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Governance and Structural Transformation in Africa: Thresholds of Lifelong Gender Inclusive Education

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Governance and Structural Transformation in Africa: Thresholds of Lifelong Gender Inclusive Education

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Abstract

The present research is focused on how lifelong gender inclusive education moderates the effect of governance on structural transformation. It is based on a sample of forty-one countries in Africa for the period 2004 to 2021 and the adopted empirical strategy is the generalized method of moments (GMM). The estimation exercise is tailored such that lifelong gender inclusive education in interacted with political (i.e., political stability/no violence and voice & accountability), economic (i.e., government effectiveness and regulatory quality) and institutional (i.e., corruption-control and the rule of law) governance dynamics in order to affect manufacturing value added. Lifelong gender inclusive education is understood as the combined knowledge acquired in terms of gender parity education in primary, secondary and tertiary schools. The following findings are established. (i) Gender inclusive lifelong learning does not effectively moderate political governance and associated components (i.e., political stability/no violence and voice & accountability) as well as institutional governance and associated components (i.e., corruption-control and the rule of law) in order to improve manufacturing value added. (ii) Gender inclusive lifelong learning effectively moderates economic governance and associated dimensions (i.e., government effectiveness and regulatory quality) to improve manufacturing value added. However, only the thresholds corresponding to government effectiveness and economic governance are within policy range. Robustness of the findings is broadly confirmed, especially within the remits of additional elements in the conditioning information set and general governance. Policy implications are discussed.

Keywords: Governance, gender inclusion, lifelong learning, structural transformation
JEL Classification : E60 ; F40 ; F59 ; D60 ; O55

1.Introduction

The present study is positioned on the importance of lifelong gender inclusive education in moderating the incidence of governance on structural transformation in Africa. The focus of the study is motivated on three main elements in the corresponding scholarly and policy literature on the subject, notably: (i) the evolving importance of gender inclusive education, especially in the light of the common world goals such as the United Nations' 2030 sustainable development goals (SDGs) agenda; (ii) the relevance of governance in promoting structural transformation in Africa and (iii) gaps in the attendant literature focusing on structural transformation and economic development in the sub-region. The underlying elements are expanded in the same chronology as highlighted in what follows.

First, the importance of gender inclusion in sustainable development goals (SDGs) was highlighted by the 2023 Nobel Prize in Economics, which recognized the role of gender-inclusive economic participation in achieving prosperity. Accordingly, in the light of recent stylized facts, not involving women in formal economic activities leads to substantial loses in term of economic prosperity, especially as it pertains to loss in gross domestic product (GDP). To put this point into greater perspective, it is worthwhile to note that the World Bank estimates that the non-involvement of women in the formal economic sector leads to approximately 160 trillion USD of losses in terms of annual GDP (Ostry et al., 2018; World Bank, 2019; Osinubi & Asongu, 2021). The underlying narrative is consistent with Abney and Laya (2018) who have posited that by involving more women in the formal economic sector, by 2025, global GDP could increase by as much as $28 trillion. In the same vein, according to Ifelunini *et al*. (2022), achieving about half of potential economic development is only feasible if women are provided with equal opportunities of engaging in the formal economic sector. Moreover, contemporary gender inclusive education literature on Africa has focused on *inter alia*, inclusive education and health performance (Kouladoum, 2023), globalization in gender inclusive education for economic development (Asongu et al., 2024), understanding challenges and opportunities of gender equity in education (Kuteesa et al., 2024) and assessing country attainment of country gender education equality performance (Bennell, 2023).

Second, in accordance with the extant literature (Akpa & Asongu, 2023; Saba *et al*., 2023), governance is relevant in providing a conducive environment for economic prosperity, especially as it pertains to structural transformation which is vital for the economic development of countries in Africa. Accordingly, elements of political, economic and institutional

governance are essential in driving structural transformation in the sub-region, not least because, *inter alia*: (i) the proper election and replacement of political leaders (i.e., political governance), (ii) effective policies for the delivery of public commodities to the population (i.e., economic governance) as well as (iii) the respect by citizens and the State of institutions that govern interactions between them; are essential in promoting an enabling environment for economic activities that drive economic prosperity and by extension, the much needed structural transformation that go hand-in-glove with economic development. The underlying narrative on the importance of governance in driving various dynamics of economic development is broadly consistent with the extant governance-centric literature on the subject (Anthony-Orji *et al*., 2019; Amavilah *et al*., 2017; Ongo Nkoa & Song, 2020; Saba *et al*., 2023; Akpa & Asongu, 2023). The focus of this study as posited in the first paragraph of the introduction is also motivated by an apparent gap in the extant literature on the subject.

Third, to the best knowledge, the extant structural transformation literature, especially is it relates to the concern linked to the development of Africa has not focused on the problem statement being examined in the present exposition. Accordingly, the extant literature has largely been concerned with *inter alia*: the nexus between governance and structural transformation (see Section 2.1) (Kraipornsak, 2018; Nguyen & Trinh, 2018; Awan *et al*., 2018; Fraj *et al*., 2018; Boţa-Avram *et al*., 2018; Nguyen *et al*., 2019; Thanh *et al*., 2019; Ouhirra & Sabri, 2019; Ahmed et al., 2021; Sun, 2021; Aminu et al., 2022) on the one hand and on the other, linkages between inclusive education and structural transformation (see Section 2.2) (Nowak & Dahal, 2016; Pastor *et al*., 2018; Raheem *et al*., 2018; Adedeji & Adeniyi, 2019; Oyinlola & Adedeji, 2019; Morris & Oldroyd, 2020; Hanushek & Woessmann, 2020; Widarni & Bawono, 2021; Tasseva, 2021; Adeniyi *et al*., 202; Adeleye *et al*., 2022; Saldanha *et al*., 2022).

In the light of the extant literature discussed in Section 2, it is apparent that the problem statement being considered within the remit of the present exposition has not been engaged in the extant literature. Accordingly, while there is a bulk of literature on the importance of inclusive education in structural transformation on the one hand (Nowak & Dahal, 2016; Pastor *et al*., 2018; Adeniyi *et al*., 2021) and on the other, the importance of governance in structural transformation, the extant literature is scant on the relevance of inclusive education in moderating the influence of governance on structural transformation. Moreover, the present exposition goes a step further by conceiving and appreciating education within the framework

of lifelong gender inclusive education. The conception of education in terms of lifelong gender inclusive education has two rewarding features in the light of the engaged extant literature.

On the one hand, contrary to the extant literature discussed in Section 2, the present study is not based on linear linkages between macroeconomic factors and structural transformation. Accordingly, the present study argues that while such linear linkages are worthwhile for policy implications, non-linear nexuses are even more worthwhile, especially when considered within the remit of interactive regressions such that moderating variables exercise an influence in the incidence of the main channel or mechanism on the outcome variable. Accordingly, within the framework of the present study, to close the identified research gap, the regressions are tailored such that the thresholds at which the moderators influence that main channel to influence the outcome variable in the targeted direction are assessed. Put in more perspective, the study aims to assess what thresholds of gender inclusive lifelong learning affect the incidence of governance on structural transformation it the sampled countries.

On the other hand, the concept of lifelong learning, especially within the remit of gender inclusive lifelong learning has not been overly employed in attendant literature. This is essentially because, in accordance with the extant literature (Tchamyou, 2020), such measurement of lifelong learning is not apparent in developing countries owing to data availability constraints. Accordingly, in this study, still building on the extant literature (Asongu & Tchamyou, 2019), lifelong learning is conceived and measured as the education acquired throughout a measurable education life cycle of the person. By measurable education life cycle, in accordance with the attendant literature, reference is being made to primary, secondary and tertiary education enrolments (Tchamyou, 2020).

In the light of the above, the present study contributes to the extant literature by assessing how gender inclusive lifelong learning moderates the incidence of governance on structural transformation in Africa. It follows that the corresponding research question being considered is the following: how does gender inclusive lifelong learning moderate the incidence of governance on structural transformation in Africa? To respond to the question, thresholds of gender inclusive lifelong learning that influence the nexus between governance and structural transformation are provided in this study. Thresholds are significant for policy makers because they provide actionable critical levels of the policy or moderating inclusive education variables that policy makers can act upon in order to influence the nexus between governance and structural transformation in the targeted direction.

The remainder of the study is structured in the following manner. The extant literature and corresponding theoretical underpinnings as well as the relevant testable hypotheses are covered in Section 2 while Section 3 is focused on the data and methodology. Section 4 is concerned with the empirical results whereas Section 5 concludes with implications and future research directions.

2.Literature review and hypothesis development

2.1. Governance and structural transformation in Africa

In order to examine the relationship between governance and structural change in Africa, Ahmed *et al*. (2021) have used six indices of governance quality: government effectiveness, rule of law, control of corruption, political stability and absence of violence/terrorism, regulatory quality, and voice of accountability. Using the Generalized Method of Moments (GMM) and Generalized Least Squares regressions, they take into account 46 SSA nations between the years 1996 and 2016. The findings indicate that only improved government performance has a beneficial impact on the value added to the three sectors of economies in SSA (agricultural, industrial, and service), consisting of a proxy for structural change. Aminu *et al*. (2022) use the System GMM technique to focus on economic growth for 50 African countries from 2002 to 2020 in order to investigate the impact of good governance on structural transformation. The empirical results show that every measure of good governance, with the exception of government effectiveness (which is positive but statistically insignificant) is positive and statistically significant in influencing the rate of economic growth in the region.

Farooque and Sun (2021), using the GMM to account for endogeneity issues and unobserved heterogeneity, investigate the effect of corruption and macro-level governance on economic prosperity for 40 Sub-Saharan African and Middle Eastern and North African (MENA) countries over the period of 2003–2014. There is growing interest in nexuses between corruption, national governance and economic growth. The empirical findings demonstrate that the governance index greatly increases economic growth and, consequently, structural transformation. On the other hand, corruption has a very detrimental impact on economic expansion. Additionally, population and foreign direct investment have a beneficial impact on economic growth, whereas trade openness and educational attainment reveal a discouraging effect.

According to Nguyen *et al*. (2019), structural development in Vietnamese provinces is highly influenced by provincial governance and public administration as measured by transparency,

accountability, and the provision of public services. Additionally, Thanh *et al*. (2019) used sequential (two-stage) estimates to investigate public spending, public governance, and economic growth at the provincial level in Vietnam from 2006 to 2015. The study comes to the conclusion that good governance, which is exemplified by various characteristics like greater transparency, lower informal charges, and unbiased policy, plays a fundamental role in enhancing the effect of government expenditure on economic prosperity in Vietnamese provinces, especially via its linkages with private sector investment. Ouhirra and Sabri (2019) study a sample of four nations, namely Morocco, Algeria, Tunisia, and Turkey, with the aid of the fixed effects technique. The findings indicate that democracy and structural change brought about by economic growth are positively and significantly correlated.

In a similar vein, Awan *et al*. (2018) use panel data for the years 1996 to 2014 to analyze the relationships between governance, corruption, and structural transformation as evidenced by economic growth in five South Asian Association for Regional Cooperation (SAARC) nations: Bangladesh, India, Nepal, Pakistan, and Sri Lanka. Fixed effects panel regression analysis revealed that in a few SAARC nations, government effectiveness has a positive and significant impact on structural transformation through economic growth. In contrast to the aforementioned, Nguyen and Trinh (2018) demonstrated that human capital has a major impact on the growth of productivity in Vietnamese provinces whereas spending at the local level does not significantly influence economic growth. Based on a panel of 50 experts, Fraj *et al*. (2018) analyzed governance and economic growth with an emphasis on the role of exchange regime throughout the period of 1996–2012. According to the findings, exchange rate flexibility greatly destabilizes developing economies and quickens the structural transformation of industrialized countries, but governance is not very significant in explaining economic development and structural change.

Kraipornsak (2018) compared the degree of governance in Thailand and a select number of other Asian nations. The outcome demonstrated that strong governance can also be a significant element that leads to structural change through the growth of income per head, in addition to growth in total factor productivity and in capital per head. The causal nexuses among economic growth, macro-level governance, and sustainable development in 136 countries from 2006 to 2015 is examined by Boţa-Avram *et al*. (2018). They consistently present data showing that improved governance has a major favorable impact on structural transformation, as measured by economic growth.

2.2 Inclusive education and structural transformation in Africa

According to empirical research, not all educational levels significantly affect structural change brought about by economic growth. Following the work of Adeniyi *et al*. (2021), higher education has a greater impact on structural change as well as economic progress. However, because they serve as the cornerstone for university education, the significance of basic and secondary education should not be discounted. Using ordinary least squares (OLS), Nowak and Dahal (2016) found a positive correlation between education and economic growth in their study on the impact of education on economic growth in Nepal. They demonstrate that higher education has the greatest impact on growth, whilst primary education has less of an impact. The reason tertiary education institutions contribute more to growth than primary and secondary schools do, is because of the knowledge and skills they teach. The abilities required for greater economic output are still not thought to be properly possessed by people with only an elementary education. Research and development (R&D) are one of the ways that education helps the economy flourish. According to Pastor *et al*. (2018), higher educational institutions' R&D into technical capital serves as a substantial source of growth in European nations.

Due to the fact that some nations with strong growth rates nonetheless exhibit significant levels of poverty and unemployment, recent attention has been turned toward inclusive growth. More significantly, Raheem *et al*. (2018) show that inclusive growth is relevant at the global, regional, and national levels. For instance, Adedeji and Adeniyi (2019) find that, with the exception of Burkina Faso, in all countries in the ECOWAS region, primary school enrollment strongly influenced inclusive growth. In a similar vein, Oyinlola and Adedeji (2019) demonstrate how human capital favorably impacts inclusive growth in the SSA area. Additionally, according to Raheem *et al*. (2018), education spending has a big impact on the expansion of inclusion in the SSA region.

Tasseva (2021) recently demonstrated that the extension of education worsens economic inequality in Great Britain by giving high- and middle-income households a disproportionate share of income gains. Indeed, it is more challenging to intuitively understand the favorable relationship between increased educational opportunities and wealth inequality. The evidence of a positive link runs counter to current education policy, which is largely predicated on expanding education as a way to address income disparity. They are not as immediately logically consistent as those arguing a negative relationship.

A study on the dynamics of economic prosperity and human capital in the Middle East and North African countries is conducted by Adeleye *et al*. (2022). The study uses two indices of

human capital, life expectancy at birth and educational enrollment, on an imbalanced panel data of 19 MENA nations covering the years 1980 to 2020. The results show that both measures of human capital positively affect economic growth. Further analysis of the results reveals that life expectancy appeared to be the most powerful human capital indicator. Saldanha *et al*. (2022) use data of cross-sectional nature from a sample of 186 Credit Unions in the USA to find that economic growth is positively attenuated by market intensity and human capital and market intensity.

Human capital is to be considered as a fundamental component driving economic growth since, according to Morris and Oldroyd (2020), human resources quality has an influence on economic prosperity by increasing employees, income, and welfare. According to Hanushek and Woessmann (2020), the knowledge capital of workers in both developed and developing nations has a significant influence on economic prosperity. The authors caution that in developing nations, debates of development strategy frequently oversimplify and misrepresent this reality by putting too much emphasis on making sure everyone has access to education while ignoring the value of high-quality instruction. Their reported findings suggest that knowledge, rather than just the amount of time spent in school, is the component responsible for economic progress. Widarni and Bawono (2021) investigate the long-term relationship between economic growth and its drivers as well as the effects of technology and human resources on economic growth both in the short and long terms. They do this by using annual data from Indonesia for 35 years as the basis for their study. The authors come to the conclusion that while effective technology drives economic growth in both the long and short runs, human capital is more successful at supporting economic growth over the long term.

2.3 Theoretical underpinnings and hypothesis development

This section is discussed in three main strands, especially as it pertains to: (i) the theoretical underpinnings motivating the study, in the light of nexuses between inclusive education, governance and structural transformation; (ii) the contextualization of the theoretical underpinnings and (iii) statement on the testable hypothesis building on the stated theoretical underpinning as well as the corresponding contextualization covered in previous sections. The underlying points are discussed in the same chronology as highlighted in what follows.

First, from a theoretical standpoint, there are two main theories that motivate the positioning of the study, especially as it relates to assessing to the manner gender inclusive lifelong learning affects how governance influences structural transformation in an economy. The attendant theoretical underpinnings which are largely drawn from the extant literature include: the theory

of innovative growth from Schumpeter and the endogenous growth theory (Amavilah *et al*., 2017; Hasan & Bousrih, 2020).

On the one hand, concerning the innovative growth theoretical underpinnings from Schumpeter, it is relevant to point out that, with respect to the theoretical premise, an economic sphere is a fundamental driving process of learning that is worthwhile in bringing about the much needed structural transformation, especially when channeled via governance mechanisms such as political (voice & accountability and political stability/no violence), economic (government effectiveness and regulatory quality) and institutional (the rule of law and corruption-control) governance perspectives. Changes in the economic sphere as articulated by the theoretical underpinnings can thus, be worthwhile from interactions between gender inclusive lifelong learning and various components of governance (i.e., political, economic and institutional). Accordingly, such nexuses can be considered as driving entrepreneurial innovation which is fundamental in boosting structural transformation within an economy (Amavilah *et al*., 2017; Hasan & Bousrih, 2020).

On the other hand, another theoretical premise from which to assess the linkages being considered within the remit of the present exposition is the endogenous growth theory. According to the attendant theoretical exposition, structural transformation and by extension, economic development is fundamentally driven by interactions between macroeconomic and microeconomic factors that are within the country. Within the remit of the present exposition, the main channel considered (i.e., governance dynamics) as well as the corresponding moderator (i.e., gender inclusive lifelong learning) are factors that are domestically-oriented for the most part. It follows that the endogenous growth theory is relevant for the present exposition because both governance and gender inclusive lifelong learning are determined by domestic policies. Put in other words: (i) gender inclusive lifelong learning can influence how the election and replacement of political leaders (i.e., political governance, entailing voice & accountability and political stability/no violence) affect structural transformation. (ii) In the same vein, gender inclusive lifelong learning can also affect the manner in which economic governance (i.e., the formulation and implementation of measures that deliver public commodities, encompassing, government effectiveness and regulatory quality) affects structural transformation. (iii) Gender inclusive lifelong learning can also influence how institutional governance (i.e., the respect by the State and institutions that govern interactions between them, proxied with corruption-control and rule of law) affects structural transformation within the remit of manufacturing added value (Amavilah *et al*., 2017; Hasan & Bousrih, 2020).

In the second strand on contextualizing the theoretical underpinnings, it is important to acknowledge that this corresponding strand essentially consists of aligning the theoretical underpinnings to the context of the study, especially as it pertains to the adoption of the moderating variable, the main channels or mechanisms and the outcome variable. Accordingly, in the light of the motivation of the study as well as the corresponding theoretical elements discussed in the preceding paragraph, the purpose of the study is to assess how lifelong gender inclusive education moderates the relevance of governance dynamics on structural transformation within the remit of manufacturing added value. The choice of the moderator (i.e., gender inclusive lifelong learning) as well as the corresponding mechanism (i.e., governance) is consistent with the two theoretical underpinnings discussed above, especially as it relates to Schumpeter's theory on innovation as well as the complementary endogenous growth theory. In contextualizing the underlying theoretical exposition, there is an attendant assumption that good governance can be complemented with human capital in order to affect economic development by means of structural transformation. The corresponding independent variables of interest are domestically-driven on thus, are consistent with the endogenous theory of economic development, not least, because the outcome of structural transformation is also internally or domestically-driven. It follows that, as far as contextualizing the theoretical underpinnings is concerned, there is an assumption that education and governance are fundamental in transforming an economy structurally.

The highlighted contextualizing is also consistent with contemporary governance literature (Saba *et al*., 2023). Accordingly, it has been posited by Saba *et al*. (2023) that the knowledge economy and governance are essential in boosting productivity and structural transformation within an economy, especially as it concerns incremental prospects from various economic sectors such as the manufacturing sector, considered within the remit of the present exposition as the main outcome variable. Put in other words, in accordance with Saba *et al*. (2023), intersectoral development influences the government to formulate and implement relevant policies that allow similar economic activities in the agriculture and industrial sectors to run smoothly. It stems from the basic assumption that governance dynamics within the purview of political, economic and institutional governance prospects will likely influence economic development within an economy and even more so when such governance policies are complemented with human capital policies such gender inclusive lifelong learning.

The third strand in this section, which involves the corresponding testable hypothesis is formulated on the basis of the previous strands, especially in the light of the theoretical

underpinnings on the one hand and on the other, the attendant theoretical underpinnings contextualization within the remit of the study. The underlying motivates the following testable hypothesis that is considered within the empirical analysis section of the study:

Hypothesis 1: Lifelong gender inclusive education moderates governance to positively affect structural transformation.

Whether the testable hypothesis withstands empirical scrutiny is a question is empirical validity which is assessed in Section 3.

3.Data and methodology

3.1 Data

Consistent with the elements of the motivation discussed in the introduction and subsequently in Section 2 of this study, the research is concerned with 41 countries in Africa building on data for the period 2004-2021. Accordingly, the choice of the sampled countries as well as the corresponding periodicity is contingent on data availability at the time of the study. The relevant data are obtained from two main sources, notably: (i) World Development Indicators of the World Bank and (ii) World Governance Indicators of the World Bank. In essence, the attendant governance indicators are sourced from the latter whereas the outcome variable, independent moderator variable of interest and control variables are obtained from the former source. Moreover, the moderator which is gender inclusive lifelong education is derived from principal components analysis (PCA). Accordingly, the indicators employed in the PCA from which the lifelong learning indicator is derived are from the World Development Indicators of the World Bank.

In the light of the above, consistent with the extant literature (Tchamyou, 2020), gender inclusive lifelong learning is defined as gender inclusive knowledge acquired throughout the educational life cycle. By educational life cycle, we are referring to primary education, secondary education and tertiary education. It is also worthwhile to articulate that the three levels of education are taken into account because consistent with the extant African-centric education literature (Asiedu, 2014), all three levels of education are important in order to understand how educational dynamics affect economic development, especially when economies are at the initial phase of industrialisation as it is the case with most of the sampled countries in the present exposition.

Given this insight, it is apparent from the Table 1 (i.e., showing the PCA) that about 83% of information from the retained first principal component is information from the three education

levels considered in the measurement of the lifelong learning indicator. In other words, about 83% of females that start primary school end-up going through tertiary school. It is worthwhile to note that the information criterion used for the retention of the first principal component (PC) is the Kaiser 1 criterion which is the position that the eigen value should be higher than one (Tchamyou, 2020). This criterion is consistent with the choice of the lifelong learning indicator in Table 1 because the corresponding first principal component represents an eigenvalue of 2.515. The remaining eigenvalues for the first and second principal components are respectively, 0.430 and 0.053 which do not meet the Kaiser 1 criterion used in the retention of principal components.

Still in accordance with elements of the motivation and in line with the relevant literature (Asongu & Odhiambo, 2022; Asongu *et al*., 2022), manufacturing value added is employed to proxy for structural transformation. Moreover, six governance variables are employed in accordance with the extant governance-centric literature. This includes: (i) political governance (i.e., captured with political stability/no violence and voice & accountability); (ii) economic governance (i.e., understood within the remits of government effectiveness and regulatory quality) and (iii) institutional governance (i.e., conceived in terms of corruption-control and the rule of law). Building on elements in Section 2, especially as it pertains to contextualizing the governance indicators within the remit of the study, we leverage on the relevant governance-centric literature (Tchamyou, 2021) to define: (i) political governance as the election and replacement of political leaders; (ii) economic governance is understood as the formulation and implementation of policies designed to deliver public commodities while (iii) institutional governance is understood as the respect by the State and citizens of institutions that govern interactions between them.

It is important to note that the same information criterion used for retaining the first principal component in the gender inclusive lifelong learning indicator in Table 1 is the same as that employed in Table 2 for the retention respectively of, the political governance, economic governance, institutional governance and general governance composite indicators.

In the light of the above, it is apparent that the main outcome variable is manufacturing value added which is used to measure structural transformation while the main channel or mechanism is governance. Moreover, the moderating or policy variable is gender inclusive lifelong learning. In order to account for variable omission bias and thus, avoid estimations that are not robust, some variables are involved in the conditioning information set. While in the main regressions, the mobile phone is used as the main control variable, in the robustness checks four main control variables are employed. The choice of the attendant control variables is consistent

with the extant literature on structural transformation, economic development and productivity (Dreher *et al*., 2008; Bicaba *et al*., 2017; Asongu *et al*., 2020a, 2020b, 2022c; Efobi *et al*., 2019; Tifuh, 2022; Asongu & Odhiambo, 2023). Consistent with the attendant literature, mobile phones are expected to positively affect structural transformation, not least, because they offer valuable opportunities for economic activities that are associated with positive externalities in terms of economic development. The expected signs of the remaining four control variables which are employed distinctly in the specifications in the robustness check section are discussed in Section 4.2 when they are employed. It is worthwhile to emphasis that the use of one control variable in each specification is consistent with the extant GMM-centric literature, especially as it pertains to the choice between a valid model and control for variable omission bias (Osabuohien & Efobi, 2013; Asongu & Odhiambo, 2020).

The list of sampled countries is disclosed in Appendix 1, while the definitions of the variables and corresponding sources are provided in Appendix 2. Appendix 3 discloses the attendant summary statistics whereas the correlation matrix is provided in Appendix 4.

Table 1. Principal Component Analysis (PCA) for Inclusive Education (Educatex)

Principal Components	Component Matrix (Loadings)			Proportion	Cumulative Proportion	Eigen Value
	PSE	SSE	TSE			
First PC (Educatex)	0.579	0.616	0.533	0.838	0.838	2.515
Second PC	-0.560	-0.173	0.810	0.143	0.982	0.430
Third PC	0.5914	-0.768	0.245	0.018	1.000	0.053

PC. Principal Component. PSE. School enrollment, primary and secondary (gross), gender parity index (GPI). SSE. School enrollment, secondary (gross), gender parity index (GPI). TSE. School enrolment, tertiary (gross), gender parity index (GPI).

Table 2. Principal Component Analysis (PCA) for Composite Governance

Principal Components	Component Matrix (Loadings)						Proportion	Cumulative Proportion	Eigen Value
	VA	PolS	GE	RQ	CC	RL			
First PC (Ggov)	0.379	0.365	0.429	0.416	0.415	0.438	0.809	0.809	4.859
Second PC	-0.196	0.878	-0.224	-0.362	0.061	-0.057	0.071	0.881	0.428
Third PC	0.879	0.088	-0.303	-0.103	-0.303	-0.152	0.059	0.941	0.358
First PC (Polgov)	0.707	0.707					0.809	0.809	1.618
Second PC	0.707	-0.707					0.1909	1.000	0.381
First PC (Ecogov)			0.707	0.707			0.949	0.949	1.898
Second PC			0.707	-0.707			0.050	1.000	0.101
First PC (Instgov)					0.707	0.707	0.941	0.941	1.883
Second PC					0.707	-0.707	0.058	1.000	0.116

PC. Principal Component. va: Voice & Accountability. pols: Political Stability. polgv: Political Governance. ge: Government Effectiveness. rq: Regulation Quality. ecogov: Economic Governance. cc: Corruption and control. rl: Rule of Law. instgov: Institutional Governance. ggov: General Governance.

3.2 Methodology

Building on the extant GMM-focused studies on economic development, inter alia, Nyasha *et al*. (2021), Saba *et al*. (2023) and Asongu *et al*. (2023), the outcome variable in this study is manufacturing value added that is employed as a proxy for structural transformation. In accordance with Barro's standard economic development model, the dependent variable is lagged on the right-hand side of Equation (1) in order to articulate the persistent nature of the specification and by extension the outcome variable.

$$y_{it} = \alpha_{it} + \vartheta_i + \rho_t + \gamma(X_{it}) + \varepsilon_{it} \quad (1)$$

where, y is the outcome indicator or manufacturing value added; X represents the vector of explanatory variables (governance, inclusive lifelong learning, mobile phones, GDP per capita growth, population growth, private credit and urbanization); γ shows a scalar vector of parameters; and ε denotes the error term. Subscripts "i" and "t" show time and country, respectively, such that $t = 1, \ldots, T; i = 1, \ldots, N$. Moreover, T reflects the observations that are apparent across time whereas N denotes the number of individuals sampled. Furthermore, ϑ_i and ρ_t reflect respectively country- and time-specific effects. Note should be taken of the perspective that from a pragmatic angle, it is difficult to find independent variables that reflect strict exogeneity. It follows that some of the independent indicators in the structural transformation model may have components that are endogenous, which could also be contingent on non-contemporary characteristics of the attendant variables. In order to take the underlying concern into account, a lagged manufacturing added value is introduced into the model, in line with the extant literature (Arellano & Bond, 1991; Fayissa *et al.,* 2008; Nyasha *et al*., 2021). Hence, Equation (1) can be rewritten in Equation which because of simplicity is available upon request.

Given the above, the analytical technique used in the present exposition is consistent with Roodman (2009) which is an amelioration of the Arellano and Bover (1995) GMM-centric approach in difference. It is worthwhile to emphasize that a plethora of advantages are consistent with the Roodman (2009) empirical approach, *inter alia*: control for cross sectional dependence, accounting for the unobserved heterogeneity, employment of internal instruments to account for simultaneity or reverse causality and restricting instrument proliferation (Boateng *et al*., 2018; Tchamyou *et al*., 2019a, 2019b; Asongu & Odhiambo, 2018, 2019).

Concerning the identification and exclusive restrictions, the study is consistent with the extant literature in considering all the main channels (i.e., governance), moderator (gender inclusive

education), and control variables as endogenous explaining while the time fixed effects are acknowledged as strictly exogenous because in accordance with the extant literature (Tchamyou & Asongu, 2017), it is not feasible for time fixed effects to be endogenous after a first difference.

4.Empirical analysis

4.1 Empirical results

The empirical results are provided in this section in Tables 3, 4 and 5. While Table 3 shows findings on nexuses between political governance, lifelong learning and structural transformation, Table 4 shows the corresponding results on linkages between economic governance, lifelong learning and structural transformation. In the same vein, the findings provided in Table 5 pertain to connections between institutional governance, lifelong learning and structural transformation.

It is worthwhile to note that the purpose of the study is to assess how gender lifelong learning influences the incidence of governance on structural transformation in the sampled countries. It follow that in accordance with the extant literature based on interactive regressions (Nchofoung & Asongu, 2022a, 2022b; Nchofoung et al., 2021, 2022), in order to assess the moderating role of gender inclusive lifelong learning in the incidence of governance on the outcome variables, net effects and/or thresholds should be computed in order to avoid interpreting the estimated coefficients as in linear additive models and thus avoiding the pitfalls of interactive regressions documented in Brambor *et al.* (2006). Prior to discussing the computation of the relevant gender inclusive lifelong thresholds, it is pertinent to provide insights into the information criteria that is employed to assess the validity of estimated coefficients in what follows.

In accordance with the extant GMM-oriented studies (Asongu *et al*., 2023), four essential criteria of information are employed to assess whether the estimated coefficients are valid or not. First of all, the Arellano and Bond first order test for autocorrelation should display non-significance whereas the corresponding second order test should show plausible significance. When the two underlying conditions are met, it is said that there is an absence of autocorrelation in the residuals. Second, the employed internal instruments also have to be valid and hence, it is essential that the corresponding Sargan and Hansen tests for overidentification restrictions fail to be valid. This is for the most part because the null hypotheses of the attendant tests are positions that the instruments are valid. Hence, the corresponding null hypotheses should not be rejected in order for the considered internal instruments to display some form of validity. In

event of conflict of interest between the Sargan test and the Hansen test, there is a leaning for the Hansen test because it is more robust, though often weakened by the proliferation of instruments. The corresponding concern of instrument proliferation is mitigated by making sure that in every specification, the number of groups or countries are higher than the corresponding number of instruments.

Third, further to the Hansen and Sargan tests, the Difference in Hansen (DHT) is also employed to assess if the considered instruments exhibit strict exogeneity by clarifying the outcome variable or manufacturing value added exclusively within the remit of the engaged mechanism, moderating and control variables. It is imperative to highlight that the independent variable of interest constitutes the considered governance dynamics whereas the moderating indicator is lifelong gender inclusive education. Accordingly, the null hypothesis of the DHT should not be rejected in order for the instruments to display strict exogeneity. Fourth, last but not the least, the Fisher statistics is employed to provide insights into the validity of the overall specification. Hence, it should also be significant in order for the estimated model to be overwhelmingly valid.

Having provided insights into the information criterion for the assessment of the testable hypothesis, as well as the corresponding information criteria for the validity of models, it is also pertinent to proceed with a clarification of the gender inclusive lifelong thresholds that are relevant to mitigate the potentially negative incidence of governance on structural transformation. Taking Table 4 as an example, in the second column, it is apparent that government effectiveness has an unconditional negative effect on the outcome variable while the interaction between gender inclusive lifelong education and government effectiveness has a positive effect. It follows that gender inclusive lifelong learning can effectively moderate the negative incidence of government effectiveness on manufacturing added value. Moreover, there is a gender inclusive lifelong learning threshold at which the negative incidence of government effectiveness on manufacturing added value is completely annulled, such that, above that threshold, gender inclusive lifelong learning moderates government effectiveness to have an overall positive impact on manufacturing value added. It follows that policy makers should ensure that gender inclusive lifelong learning exceeds the considered threshold in order for the interaction between gender inclusive lifelong learning and government effectiveness to have a positive effect on manufacturing value added.

Table 3. Political Governance, Lifelong Gender Inclusive Education and Structural Transformation

	Dependent variable: Manufacturing Value Added (MVA)		
	Voice & Accountability	Political Stability	Political Governance
MVA (-1)	**0.976*** **	**0.965*** **	**0.963*** **
	(0.061)	**(0.033)**	**(0.037)**
Educatex	-0.045	-0.159	-0.227
	(0.186)	(0.128)	(0.152)
Voice & Accountability	-0.484		
	(0.297)		
Voice & Accountability x Educatex	**0.328** **		
	(0.141)		
Political Stability		-0.038	
		(0.078)	
Political Stability x Educatex		**0.162*** **	
		(0.051)	
Political Governance			-0.078
			(0.081)
Political Governance x Educatex			**0.118*** **
			(0.037)
Log (Mobile Phone)	0.446	**0.409*** **	**0.393** **
	(0.280)	**(0.121)**	**(0.156)**
Time Effects	Yes	Yes	Yes
Constant	-1.868	**-1.347***	-1.222
	(1.289)	**(0.681)**	(0.736)
Educatex Thresholds	na	na	na
AR (1)	(0.024)	(0.024)	(0.027)
AR (2)	**(0.867)**	**(0.769)**	**(0.774)**
Sargan OIR	**(0.636)**	**(0.758)**	**(0.730)**
Hansen OIR	**(0.945)**	**(0.864)**	**(0.863)**
DHT for instruments			
a)Instruments in levels			
H excluding group	**(0.504)**	**(0.786)**	**(0.688)**
Dif(null, H=exogenous)	**(0.975)**	**(0.745)**	**(0.794)**
b)IV(years, eq(diff))			
H excluding group			
Dif(null, H=exogenous)			
Fisher	**108129.60*** **	**4470000*** **	**657872.42*** **
Instruments	35	35	35
Countries	36	36	36
Observations	266	266	266

***, ** , *: respectively denote the 1%, 5% and 10% levels of significance. DHT: shows the Difference in Hansen Test used to assess the Exogeneity of Instruments Subsets. OIR: Over-identifying Restrictions Test. Dif: Difference. Bold values have two principal significances. On the one hand, the significance of the Fisher statistics and estimated coefficients. On the other hand, the non-rejection of the null hypotheses of: (a) autocorrelation absence in the AR(1) & AR(2) tests and; (b) the instruments that are valid based on the Sargan and Hansen OIR tests. For the estimated coefficients, values in parentheses reflect standard errors while for the information criteria (i.e., AR, Sargan, Hansen, DHT and IV tests), p-values are disclosed. na: not applicable given that at least one estimated coefficient that is indispensable for the computation of net effects does not reflect significance.

Table 4. Economic Governance, Lifelong Gender Inclusive Education and Structural Transformation

	Dependent variable: Manufacturing Value Added (MVA)		
	Government Effectiveness	Regulation Quality	Economic Governance
MVA (-1)	**1.016*** **	**1.093*** **	**1.021*** **
	(0.042)	**(0.054)**	**(0.042)**
Educatex	**0.531*** **	0.152	-0.009
	(0.185)	(0.187)	(0.161)
Government Effectiveness	**-1.152*** **		
	(0.278)		
Government Effectiveness x Educatex	**0.454*** **		
	(0.121)		
Regulation Quality		**-1.039*** **	
		(0.298)	
Regulation Quality x Educatex		**0.256** **	
		(0.102)	
Economic Government			**-0.486*** **
			(0.114)
Economic Government x Educatex			**0.190*** **
			(0.053)
Log (Mobile Phone)	0.026	0.115	0.168
	(0.181)	(0.214)	(0.205)
Time Effects	Yes	Yes	Yes
Constant	**-1.152***	**-1.932** **	-0.800
	(0.594)	**(0.765)**	(0.762)
Educatex Thresholds	2.537	4.058	2.557
AR (1)	(0.029)	(0.023)	(0.024)
AR (2)	**(0.950)**	**(0.876)**	**(0.896)**
Sargan OIR	**(0.339)**	**(0.452)**	**(0.607)**
Hansen OIR	**(0.505)**	**(0.445)**	**(0.778)**
DHT for instruments			
a)Instruments in levels			
H excluding group	**(0.478)**	**(0.835)**	**(0.853)**
Dif(null, H=exogenous)	**(0.458)**	**(0.237)**	**(0.577)**
b)IV(years, eq(diff))			
H excluding group			
Dif(null, H=exogenous)			
Fisher	**2680000*** **	**1560000*** **	**2800000*** **
Instruments	35	35	35
Countries	36	36	36
Observations	266	266	266

***, ** , *: respectively denote the 1%, 5% and 10% levels of significance. DHT: shows the Difference in Hansen Test used to assess the Exogeneity of Instruments Subsets. OIR: Over-identifying Restrictions Test. Dif: Difference. Bold values have two principal significances. On the one hand, the significance of the Fisher statistics and estimated coefficients. On the other hand, the non-rejection of the null hypotheses of: (a) autocorrelation absence in the AR(1) & AR(2) tests and; (b) the instruments that are valid based on the Sargan and Hansen OIR tests. For the estimated coefficients, values in parentheses reflect standard errors while for the information criteria (i.e., AR, Sargan, Hansen, DHT and IV tests), p-values are disclosed. na: not applicable given that at least one estimated coefficient that is indispensable for the computation of net effects does not reflect significance. The range of Lifelong Gender Inclusive Education is -4.608 to 2.870.

Table 5. Institutional Governance, Lifelong Gender Inclusive Education and Structural Transformation

	Dependent variable: Manufacturing Value Added (MVA)		
	Control of Corruption	Rule of Law	Institutional Governance
MVA (-1)	**0.968*** **	**0.972*** **	**0.989*** **
	(0.026)	**(0.059)**	**(0.044)**
Educatex	0.025	-0.004	-0.045
	(0.210)	(0.195)	(0.176)
Control of Corruption	-0.398		
	(0.292)		
Control of Corruption x Educatex	0.115		
	(0.183)		
Rule of Law		-0.428	
		(0.294)	
Rule of Law x Educatex		0.088	
		(0.193)	
Institutional Government			-0.207
			(0.142)
Institutional Government x Educatex			0.020
			(0.053)
Log (Mobile Phone)	**0.440** **	**0.352***	0.365
	(0.191)	**(0.208)**	(0.243)
Time Effects	Yes	Yes	Yes
Constant	**-1.808** **	**-1.460***	-1.437
	(0.719)	**(0.777)**	(0.909)
Educatex Thresholds	na	na	na
AR (1)	(0.035)	(0.030)	(0.034)
AR (2)	**(0.743)**	**(0.985)**	**(0.821)**
Sargan OIR	**(0.678)**	**(0.205)**	**(0.389)**
Hansen OIR	**(0.388)**	**(0.798)**	**(0.554)**
DHT for instruments			
a)Instruments in levels			
H excluding group	**(0.543)**	**(0.428)**	**(0.647)**
Dif(null, H=exogenous)	**(0.296)**	**(0.850)**	**(0.419)**
b)IV(years, eq(diff))			
H excluding group			
Dif(null, H=exogenous)			
Fisher	**835035.23*** **	**2990000*** **	**617373.11*** **
Instruments	35	35	35
Countries	36	36	36
Observations	266	266	266

***, ** , *: respectively denote the 1%, 5% and 10% levels of significance. DHT: shows the Difference in Hansen Test used to assess the Exogeneity of Instruments Subsets. OIR: Over-identifying Restrictions Test. Dif: Difference. Bold values have two principal significances. On the one hand, the significance of the Fisher statistics and estimated coefficients. On the other hand, the non-rejection of the null hypotheses of: (a) autocorrelation absence in the AR(1) & AR(2) tests and; (b) the instruments that are valid based on the Sargan and Hansen OIR tests. For the estimated coefficients, values in parentheses reflect standard errors while for the information criteria (i.e., AR, Sargan, Hansen, DHT and IV tests), p-values are disclosed. na: not applicable given that at least one estimated coefficient that is indispensable for the computation of net effects does not reflect significance.

Furthermore, in order for the gender inclusive lifelong indicator to make economic sense and have policy relevance, it should be within the statistical range provided in the summary statistics. The corresponding lifelong gender inclusive education range disclosed in Appendix 3 is -4.608 (i.e., minimum) to 2.870 (i.e., maximum). It follows that in the light of attendant thresholds provided in Table 4, the lifelong gender inclusive education thresholds corresponding to government effectiveness and economic governance make economic sense and are policy-relevant because they are within statistical range whereas the corresponding lifelong gender inclusive education threshold associated with regulation quality (i.e., 4.058)

does not make economic sense because it is above the maximum of the statistical range. Where thresholds cannot be computed, the sign "na" standing for "not applicable" is employed to clarify that the threshold cannot be computed because at least one estimated coefficient relevant for its computation is not significant. For insights into the computations, the thresholds corresponding to government effectiveness, regulatory quality and economic governance in respectively, Column 2, Column 3 and Column 4 of Table 4 are computed as respectively, 2.537 (1.152/0.454), 4.058(1.039/0.256) and 2.557 (0.486/0.190).

Given the provided insights, the following findings can be established for Table 3, Table 4 and Table 5. (i) Gender inclusive lifelong learning does not effectively moderate political governance and associated components (i.e., political stability/no violence and voice & accountability) as well as institutional governance and associated components (i.e., corruption-control and the rule of law) in order to improve manufacturing value added. (ii) Gender inclusive lifelong learning effectively moderates economic governance and associated dimensions (i.e., government effectiveness and regulatory quality) to improve manufacturing value added. However, only the thresholds corresponding to government effectiveness and economic governance are within policy range.

4.2 Robustness checks

In order to further assess the robustness of the findings, the present exposition considers more variables in the conditioning information set, especially as it pertains to accounting for other factors that could not be taken into account when only mobile phone penetration was employed as the main control variables in the baseline specifications. Accordingly, as argued in the data section, not more than one control can be involved in the specifications in order to avoid instrument proliferation even when the collapse option is employed in the specifications. Hence, in addition to mobile phone penetration that is involved in the conditioning information set, four more factors are controlled in order to account for variable omission bias, notably: income levels, population growth, private domestic credit and urbanization. In what follows, the expected signs of the additional factors in the conditioning information set are discussed.

In the light of the above, concerning the expected signs: (i) Levels of income are anticipated to positively influence manufacturing value added (Asongu et al., 2020a), though the attendant sign could also be unexpected when the fruits of economic development within a country or panel of countries are not equitably distributed across the population in order to stimulate structural transformation (Bicaba *et al*., 2017; Tchamyou, 2020; Tchamyou *et al*., 2019; Asongu *et al.*, 2020a). (ii) Consistent with contemporary literature (Osinubi & Asongu, 2021),

population growth is expected to be negatively correlated with manufacturing added value, in light of the premise that the increasing population of Africa has not been linked to growing employment opportunities also related to structural transformation. (iii) As argued by extant literature (Konte, 2023), financial access is relevant in structural transformation, through concerns related to information asymmetry and hence, limited access to finance can also dampen the expected positive nexus (Asongu, 2020). (iv)The height of urbanization is also anticipated to positively affect manufacturing value added, though the corresponding significance can also be contingent on the manner in which it is organized (Raihan et al., 2023).

Table 6. General Governance, Lifelong Gender Inclusive Education and Structural Transformation

	Dependent variable: Manufacturing Value Added (MVA)				
	ICT	Development level	Demographic	Financial access	Urbanization
MVA (-1)	**0.997*** **	**1.067*** **	**1.070*** **	**1.095*** **	**0.924*** **
	(0.047)	**(0.087)**	**(0.083)**	**(0.076)**	**(0.081)**
Educatex	-0.042	0.114	-0.003	0.090	0.118
	(0.216)	(0.087)	(0.121)	(0.143)	(0.120)
General Government	**-0.164***	**-0.174** **	**-0.301*** **	**-0.251** **	-0.127
	(0.088)	**(0.072)**	**(0.077)**	**(0.111)**	(0.076)
General Government x Educatex	**0.072*** **	**0.114*** **	0.042	**0.076***	0.048
	(0.016)	**(0.033)**	(0.030)	**(0.043)**	(0.030)
Log (Mobile Phone)	0.237				
	(0.214)				
GDP per capita growth		-0.021			
		(0.021)			
Population growth			**-0.766** **		
			(0.283)		
Private Credit				0.011	
				(0.016)	
Urbanization					0.005
					(0.008)
Time Effects	Yes	Yes	Yes	Yes	Yes
Constant	-0.971	-0.825	1.323	-1.284	0.537
	(0.723)	(0.894)	(1.236)	(0.904)	(1.027)
Educatex Thresholds	2.277	1.526	na	3.302	na
AR (1)	(0.029)	(0.024)	(0.026)	(0.033)	(0.030)
AR (2)	**(0.907)**	**(0.725)**	**(0.797)**	**(0.875)**	**(0.735)**
Sargan OIR	**(0.488)**	**(0.797)**	**(0.580)**	**(0.940)**	**(0.403)**
Hansen OIR	**(0.785)**	**(0.688)**	**(0.858)**	**(0.987)**	**(0.803)**
DHT for instruments					
a)Instruments in levels					
H excluding group	**(0.661)**	**(0.465)**	**(0.592)**	**(0.824)**	**(0.628)**
Dif(null, H=exogenous)	**(0.696)**	**(0.689)**	**(0.836)**	**(0.970)**	**(0.739)**
b)IV(years, eq(diff))					
H excluding group					
Dif(null, H=exogenous)					
Fisher	**3260000*** **	**580018.77*** **	**358174.05*** **	**5720000*** **	**10000000*** **
Instruments	35	35	35	35	35
Countries	36	36	36	34	37
Observations	266	267	267	256	267

***, ** , *: respectively denote the 1%, 5% and 10% levels of significance. DHT: shows the Difference in Hansen Test used to assess the Exogeneity of Instruments Subsets. OIR: Over-identifying Restrictions Test. Dif: Difference. Bold values have two principal significances. On the one hand, the significance of the Fisher statistics and estimated coefficients. On the other hand, the non-rejection of the null hypotheses of: (a) autocorrelation absence in the AR(1) & AR(2) tests and; (b) the instruments that are valid based on the Sargan and Hansen OIR tests. For the estimated coefficients, values in parentheses reflect standard errors while for the information criteria (i.e., AR, Sargan, Hansen, DHT and IV tests), p-values are disclosed. na: not applicable given that at least one estimated coefficient that is indispensable for the computation of net effects does not reflect significance. The range of Lifelong Gender Inclusive Education is -4.608 to 2.870

The robustness test is also employed with the general governance indicator which is the first principal component of the six main governance dynamics employed in the study, notably: political governance (entailing voice & accountability and political stability/no violence); economic governance (consisting of regulatory quality and government effectiveness) and institutional governance (entailing corruption-control and the rule of law). The general governance indicator is obtained by means of PCA in Table 2. The information criterion for the assessment of the testable hypothesis as well as the validity of the results used in the preceding tables also holds for the robustness test analysis. Accordingly, from the corresponding results provided in Table 6, the robustness of the findings is broadly confirmed, especially within the remits of additional elements in the conditioning information set. These additional elements in the conditioning information set for which the findings are policy-relevant are the second and third columns which have gender inclusive lifelong thresholds that are within statistical range. In the same vein, the corresponding thresholds in the fifth column is not policy-relevant because it is beyond the statistical range. Moreover, the control variables have the expected signs for the most part. Ultimately, the tested hypothesis broadly withstands further scrutiny when more elements are involved in the conditioning information set as well as when general governance is employed as the main channel.

Overall, though the study has complemented the sparse literature on linkages between lifelong learning, governance and structural transformation, the study is broadly consistent with the strand of literature on the relevance of governance in economic transformation (Anthony-Orji *et al*., 2019; Amavilah *et al*., 2017; Ongo Nkoa & Song, 2020; Saba *et al*., 2023; Akpa & Asongu, 2023) as well as the corresponding literature on the pertinence of inclusive education in positive structural change (Nowak & Dahal, 2016; Pastor *et al*., 2018; Adeniyi *et al*., 2021).

5. Concluding implications and future research directions

The present research is focused on how lifelong gender inclusive education moderates the effect of governance on structural transformation. It is based on a sample of forty-one countries in Africa for the period 2004 to 2021 and the adopted empirical strategy is the generalized method of moments (GMM). The estimation exercise is tailored such that lifelong gender inclusive education is interacted with political (i.e., political stability/no violence and voice & accountability), economic (i.e., government effectiveness and regulatory quality) and institutional (i.e., corruption-control and the rule of law) governance dynamics in order to affect manufacturing value added. Lifelong gender inclusive education is understood as the combined

knowledge acquired in terms of gender parity education in primary, secondary and tertiary schools. The following findings are established. (i) Gender inclusive lifelong learning does not effectively moderate political governance and associated components (i.e., political stability/no violence and voice & accountability) as well as institutional governance and associated components (i.e., corruption-control and the rule of law) in order to improve manufacturing value added. (ii) Gender inclusive lifelong learning effectively moderates economic governance and associated dimensions (i.e., government effectiveness and regulatory quality) to improve manufacturing value added. However, only the thresholds corresponding to government effectiveness and economic governance are within policy range. Robustness of the findings is broadly confirmed, especially within the remits of additional elements in the conditioning information set and general governance. Policy implications are discussed in what follows, especially as it pertains to enhancing governance, boosting lifelong learning and improving gender inclusion.

First, while it has been established from the study that governance has a negative unconditional effect on manufacturing added value which is subsequently moderated by gender inclusive lifelong learning in order to positively influence structural transformation, a reason for the underlying negative unconditional nexus, requiring moderation could be that governance quality in the sampled countries has traditionally been established to be comparatively low, relative to developed countries (Amavilah et al., 2017). It follows that, when increasing governance levels, the rewards of governance in terms of structural transformation is very likely to increase. These governance dynamics, relate to *inter alia*, the considered governance dynamics employed in the study, notably: political governance, economic governance and institutional governance.

In the light of the considered first policy implications, it is fair to posit that the corresponding policy implications could be directly adapted to the conception and definition of the relevant governance dynamics: (i) improving political governance especially as concerns the process by which political leaders are elected and replaced which should free and fair; (ii) enhancing economic governance given that policies that are formulated and implemented in view of providing the population with public commodities should be sound and (iii) consolidating institutional governance, especially in the light of strictly observing that the rule of governing interactions between citizens and the State, are respected by the corresponding citizens and the State.

It relevant to further complement the underlying policy recommendation by stating that enhancing governance is considered as a fundamental priority in most countries with relatively

low levels of infrastructure development. This is essentially because when government revenues are mismanaged it leads to less funds being allocated to the relevant manufacturing sector with the ultimate goal of structural transformation. It is also imperative to state that the considered governance focus, embodies both authorities in the government as well as those that are not within the sphere of the State. In summary, given that governance can also be acknowledged as the manner in which public and private commodities are established, it obviously implies that better governance standards will engender higher levels of positive structural change in the sampled countries.

Second, it is also apparent in the study that lifelong learning is essential in the manner in which governance is connected with structural transformation in the sampled countries. As a direct policy implication, citizens in the sampled countries should be encouraged to pursue lifelong learning avenues, in order for the expected benefits of governance (discussed in the previous paragraphs) to be realized in the sampled countries. Hence, people should not just consider ending after primary and secondary education, but should also be encouraged to consider tertiary education and by extension, learning processes even after tertiary education. Corporate social responsibilities of corporations could also consider lifelong learning as a critical measure for corporate success and national economic development. Importantly, lifelong policies should therefore by implemented by both corporations and governments in view of reaching the established gender inclusive lifelong learning thresholds. Beyond the established thresholds and in the presence of good governance dynamics, obviously structural change, productivity and other factors linked to structural transformation will follow.

Third, as seen in the introduction, the absence of women in some sectors of the economy leads to substantial loses in terms of economic development and GDP. These loses can be extended to structural transformation as considered within the remit of the present exposition, not least, because we have seen that manufacturing value added increases when gender inclusive lifelong learning moderates the effect of governance on manufacturing value added. Moreover, given that some thresholds of gender inclusive lifelong learning were worthwhile in order to secure the positive incidence of governance in manufacturing value added, increasing gender parity education at all levels (i.e., primary, secondary and tertiary) of schooling will go a long way to enhancing the manner in which government institutions are designed to structurally transform the sampled economies.

In terms of theoretical implications, the theoretical underpinnings motivating the study are confirmed only when some critical levels of gender inclusive education are attained. In the essence, we have shown that the theoretical underpinnings on the innovative growth theory of

Schumpeter as well as the endogenous growth theory are contingent on some critical levels of gender inclusion in learning, especially as it pertains to how governance affects structural transformation. In essence, from the findings, it is apparent that the highlighted theoretical underpinnings in Section 2.3 are not linear.

This study obviously leaves room for further research, especially in the light of considering how the nexuses engaged affect other macroeconomic factors in Africa in particular and developing countries in general. Moreover, it is essential for other estimation techniques that are constrained by missing data to be employed within the remit of nonlinear estimations. Some examples of these include, *inter alia*: (i) the Panel Threshold Regression technique of Hansen (1999) and (ii) the Panel Smooth Transition Regression approaches of González *et al*. (2005) and González *et al*. (2017). Moreover, as concerns the data, while the most updated year used in the sample is 2021, using more updated data as time unfolds would provide more insights into the investigated nexuses, especially by means of estimation techniques that can accommodate the involvement of more variables in the conditioning information set. Accordingly, when the GMM estimation approach is employed, there is always a choice between having robust models with limited variables in the conditioning information set and having models that are not robust to instrument proliferation because of many variables involved in the conditioning information set.

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Appendices

Appendix 1. List of countries (41) of the study

Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Congo. Dem. Rep., Congo. Rep., Cote d'Ivoire, Djibouti, Egypt. Arab Rep., Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, South Africa, Sudan, Zambia and Zimbabwe	

Source. Authors' construction

Appendix 2. Definitions and sources variables

Variables	Signs	Definitions	Sources
Manufacturing value added	MVA	Manufacturing, value added (% of GDP). Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Note: For VAB countries, gross value added at factor cost is used as the denominator.	WDI (World Bank)
	PSE	School enrollment, primary and secondary (gross), gender parity index (GPI). Gender parity index for gross enrollment ratio in primary and secondary education is the ratio of girls to boys enrolled at primary and secondary levels in public and private schools.	WDI (World Bank)
Inclusive education	SSE	School enrollment, secondary (gross), gender parity index (GPI). Gender parity index for gross enrollment ratio in secondary education is the ratio of girls to boys enrolled at secondary level in public and private schools.	WDI (World Bank)
	TSE	School enrolment, tertiary (gross), gender parity index (GPI). Gender parity index for gross enrollment ratio in tertiary education is the ratio of women to men enrolled at tertiary level in public and private schools.	WDI (World Bank)
Lifelong Gender Inclusive Education	Educatex	First Principal Component of School enrollment, primary and secondary (gross), secondary (gross), and tertiary (gross), gender parity index (GPI).	PCA
Political Stability	PolS	"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".	WDI (World Bank)
Voice & Accountability	VA	"Voice and accountability (estimate): measures the extent to which a country's citizens are able to participate in selecting their government and to enjoy freedom of expression, freedom of association and a free media".	WDI (World Bank)
Political Governance	Polgov	First Principal Component of Political Stability and Voice & Accountability. The process by which those in authority are selected and replaced.	PCA
Government Effectiveness	GE	"Government effectiveness (estimate): measures the quality of public services, the quality and degree of independence from political pressures of the civil service, the quality of policy formulation and implementation, and the credibility of governments' commitments to such policies".	WDI (World Bank)
Regulation Quality	RQ	"Regulation quality (estimate): measured as the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development".	WDI (World Bank)

Economic Governance	Ecogov	"First Principal Component of Government Effectiveness and Regulation Quality. The capacity of government to formulate & implement policies, and to deliver services".	PCA
Rule of Law	RL	"Rule of law (estimate): captures perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police, the courts, as well as the likelihood of crime and violence".	WDI (World Bank)
Corruption and control	CC	"Control of corruption (estimate): captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests".	WDI (World Bank)
Institutional Governance	Instgov	First Principal Component of Rule of Law and Corruption-Control. The respect for citizens and the state of institutions that govern the interactions among them.	PCA
General Governance	Ggov	First Principal Component of Political, Economic and Institutional Governances.	PCA
Log (Mobile Phone)	lmob	Logarithme of the Mobile phone subscriptions (per 100 people)	WDI (World Bank)
GDP per capita growth	Gdppcgrowth	Gross Domestic Product (GDP) per capita growth (% annual)	WDI (World Bank)
Population growth	Popgrowth	Population growth (annual %)	WDI (World Bank)
Private credit	Dcps	Domestic credit to private sector (% of GDP)	WDI (World Bank)
Urbanization	urbangrowth	Urban population (% of total population)	WDI (World Bank)

WDI: World Bank Development Indicators of the World Bank.

Appendix 3. Summary Statistics

Variable	Obs	Mean	SD	Min	Max
Manufacturing value added	671	10.1	5.733	0.233	35.215
School enrollment, primary and secondary	444	0.919	0.107	0.599	1.176
School enrollment secondary	452	0.872	0.179	0.332	1.215
School enrolment tertiary	406	0.712	0.31	0.064	1.494
Lifelong Gender Inclusive Education	310	0.000	1.586	-4.608	2.87
Voice & Accountability	738	-0.605	0.764	-2.226	0.974
Political Stability	738	-0.586	0.905	-2.699	1.201
Political Governance	738	0.000	1.272	-2.662	2.615
Government Effectiveness	738	-0.762	0.581	-1.887	1.161
Regulation Quality	738	-0.691	0.62	-2.282	1.197
Economic Governance	738	0.000	1.378	-3.036	4.487
Rule of Law	738	-0.625	0.61	-1.581	1.161
Corruption and control	738	-0.692	0.615	-1.87	1.024
Institutional Governance	738	0.000	1.373	-2.429	3.487
General Governance	738	0.000	2.204	-4.423	5.77
Log (Mobile Phone)	729	3.716	1.098	-1.577	5.142

S.D: Standard Deviation.

Appendix 4. Correlation matrix

	Dependent variable	Inclusive education				Governance variables										Control variable
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) mva	1.000															
(2) pse	0.095	1.000														
(3) sse	0.072	0.916	1.000													
(4) tse	0.173	0.617	0.785	1.000												
(5) educatex	0.120	0.922	0.980	0.861	1.000											
(6) va	-0.019	0.429	0.453	0.468	0.487	1.000										
(7) pols	0.101	0.450	0.490	0.476	0.511	0.725	1.000									
(8) polgov	0.043	0.473	0.507	0.509	0.537	0.931	0.926	1.000								
(9) ge	0.091	0.571	0.621	0.597	0.646	0.698	0.734	0.771	1.000							
(10) rq	0.152	0.511	0.528	0.503	0.557	0.719	0.700	0.764	0.898	1.000						
(11) ecogov	0.122	0.557	0.593	0.568	0.621	0.727	0.737	0.788	0.978	0.971	1.000					
(12) cc	-0.000	0.596	0.686	0.569	0.671	0.657	0.741	0.752	0.831	0.757	0.817	1.000				
(13) rl	0.057	0.599	0.630	0.574	0.652	0.778	0.788	0.843	0.923	0.870	0.922	0.876	1.000			
(14) instgov	0.029	0.617	0.679	0.590	0.683	0.741	0.790	0.824	0.905	0.840	0.898	0.968	0.969	1.000		
(15) ggov	0.068	0.586	0.633	0.590	0.654	0.840	0.859	0.914	0.941	0.911	0.951	0.901	0.969	0.966	1.000	
(16) lmob	0.103	0.515	0.502	0.426	0.523	0.368	0.211	0.314	0.339	0.388	0.371	0.303	0.327	0.325	0.357	1.000

mva: manufacturing. pse: School enrollment, primary and secondary. sse: School enrollment secondary. tse: School enrolment tertiary. educatex: Lifelong Gender Inclusive Education. va: Voice & Accountability. pols: Political Stability. polgov: Political Governance. ge: Government Effectiveness. rq: Regulation Quality. ecogov: Economic Governance. cc: Corruption and control. rl: Rule of Law. instgov: Institutional Governance. ggov: General Governance. lmob: Log (Mobile Phone).