The Palma Ratio (Palma)	
TSE (-1)	**0.923*** **	**0.853*** **	**0.927*** **	**0.808*** **	**0.926*** **	**0.814*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Domestic Credit (Credit)	-0.002	0.004	0.001	0.012	-0.002	0.0008
	(0.788)	(0.697)	(0.831)	(0.291)	(0.186)	(0.784)
The Gini Coefficient (Gini)	-0.053	0.307	---	---	---	---
	(0.896)	(0.712)				
The Atkinson Index (Atkinson)	---	---	0.042	0.639	---	---
			(0.820)	(0.134)		
The Palma Ratio (Palma)	---	---	---	---	-0.011	-0.004
					(0.225)	(0.745)
Credit × Gini	0.003	-0.007	---	---	---	---
	(0.819)	(0.698)				
Credit × Atkinson	---	---	-0.002	-0.018	---	---
			(0.806)	(0.290)		
Credit × Palma	---	---	---	---	0.0003	-0.00009
					(0.230)	(0.859)
Internet	**0.003*** **	**0.003*** **	**0.002*** **	**0.006*** **	**0.002*** **	**0.004*** **
	(0.000)	**(0.001)**	**(0.001)**	**(0.000)**	**(0.000)**	**(0.000)**
Government Expenditure	---	**0.010** **	---	**0.006*** **	---	**0.012*** **
		(0.039)		**(0.001)**		**(0.001)**
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Thresholds	na	na	na	na	na	na
AR(1)	**(0.281)**	**(0.272)**	**(0.268)**	**(0.273)**	**(0.274)**	**(0.277)**
AR(2)	**(0.307)**	**(0.343)**	**(0.393)**	**(0.349)**	**(0.326)**	**(0.334)**
Sargan OIR	(0.042)	**(0.214)**	(0.032)	**(0.140)**	(0.033)	**(0.207)**
Hansen OIR	**(0.764)**	**(0.733)**	**(0.286)**	**(0.320)**	**(0.713)**	**(0.306)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.269)**	**(0.639)**	**(0.184)**	**(0.277)**	**(0.311)**	**(0.547)**
Dif(null, H=exogenous)	**(0.852)**	**(0.650)**	**(0.373)**	**(0.361)**	**(0.772)**	**(0.233)**
(b) IV (years, eq(diff))						
H excluding group	**(0.206)**	**(0.610)**	**(0.177)**	**(0.154)**	**(0.147)**	**(0.251)**
Dif(null, H=exogenous)	**(0.894)**	**(0.658)**	**(0.380)**	**(0.550)**	**(0.899)**	**(0.391)**
Fisher	**8014.48*** **	**191345.16*** **	**4299.74*** **	**178176.41*** **	**7807.15*** **	**1.67e+06*** **
Instruments	28	32	28	32	28	32
Countries	35	32	35	32	35	32
Observations	151	139	151	139	151	139

***,**,*: 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 Fisher 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.na: not applicable because at least one estimated coefficient need for the computation of net effects is not significant. Constants are included in all regressions.

5. Concluding implications, caveats and future research directions

This research complements the extant literature by establishing inequality critical masses that should not be exceeded in order for financial access to promote gender parity inclusive education in Sub-Saharan Africa. The focus is on 42 countries in the sub-region and the data is for the period 2004-2014. The estimation approach is the Generalized Method of Moments. Inclusive education is measured with gender parity "primary and secondary education" and gender parity tertiary education while three indicators are employed to assess inequality, notably: the Gini coefficient, the Atkinson index and the Palma ratio. The following main findings are established when remittances are involved in the conditioning information set. The Palma ratio should not exceed 6.000 in order for financial access to promote gender

parity inclusive "primary and secondary education" and the Atkinson index should not exceed 0.695 in order for financial access to promote inclusive tertiary education. However, when the internet is involved in the conditioning information set, it is established that in order for financial access to promote inclusive primary and secondary education: (i) the Gini coefficient should not exceed 0.571; (ii) the Atkinson index should not be above 0.750 and (iii) the Palma ratio should be maintained below 8.000. While GMM modeling is contingent on variables in the conditioning information set, irrespective of the choice of variable in the conditioning information set, what is apparent is that inequality decreases the incidence of financial access on inclusive education. Hence, a common policy measure is to reduce inequality in order to promote inclusive education using the financial access mechanism. In what follows, attendant policy implications are discussed in the light of the post-2015 development agenda of SDGs.

Given the theoretical insights motivating this study, financial access was anticipated to positively affect inclusive education while income inequality was also expected to negatively moderate the incidence of financial access on the outcome variable. These theoretical underpinnings withstand empirical scrutiny in the light of established findings in this research. Three policy implications emerge from the findings. These implications pertain to: (i) the stubbornly high rate of income inequality in sub-Saharan Africa; (ii) the need to increase financial access and (iii) the imperative of promoting gender participation in the formal economic sector by means of engaging more women in education. These implications are expanded in the same order as they are highlighted.

First and foremost, as discussed in the motivation of the study, inequality was found to be a fundamental challenge in the achievement of MDGs and prospective studies maintain that unless this policy syndrome of income inequality is addressed, most SDGs will not be achieved. The need to mitigate inequality is consistent with the findings of this research because it is apparent from the results that at certain thresholds of inequality, financial access no longer improves inclusive education. It follows that reducing income inequality augments the positive relevance of financial access in promoting inclusive education from the perspective of engaging more girls in formal education. Moreover, complementary policies that enhance financial access and reduce income inequality simultaneously will induce positive gender inclusive externalities in the education sector. As apparent in a recent United Nations report (UN, 2017), gender exclusion can be reduced by engaging a plethora of complementary policies. Our findings are consistent with this report in the perspective that

financial access is a necessary but not a sufficient condition for the promotion of inclusive education in the sub-region.

Second, the positive incidence of access to finance is an indication of the fact that more should be done by the policy makers of sampled countries to increase financial access, especially to the previously unbanked segments of the population. As maintained by Tchamyou *et al*. (2019a) and Asongu and Odhiambo (2019d), financial access in the sub-region is very low compared to other regions of the world. Within the context of this research, in the design of policies that are relevant to enhancing access to finance, consideration should be placed on gender parity so that women are endowed with as many opportunities as men.

Third, boosting inclusive education for the female gender will ultimately engender other positive externalities that are relevant for the achievement of SDG, notably: (i) SDG-4 (i.e. "*ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*") and (ii) (i) SDG-5 (i.e. "*achieve gender equality and empower all women and girls*"). In essence, in the light of the introduction motivating this study, women in SSA are among the poorest in the world and encouraging the participation of girls in formal educational institutions will go a long way to improving their social mobility and endowing them with more employment avenues. In essence, the exclusion of women in the education and formal economic sectors represent substantial wastes of human resources because no country can develop in a sustainable manner (i.e. socially, economically and politically) if most women are excluded from being educated and by extension, contributing little to the economic prosperity of the nation.

Given the main insights that financial access can be constrained by other policy syndromes in its effectiveness on inclusive education, it will be worthwhile for future studies to extend the established findings by considering complementary mechanisms with which financial access can improve the involvement of women in the formal education sector and by extension, the formal economic sector. Furthermore, consistent with Asongu and Odhiambo (2020), given the unbalanced panel dataset used for the empirical analysis, other estimation techniques that are appropriate for non-linear estimation (and which require a balanced panel datastructure) could be considered as alternative empirical strategies. These include, the: (i) Panel Smooth Transition Regression (PSTR) from Gonzalez, Terasvirta and van Dijk (2005) and Gonzalez, Terasvirta, van Dijk and Yang (2017) and (ii) Panel Threshold Regression (PTR) of Hansen (1999, 2000).

In the suggested future research directions, engaging alternative measures of financial access such as bank account per 1,000 adults and bank branches per 100,000 are worthwhile.

These measures are documented in Čihák, Demirgüç-Kunt, Feyen and Levine (2012). This suggestion is motivated by the fact that domestic credit from deposit banks and other financial institutions could be skewed in favor of large firms. While the study has justified the nexus between the measurement of financial access (used in the study) and the poor, with a decomposition of the financial system into formal and non-formal sectors, it is worth emphasizing that the suggested measures of financial access proposed by Čihák et al. (2012) can also be criticized because the percentage of people with bank accounts does not intrinsically reflect financial access because these people could simply be using their bank accounts to have access to their bank deposits. And when people with bank accounts largely use their bank accounts to have access to their deposits in banks, the attendant measurements(i.e. percentage of people with bank accounts, accounts per thousand of adults and number bank branches) become more representative of financial depth (i.e. financial system deposits and money supply). Hence, the suggested measurements also have a shortcoming of not articulating the fundamental role of banking institutions which is to transform mobilized deposits into credit for both households and corporations.

6. Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendices

Appendix 1: Segments of the financial system by degree of formality in Paper's context

Paper's context			Tiers	Definitions	Institutions	Principal Clients
Formal financial system	IMF Definition of Financial System from International Financial Statistics (IFS)	Formal Financial sector (Deposit Banks)	Formal banks	Licensed by central bank	Commercial and development banks	Large businesses, Government
Semi-formal and informal financial systems		Semi-formal financial sector (Other Financial Institutions)	Specialized non-bank financial institutions		Rural banks, Post banks, Saving and Loan Companies, Deposit taking Micro Finance banks	Large rural enterprises, Salaried Workers, Small and medium enterprises
			Other non-bank financial institutions	Legally registered but not licensed as financial institution by central bank and government	Credit Unions, Micro Finance NGOs	Microenterprises, Entrepreneurial poor
	Missing component in IFS definition	Informal financial sector	Informal banks	Not legally registered at national level (though may be linked to a registered association)	Savings collectors, Savings and credit associations, Money lenders	Self-employed poor

Source: Asongu and Acha-Anyi (2017)

Appendix 2: Definitions of Variables

Variables	Signs	Definitions of variables (Measurements)	Sources
Inclusive Education	PSSE	School enrollment, primary and secondary (gross), gender parity index (GPI)	WDI
	TSE	School enrollment, tertiary (gross), gender parity index (GPI)	WDI
Domestic Credit	Credit	Private domesticcredit from depositbanks and other financial institutions (% of GDP)	FDSD
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 bydetermining which end of the distribution contributed most to the observed inequality*".	GCIP
Palma Ratio	Palma	"*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
Remittances	Remit	Remittance inflows to GDP (%)	WDI
Internet Penetration	Internet	Internet users (per 100 people)	WDI
Government Exp.	Gov.Exp.	General government expenditure (% of GDP)	WDI

WDI: World Bank Development Indicators of the World Bank. FDSD: Financial Development and Structure Database of the World Bank. GCIP: Global Consumption and Income Project. Exp: Expenditure.

Appendix 3: Summary statistics (2004-2014)

	Mean	SD	Minimum	Maximum	Obs
Primary & Secondary School Enrolment	0.919	0.111	0.600	1.105	307
Tertiary School Enrolment	0.731	0.433	0.064	3.295	232
Private Domestic Credit	20.913	24.628	0.873	150.209	440
Gini Index	0.586	0.034	0.488	0.851	461
Atkinson Index	0.705	0.058	0.509	0.834	461
Palma Ratio	6.457	1.477	3.015	14.434	461
Remittances	4.313	6.817	0.00003	50.818	416
Internet Penetration	7.676	10.153	0.031	54.260	453
Government Expenditure	14.664	5.943	4.157	63.935	415

S.D: Standard Deviation.

Appendix 4 : Correlation matrix (uniform sample size : 144)

	Inclusive education		Inequality				Control variables		
	PSSE	TSE	Gini	Atkinson	Palma	Credit	Remit	Internet	Gov. Exp.
PSSE	1.000								
TSE	0.570	1.000							
Gini	0.332	0.202	1.000						
Atkinson	0.211	0.202	0.898	1.000					
Palma	0.302	0.187	0.964	0.934	1.000				
Credit	0.453	0.317	-0.035	-0.048	-0.026	1.000			
Remit	0.154	0.080	0.089	0.109	0.086	0.082	1.000		
Internet	0.542	0.807	0.114	0.049	0.072	0.529	0.075	1.000	
Gov. Exp.	0.118	0.292	0.145	0.129	0.174	0.090	0.019	0.230	1.000

PSSE: Primary and Secondary School Enrolment. TSE: Tertiary School Enrolment. Gini: the Gin coefficient. Atkinson: the Atkinson index. Palma: the Palma ratio. Remit: Remittances. Credit: Private Domestic Credit.

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