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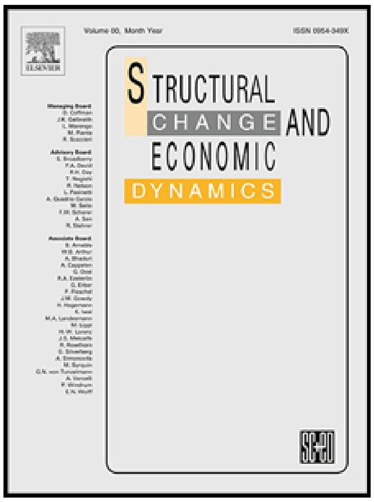

Structural Breaks, Institutional Quality and Productivity Growth in Sub-Saharan Africa

Eunice Adu-Darko , Kefei You

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Highlights

- We assess how institutional quality (IQ) affects TFP growth in SSA in 1986-2019.
- We adopt Rodrik's (2000) concept of market-supporting institutions.
- We consider structural breaks and identify three in 1993, 2002, and 2007.
- IQ contributed to TFP growth in the first three regimes but not in the final one.
- TFP declined in regime one then turned positive growth rate in subsequent regimes

Structural Breaks, Institutional Quality and Productivity Growth in Sub-Saharan Africa

Eunice Adu-Darko
Central University, Ghana

Kefei You*
University of Greenwich, UK

November 2024

Abstract

This paper examines the effect of institutional quality on total factor productivity (TFP) growth in 31 Sub-Saharan African economies during 1986-2019. Institutional quality, based on Rodrik's (2000) concept of market-supporting institutions aligned with the African Union's Agenda 2063, influences TFP growth alongside exogenous technological progress. We account for multiple structural breaks adopting the Karavias et al. (2022) method. Incorporating the three significant structural breaks identified in 1993, 2002, and 2007, institutional quality consistently contributed to TFP growth during 1986-1993, 1994-2002, and 2003-2007. It had no impact during 2008-2019. Despite institutional quality's support, regional TFP declined during 1986-1993 due to negative technological progress. It grew slowly in 1994-2002 and accelerated its pace during 2003-2007, both powered entirely by enhancements in institutional quality. In 2008-2019, driven by the final ignition of positive technological progress, TFP continued to grow but at a slower rate due to the absence of contribution from institutional quality.

Keywords: Institutional Quality, Technological Progress, Total Factor Productivity, Structural Breaks, Sub-Saharan Africa

JEL classification: C23, O40, O43, O55

1. INTRODUCTION

The importance of institutional quality to economic growth has been well established in the existing literature (e.g., Knack and Keefer, 1995; Williamson, 2000; Rodrik et al., 2004; Butkiewicz and Yanikkaya, 2006; Slesman et al., 2015; Arvin et al., 2021; Ahmed et al., 2022). Indeed, without respect for rules and enforcement on property rights and contracts, the markets will be marked by high levels of uncertainty and fail to function efficiently. This position has been implied consistently in the institutions and growth literature (e.g., North and Thomas, 1973; Weingast, 1997; Rodrik, 2000, 2002; Fernandez and Tamayo, 2017).

Compared to the large body of institutional quality-economic growth literature, however, relatively less attention has been devoted to examining how institutional quality contributes directly to productivity growth. Institutions can be described as the constraints put in place by humans as devices that help structure human interaction (North 1990, 1991, 1993). Hall and Jones (1999) theorise and highlight the importance of institutional quality to productivity, stressing that institutions and government policies favourable to high levels of output per labour provide an environment that supports productive activities and encourage skill acquisition, invention and technology transfer. Bonnen (1987) emphasises the system of institutions as being central to the enabling context created for productivity growth. Biggs (2007) reaches the same conclusion. Reviewing the role of institutional change in the global experience of productivity growth, Hounkonnou et al. (2012) show that the development of an enabling institutional context was a necessary condition that preceded the phenomenal productivity growth in more developed countries. Banks (2015) and more recently Cavassini et al. (2022) call for stronger institutions to promote productivity growth as part of the OECD's Global Productivity Forum. Therefore, this article focuses on the direct impact of institutional quality on productivity growth. It is motivated not only by the necessity to deepen the understanding in this area, but also by the irreplaceable contribution good institutions could bring to the growth in productivity (see discussion in Section 2 on how institutions may influence productivity growth).

Furthermore, our study is inspired by the unique context of the Sub-Saharan Africa (SSA) region. The SSA region remains the world's poorest area. The quality of institutions has a central role in the African Union's Agenda 2063 and the 2030 Sustainable Development Goals. The International Monetary Fund (IMF) (2017, 2021) also advocates strong institutions to promote productivity in the region. Yet, literature examining the direct impact of institutional quality on productivity in SSA is scant. There is an urgent need to improve productivity in order to increase income in SSA, and hence it is crucial that the role of institutional quality in enhancing productivity growth in the region is carefully assessed.

To capture the institutional quality in SSA, we refer to the African Union's Agenda 2063, which is regarded as Africa's blueprint and master plan for transforming Africa into the global powerhouse of the future. In the Agenda, institutions occupy a central role in its Goals & Priority Areas including entrenching democratic values, practices and governance, upholding justice and the rule of law, enforcing participatory development and local governance, safeguarding stability, security and peace, enhancing financial and monetary stability in African capital markets, and ensuring adequate social insurance and social protection to tackle inequality (see www.au.int/agenda2063/goals). To reflect these roles played by institutions in the Agenda, we employ Rodrik's (2000) novel concept of market-supporting institutions that includes not only market but also non-market institutions, as the market economy is necessarily embedded in both types of institutions. There are five types of market-supporting institutions: a) property rights; b) regulatory institutions; c) institutions for macroeconomic stabilisation; d) institutions for social insurance; and e) institutions of conflict management. In addition, democracy is a meta-institution for building good institutions. As illustrated in Figure 1, Rodrik's (2000) overarching democracy and five types of market-supporting institutions provide a close match with the institutions emphasised in the Agenda, and hence it is a particularly suitable measurement of institutional quality for the SSA region.

A number of global and SSA regional events have taken place in the last few decades. These events may have led to structural breaks in the region's economic indicators. Failing to recognise structural breaks can lead to invalid conclusions (Karavias and Tzavalis, 2017). Therefore, we test and account for multiple structural breaks. Specifically, we adopt the Karavias, Narayan and Westerlund (KNW) (2022) method which allows and tests for the presence of multiple unified structural breaks at unknown dates in a panel and can be applied for both pure and partial structural changes. The method can accommodate cross-sectional dependence which can cause estimator efficiency loss and invalid test statistics if not considered.

Therefore, this study aims to examine the direct impact of institutional quality on productivity growth for the SSA nations considering the presence of structural breaks. To our knowledge, the only previous study on a related issue for the SSA region is Kpognon et al. (2022). Our analysis offers three important developments. First, whilst Kpognon et al. (2022) do not consider structural breaks, we adopt the novel KNW (2022) method which can identify multiple unified structural breaks at unknown dates in a panel and can accommodate cross-sectional dependence. Second, Kpognon et al. (2022) adopt the widely used six Kaufmann et al. (2006) institutional quality indicators by using an average of these six as an overall index for governance. We employ Rodrik's (2000) market- and non-market-institutions inclusive concept of institutional quality that reflects institutions emphasised in the African Union's Agenda 2063. We also use the principal component analysis (PCA) to obtain the overall institutional quality indicator. Third, Kpognon et al. (2022) employ output per labour as an indicator for labour productivity. Our focus is on the growth rate of TFP in the SSA region. We decompose TFP growth into two components within the framework of the Cobb-Douglas (CD) production function: exogenous technological progress and productivity growth fostered by improvement in institutional quality. The effect of development in institutions in accelerating TFP growth presents a long-term growth engine that could be crucial in elevating productivity growth in SSA.

The rest of the article is organised as follows. Section 2 discusses how improvement in institutional quality could contribute to TFP growth. Section 3 reviews the relevant literature and discusses our contributions. Section 4 illustrates Rodrik's (2000) concept of institutional quality. Section 5 shows the incorporation of institutional quality into the CD productivity function as a contributor to TFP growth. Section 6 outlines the empirical methods. Section 7 discusses the data and Section 8 presents the empirical results. The final section concludes.

2. INSTITUTIONAL QUALITY AND PRODUCTIVITY GROWTH

Institutional quality can have positive influence on productivity growth through various channels. Enhanced institutional quality facilitates the transformation of resources, including internal research and development (R&D), educated employees, investments in formal training for skilled labour and managerial experience, into innovation (Barasa et al., 2017). Specifically, a weak institutional environment, such as poor protection of intellectual property rights, can impede firms' ability to leverage R&D investments for innovative output (Zhao, 2006; Martin-de Castro et al., 2013). Similarly, deficiencies in educational systems, particularly those based on privilege rather than merit, may seriously diminish the impact of human capital on innovation (Heyneman, 2004). In addition, regions with lower institutional quality may divert the attention of senior managers away from innovation towards navigating excessive requirements imposed by government regulations or addressing corruption-related challenges, thereby stifling innovation.

Furthermore, as noted by Mokyr (2009), competent institutions are instrumental in fostering innovation by nurturing an environment conducive to scientific breakthroughs and creating the necessary conditions for the assimilation of innovation. More specifically, Ganau and Rodriguez-Pose (2018) demonstrate that well-functioning institutions enable firms to capitalise on the local diversity and availability of skills, thereby harnessing the knowledge spillovers associated with positive externalities to innovate. Rodriguez-Pose and Zhang (2020) further corroborate this by illustrating that firms located in Chinese cities with higher quality of institutions exhibit greater innovation propensity and intensity. They also illustrate that better institutions reduce the amount of time firms spend dealing with government regulations in order to facilitate innovation. Donges et al. (2022) further reveal that inclusive institutions introduced by the French occupation after the French Revolution of 1789 had strong positive impact on innovation for Imperial Germany. They summarise that the inclusive institutions were formed by breaking up rigid rules, the creation of more competitive markets, and the establishment of a legal system that separated the judiciary from the public administration. Based on their findings, they propose that institutions should be considered as a first order determinant on innovation, a view shared by Putnam (2000) who advocates institutions as the key enabler of productivity growth.

Knowledge transfer, integral to invention and innovation (National Science Board, 2022), is intricately linked to institutional quality. Rodríguez-Pose and Di Cataldo (2015) posit that institutional quality is responsible for regulating learning processes, supporting the formation of mutual trust and facilitating the transmission of knowledge between innovation players. By incorporating institutional quality as a direct engine of productivity growth and employing government quality to indicate institutional quality, they find compelling evidence supporting the link between the quality of government and the capacity to innovate. Olson et al. (2000) also emphasise that good institutions are crucial in explaining innovation from the perspective that the former help form the right incentive structure within economies, thus promoting innovation.

Therefore, we anticipate that institutional quality has a strong positive effect on productivity growth, by its role in facilitating the transformation of resources into innovation, nurturing an environment conducive to scientific advancements and innovations, fostering the formation of mutual trust, and enabling the transmission of knowledge. As such, through increasing the pace of technological change, stronger institutional quality is expected to accelerate the growth rate of productivity.

3. LITERATURE REVIEW AND OUR CONTRIBUTIONS

Many studies have shown how institutional quality serves as an important factor promoting economic growth in SSA (e.g., Effiong, 2015; Momoh and Alutu, 2017; Cherit et al., 2020; Jiahao et al., 2021; Wandeda et al., 2021; Haldar and Sethi, 2022; Tinta 2022). The influence of institutional quality on other aspects of the economy in the SSA region has also been investigated including how institutional quality affects environmental efficiency (e.g., Bahizire et al, 2022), savings (e.g., Boateng et al., 2019) and FDI inflows (e.g., Kahsai et al., 2011; Adegboye et al., 2020).

There is, however, very limited research examining directly whether institutional quality contributes to productivity growth in the SSA countries. To our knowledge, for the SSA region, Kpognon et al. (2022) employ the widely adopted six Kaufmann et al. (2006) institutional quality indicators (i.e., government effectiveness, regulatory quality, political stability and absence of violence, voice and accountability, rule of law and corruption control) and an average of these six indicators as an overall index for governance for 31 SSA countries during the period 1996-2016. They find that institutional quality indicators have a positive and significant influence on labour productivity. We are aware of microeconomic studies that focus on institutional quality and firm-level productivity in SSA (e.g., Eifert et al., 2005; Goedhuys et al., 2008; Cherif et al., 2020). As such, Kpognon et al. (2022) is the only study so far analysing institutional quality-productivity relationship at macroeconomic/country level for the SSA, However, their analysis centres on how institutional quality affects the level of productivity rather than its growth rate.

Therefore, both the scarcity of relevant literature on this issue for the SSA nations and the practical necessity of investigating institutional quality as a mechanism for productivity growth in the region (see discussion in Section 1) call for more analysis on this topic and subsequently motivate this article. Our study will not only enrich the literature but also provide valuable insights to decision makers in terms of whether institutional quality provides an effective means to address the pressing challenge of raising productivity in the region. Specifically, we make three contributions to the existing literature.

First, many important and widely used economic indicators have been shown to have structural breaks (Karavias and Tzavalis, 2017). Not recognising these structural breaks can lead to invalid conclusions. Identifying structural breaks in models can help understand the true mechanisms driving changes in data (Antoch et al., 2019). In the past few decades, several global and SSA regional events have taken place, yet previous studies mentioned above have not accounted for structural breaks in their analyses. Therefore, we adopt the recent KNW (2022) method which allows and tests for the presence of multiple unified structural breaks at unknown dates in a panel and can be applied for both pure and partial structural changes. Another key advantage of this method is that it can accommodate cross-sectional dependence, which when unaccounted for, can result in estimator efficiency loss and invalid test statistics.

Second, to capture institutional quality in SSA, existing studies often employ the six indicators of Kaufmann et al. (2006) mentioned above (e.g., Kahsai et al., 2011; Boateng et al., 2019; Adegboye et al., 2020; Jiahao et al., 2021; Wandeda et al., 2021; Bahizire et al., 2022; Haldar and Sethi, 2022; Kpognon et al., 2022). In our study, the measurement of institutional quality is inspired by Rodrik's (2000) concept of market-supporting institutions that includes both market- and non-market institutions (see Section 4 for more details about these institutions). More importantly, as discussed in Section 1, Rodrik's (2000) concept of institutions is particularly suitable for the SSA region as it closely matches the institutions emphasised in the African Union's Agenda 2063 Goals & Priority Areas (see Figure 1).

Finally, we incorporate institutional quality as an instrumental factor that influences TFP growth alongside the exogenous technological progress. Doing so enables us to examine how the development in institutions accelerates technological change and knowledge accumulation, an important effect in a long-run perspective for the SSA region that goes beyond the level effect analysed in Kpognon et al. (2022).

4. RODRIK'S (2000) CONCEPT OF INSTITUTIONAL QUALITY

As institutions have different dimensions, several indicators have been suggested in the literature to measure the quality of institutions (see Samadi and Alipourian (2021) for a recent review of these indicators and Chang (2023) for a review of various data sources that have been used). However, there is no consensus among experts on which index should be used, especially in the case of transition economies (Samadi and Alipourian, 2021).

Our measurement of institutional quality is inspired by Rodrik's (2000) concept of market-supporting institutions that include both market and non-market institutions. According to Rodrik (2000), not all institutions are there to serve the needs of the market economy first and foremost, even if their presence is required by the internal logic of private property and contract enforcement. The fact that a governance structure is needed to ensure that markets can do their work does not imply that the governance structure serves only that end. In order words, the market economy is necessarily embedded in a set of non-market institutions in addition to the market institutions. The non-market institutions perform a wide array of roles including regulatory, stabilising, and legitimising functions which the market economy relies on. At the same time, they may also produce outcomes that restrict the free play of market forces in pursuit of a larger goal, such as social stability and cohesiveness. Therefore, the markets need to be supported by both market and non-market institutions to perform well.[1]

Rodrik (2000) focuses on five types of market-supporting institutions: a) property rights; b) regulatory institutions; c) institutions for macroeconomic stabilisation; d) institutions for social insurance; and e) institutions of conflict management; and treats democracy as a meta-institution for building good institutions.

Property Rights Institutions are legal frameworks aimed at reducing the consequences of asymmetric information (adverse selection and moral hazard) and asymmetric bargaining power with respect to minority versus majority controlling shareholders, monopoly versus consumers (Fernandez and Tamayo, 2017). Without property rights, an entrepreneur would not have the incentive to accumulate and innovate unless s/he has adequate control over the return to the assets that are thereby produced or improved (North and Thomas,1973; North and Weingast, 1989; Rodrik, 2000).

Regulatory Institutions regulate conduct in goods, services, labour, assets and financial markets (Rodrik, 2000). In fact, the freer the markets are, the greater the burden is on the regulatory institutions. It is important to recognise that regulatory institutions may need to extend beyond the standard list covering anti-trust, financial supervision, securities regulation, and a few others. This is true especially in developing countries where market failures may be more pervasive and the requisite market regulations more extensive.

Institutions for Macroeconomic Stabilisation are the fiscal and monetary institutions that perform stabilising functions, monetary policy through the resulting level and predictability of inflation, and fiscal policy through the reduction of public deficit (Rodrik, 2000; Fernandez and Tamayo, 2017). The most important among these institutions is a lender of last resort-typically the central bank-which guards against self-fulfilling banking crises.

Institutions for Social Insurance comprise of programmes that reduce the adverse effect and impact of economic shocks on individuals and families (Rodrik, 2000; Dion, 2008; World Bank, 2023). Social insurance programmes are institutions set up to establish and coordinate publicly provided or mandated insurance schemes against old age, disability, death of the main household provider, maternity leave and sickness cash benefits, and social-health insurance. Social insurance allows the economy to be transformed from a static to a dynamic one as it

[1] There is, however, no single mapping between the market and the set of non-market institutions required to sustain it (Rodrik, 2000). This is reflected in the wide variety of regulatory, stabilising, and legitimising institutions that observed across countries, especially in advanced industrial societies.

supports labour movement to more productive sectors. It also legitimises a market economy because it renders it compatible with social stability and social cohesion.

Institutions for Conflict Management are those that reduce social conflict that is harmful since it leads to misallocation of resources by diverting resources from economically productive activities, breeding uncertainty and eventually discouraging productive activities. Societies differ in their cleavages in ethnicity, language, culture, religion, income, etc. These divisions, when not bridged adequately, can hamper social cooperation and prevent the undertaking of mutually beneficial projects (Rodrik, 2000).

Rodrik (2000) regards democracy as a meta-institution for building good institutions. It is explained that the most reliable forms of both the blueprint and the local-knowledge approach of acquiring institutions are participatory political institutions. Further empirical evidence in Rodrik (2000) also confirms that participatory democracy helps build better institutions that lay the foundation for sustainable economic growth.

As discussed earlier, we adopt Rodrik's (2000) concept of institutions for the SSA region as it not only considers both market and non-market institutions, but also matches closely the institutions emphasised in the Agenda (see Figure 1). Based on the above five indicators plus democracy, we employ the PCA approach to obtain a single composite Institutional Quality Index for each nation (see Appendices A-C for details on data).

5. THE PRODUCTIVITY FUNCTION

We employ the CD production function (Cobb and Douglas, 1928), the most widely applied production function in literature (Gechert et al., 2019), and we incorporate institutional quality as an important contributor to TFP. Following Chow and Li (2002), the CD production function with constant returns-to-scale is written as:

$$yl = Akl^{\alpha} = TFPkl^{\alpha} = e^{gt}kl^{\alpha} \tag{1}$$

where yl and kl denote real output per labour and real capital stock per labour, respectively, α is the capital share of income, A measures the TFP, g measures growth rate of TFP over time, and i and t denote the 31 SSA countries and years during the period 1986-2019.

Taking natural logarithm of both sides of Equation (1) gives:

$$lnyl_{it} = A_0 + gt + \alpha lnkl_{it} + \varepsilon_{it} \tag{2}$$

where A_0 represents the initial level of productivity and ε_{it} is the error term. In time (t-1), Equation (4) becomes:

$$lnyl_{i(t-1)} = A_0 + g(t-1) + \alpha lnkl_{i(t-1)} + \varepsilon_{i(t-1)} \tag{3}$$

The log difference based on Equations (2) and (3) is:

$$\Delta lnyl_{it} = g + \alpha \Delta lnkl_{it} + \Delta \varepsilon_{it} \quad (4)$$

While the TFP is often assumed to grow at a constant rate, as elucidated in Section 2, improved institutions have the potential to accelerate technological change and facilitate knowledge accumulation, thereby influencing the trajectory of TFP growth. As such, the growth rate of TFP indicated by g includes the growth rate of the exogenous technological progress, λ, and the supplementary acceleration of technological advancement facilitated by enhancements in institutional quality:

$$g = \lambda + \gamma IQ \quad (5)$$

where γ measures the effect of institutional quality (IQ) on TFP growth.

Therefore, Equation (4) becomes:

$$\Delta lnyl_{it} = \lambda + \gamma IQ_{it} + \alpha \Delta lnkl_{it} + \Delta \varepsilon_{it} \quad (6)$$

Equation (6) is estimated in Section 7.

The Cobb-Douglas production function provides a straightforward way to interpret the contributions of factors, offering clear insights into the impact of these factors on production growth (Solow, 1957; Mankiw et al., 1992). The decomposition approach in the context of Cobb-Douglas production function is also widely adopted in the literature (e.g., Felipe and McCombie, 2020; Tóth, 2021).

6. METHODOLOGY

As discussed in Sections 1 and 2, a key advantage of our study is that it considers specifically the issues of structural breaks and cross-sectional dependency. Practically, we start with the cross-sectional dependency tests and if such dependency is confirmed, we move to unit root tests that allow for not only cross-sectional dependency but also structural breaks to obtain information on the data generating process of variables. Then, we carry out estimation of the production function (Equation (6)) employing the KNW (2022) method where cross-sectional dependency is considered to test for structural breaks. After we acquire the break dates and estimates in each regime according to the location of the breaks, we finally obtain the growth rate of TFP, the growth rate of the exogenous technological progress and most importantly, the contribution of institutional quality to TFP growth.

6.1. Cross-sectional Dependency Test

As mentioned earlier, ignoring cross-sectional dependence can result in estimator efficiency loss and invalid test statistics. The cross-section tests employed in this study include Breusch-Pagan's (1980) LM, Pesaran's (2004) scaled LM, Baltagi's et al. (2012) bias-corrected scaled LM and Pesaran's (2004) CD tests. Although the Breusch-Pagan LM test is the most-widely used, the Pesaran scaled LM test addresses the former's weakness of not being appropriate for testing in large N settings. The Pesaran CD test addresses size distortions in both the Breusch-Pagan LM and Pesaran scaled tests. Due to incorrect centering with large N in the Pesaran CD and Breush Pagan LM tests, Batalgi et al. (2012) design a test that derives the asymptotic distribution of the LM statistic under the null as $(N, T) \rightarrow \infty$. Finally, following KNW (2022), we further adopt the Pesaran (2021) panel test for cross-sectional independence. As the heteroskedasticity and autocorrelation consistent estimators are not sufficient when there is cross-sectional dependency in the errors (Hoechle, 2007; Moscone and Tosetti, 2012; Conley et al., 2023), we employ the Driscoll and Kraay (1998) estimators where the error structure corrects for heteroskedasticity and autocorrelation and is robust to cross-sectional dependence (Hoechle, 2007).

6.2. Unit Root Test

If cross-sectional dependency is confirmed, it motivates the use of unit root tests that allow for such dependency. For this purpose, we employ Pesaran (2007) CIPS Unit Root Test (Cross-sectionally Augmented IPS test) to account for cross-sectional correlation. We also employ the Carrion-i-Silvestre, del Barrio-Castro and López-Bazo (CBL) (2005) stationarity test. The CBL test allows for the individually located structural changes in the mean and/or the trend for each individual time series. A third test is the LM-based Im, Lee and Tieslau (ILT) (2010) unit root test. It generalises the de-meaning procedure and proposes a two-way error components model to control for cross-correlations in the panel. It allows for both level and trend breaks. The invariance property of the LM test means that, unlike the Dickey Fuller based unit root tests, it is unnecessary to simulate critical values for the test at all possible break-point locations.

6.3. The KNW (2022) Method

Model Specification

KNW (2022) considers a linear panel model with a structural break at time b:

$$y_{it} = \beta' x_{it} + \delta' z_{it}(b) + e_{it}, \tag{7}$$

where $i = 1, \ldots, N$ are cross-sectional units and $t = 1, \ldots, T$ are time periods. The $k \times 1$ vector x_{it} contains the regressors whilst the $r \times 1$ vector z_{it} is given by

$$z_{it}(b) = R' x_{it} \ \mathbb{I}(t > b), \tag{8}$$

where $\mathbb{I}(t > b)$ is the indicator function that takes the value one when $t > b$ and zero otherwise, and R is an $k \times r$ selection matrix of zeros and ones with full column rank r that picks out the elements of x_{it} whose coefficients are subject to structural breaks. If $r < k$ and $R = \left(0'_{r\times(k-r)}, I_r\right)'$, then Equation (8) is a partial structural change model as only the r last regressors in x_{it} appear in $z_{it}(b)$.

It is important to note that this model is built to accommodate a factor structure and hence is able to incorporate cross-sectional dependency across units. Thus,

$$e_{it} = \gamma_i' f_t + \varepsilon_{it}, \tag{9}$$

where f_t and γ_i are $m \times 1$ vectors of common factors and factor loading, respectively, and ε_{it} is an idiosyncratic error term. Furthermore, the test assumes that all factors are unknown and that some of the factors are correlated with regressors as in Pesaran (2006). The test also allows for serial correlation and the possibility of unit roots in f_t, x_{it} and y_{it} and hence stationarity is not a necessary condition.

In the context of our study, $N = 31$ SSA countries and $T = 34$ years (1986-2019), y_{it} is the growth rate of the real output per labour gyl_{it} (i.e., $\Delta lnyl_{it}$ in Equation (6)), and x_{it} could include the growth rate of the real capital stock per labour gkl_{it} (i.e., $\Delta lnkl_{it}$ in Equation (6)), the growth rate of the exogenous technological progress λ (its effect is captured by the constant) and institutional quality (IQ_{it}).

However, as our primary interest lies in how institutional quality affects TFP growth, and following You and Sarantis (2013), we adopt a partial structural break model where the coefficient for the growth rate of the real capital stock per labour ($\Delta lnkl_{it}$) is fixed for the entire sample period, while the constant (which represents the growth rate of exogenous technological progress, λ) and the coefficient for institutional quality (IQ_{it}) are allowed to vary across different regimes. This is also a flexible feature of the KNW (2022) method. A partial change model is useful in allowing potential savings in the number of degrees of freedom, a consideration particularly relevant for multiple changes (Bai and Perron, 1998). Additionally, a partial structural change model can be advantageous in terms of obtaining more precise estimates and more powerful tests (Casini and Perron, 2018).

Breakpoint Estimation and Testing

The KNW (2022) method allows for multiple structural breaks at unknown dates. The main idea follows Bai and Perron (1998, 2003a, b, c) that the break points estimators are the global minimisers of the sum of the squared residuals (SSR). As discussed in Ditzen, Karavias and Westerlund (DKW) (2021), in order to choose the number of breaks, we start an initial examination of the $UDmax$ to see if at least one break is present. If there is, then the number of breaks is decided based on the $SupF_T(l+1|l)$ test which rejects in favour of a $(l+1)$ breaks model if the overall minimal value of the SSR from the $(l+1)$ model is sufficiently smaller than that from the l break(s) model. Following KNW (2022) and DKW (2021), having established the presence of structural breaks and number of breaks, we proceed to estimate the break point (s) at a 95% confidence interval using the $SupW$ test. It reports test statistics and their significance, the estimated break date(s), and the associated 95% break date confidence interval. As such, the date(s) of the break is treated as unknown not only in the estimation but also in the testing. Critical values for all tests are provided by Bai and Perron (1998, 2003a, b, c) and KNW (2022). The identified break date(s) is then incorporated into the panel fixed effect regression of Equation (6) to obtain the estimated coefficients (with the Driscoll and Kraay (1998) estimators).

7. DATA

7.1. The Construction of the Rodrik's (2000) Institutional Quality Index

This study employs annual data for 31 SSA countries from 1986 to 2019. The list of the 31 counties is provided in Appendix A.

As reviewed in Section 3, to capture institutional quality in the SSA nations, previous studies often employ the six indicators of Kaufmann et al. (2006) which are published by the World Bank under its World Governance Indicator (WGI). In this study, we construct Rodrik's (2000) Institutional Quality Index. As discussed above, we are motivated not only because this index captures the concept of market-supporting institutions that includes both market- and non-market institutions, but also because it is particularly suitable for the SSA region as it aligns closely with the institutions emphasised in the African Union's Agenda 2063 Goals & Priority Areas.

Rodrik's (2000) Institutional Quality Index consists of five types of market-supporting institutions: a) property rights; b) regulatory institutions; c) institutions for macroeconomic stabilisation; d) institutions for social insurance; and e) institutions of conflict management, as well as democracy as a meta-institution for building good institutions.

Our overall methodology for the constructing this index is as follows: for each of the five types of institutions and democracy, we employ indicators that best reflect the concepts discussed in Rodrick (2000). We apply a vetting procedure and selection criteria to internally ensure the validity of our choice of data. Once we obtain all five types of institutions and democracy, we adopt PCA to construct Rodrik's (2000) Institutional Quality Index. We then further validate our institutional quality index externally by comparing it to the six Kaufmann et al. (2006) institution quality indicators-based IQ index which has been widely used in previous analyses for the SSA region.

As part of our vetting procedure, we only use reputable data sources that are long standing and have been widely employed in previous studies. When more than one data source is available after vetting, we apply the selection criteria of suitability and practicality. Suitability requires that the indicators provided by the data source must closely align with Rodrik's (2000) institutional quality concepts. This is guided by Rodrik's (2000) definitions and is also assisted by well-established interpretations of these concepts in the existing literature. Practicality implies that, when multiple suitable indicators exist, we select the one that covers the countries in our study and spans the broadest time period.

After vetting the data, we list the top two to four alternative datasets in Table 9. We then apply the selection criteria to determine which dataset to adopt for each of the five types of institutions and the overarching democracy. Table 9 summarises Rodrik's (2000) concepts for the five institutions and democracy, lists suitable data source corresponding to these concepts, presents comments on the rationale for adopting a particular data source, and references previous studies supporting the adopted indicators. This process provides internal validation supporting our choice of data series.

In the case of c) Institutions for Macroeconomic Stabilisation, Rodrick's (2000) concept includes three sub-indicators of i) central bank independence, ii) the presence of automatic stabilisers, and iii) the presence of safeguard measures against self-fulfilling crises. Instead of using a single indictor as a proxy for this type of institutions, we strictly follow Rodrick's (2000) concept and collect data for each sub-indicator to fully reflect the underlying features of this type of institutions. In the case of the central bank independence, one of the three sub-indicators of the Institutions for Macroeconomic Stability according to Rodrik (2000), we also discuss how we have selected and utilised this sub-indicator in Appendix B. We then apply PCA on these three sub-indicators to form a measure for this type of institutions.

Once we have validated our choice of data series for constructing Rodrik's (2000) Institutional Quality Index, we employ the PCA approach to develop a single composite

Institutional Quality Index. PCA is commonly used to reduce datasets to lower dimensions while retaining as much information of the original sets as possible (Kumbhakar and Mavrotas, 2005; Ang and McKibbin, 2007). Due the multifaceted nature of institutional quality measures, there might be multicollinearity and redundancy of information (Menyah, et al., 2014), and using PCA tends to mitigate the adverse effects of these issues. We found and extracted the first three principal components which showed fitting characteristics with each having an Eigenvalue greater than 1 and cumulatively exhibiting 76.2% (40.4%, 18.8% and 17.0%, respectively) of the initial variance of the considered series (Gries et al., 2009). Following Mahida and Sendhil (2017) and Brown (2009), we create a composite index of institutional quality having generated the scores for each of the three normalised and rotated factors obtained from the first three principal components. The index ranges from 0 to 1 with a higher value indicating better institutional quality.

We plot the Institutional Quality Index in Figure 2. There have been variations in the index over time across all countries, although the fluctuations are more prominent in some countries (e.g., Ethiopia, Niger, Sierra Leone) than in others. While Botswana seems to have the highest institutional quality in the region, Zaire on the other hand has the lowest. Although most countries have experienced declines in institutional quality in some years, there is an overall increasing trend in the Index for almost all countries over the entire sample period.

We also consider external validation of our Rodrik's (2000) Institutional Quality Index for the SSA nations by comparing it to the Kaufmann et al. (2006)-based institutional quality index which is widely employed by previous studies analysing the institutional quality for the region. To be consistent, we apply PCA to the six WGI indicators of Kaufmann et al. (2006) and plot the results alongside Rodrik's (2000) Institutional Quality Index in Figure 3. Note that WGI data starts from 1996, followed by 1998 and 2000, and then with annual updates from 2002 onwards. During the overlapping period 2002-2019, Figure 3 shows that there are noticeable differences between the two indices in terms of the magnitude of changes and at times, the direction of the trajectory (e.g., in the early 2000s). However, in many years, both indices exhibit similar upward or downward trends. It confirms our Rodrik's (2000) Institutional Quality Index is meaningful and valid.

Additionally, given that most previous studies employ the WGI database which includes the six indicators of Kaufmann et al. (2006) to analyse the institutional quality for the SSA region, whilst our study adopts the International Country Risk Guide (ICRG) data for most of the institutions (with rationale is explained in Table 9), we provide a comparison between the WGI and ICRG indicators in Table 10. Table 10 highlights several advantages of the ICRG dataset in the context of this study. First, while the WGI dataset focuses on governance indicators, ICRG covers more broadly the political, economic and financial aspects. The ICRG database also employs consistent risk points conversion method for all components and has a longer data span (starting from the 1980s) compared to the WGI (starting from 1996). This serves as an additional external validation of our dataset.

7.2. An Overview of Data

For the empirical analysis in Section 8, we employ our Rodrik's (2000) Institutional Quality Index described in Section 7.1 and denote it as IQ. The GDP and capital stock data is summarised in Appendix C. The time period is 1986-2019 for the 31 SSA nations.

The descriptive statistics are presented in Table 1, which shows that the Institutional Quality Index seems to exhibit more variation than the growth rate of real output and capital per labour, as indicated by its slightly higher standard deviation.

In addition, the regional averages of both output per labour growth rate and institutional quality from 1986 to 2019 are shown in Figure 4. While institutional quality exhibited less fluctuation compared to output per labour growth, the two series display a similar overall trend. It was not until the early 1990s that an overall upward trend emerged in both variables, although the pace of this increase somewhat decelerated after the early 2000s. More recently, in the latter half of the 2000s, particularly following the 2007–2008 global financial crisis, both variables have shown a general downward trend. The pattern illustrated in Figure 4 shows there had been multiple changes in the trend in the trajectories of these two series in the past 34 years (1986-2019), firmly justifying the adoption of the KNW (2022) method to test for multiple structural breaks.

Henceforth, we take the log difference of real output per labour and real capital stock per labour to indicate their growth rates and refer to them as gyl (i.e., $\Delta lnyl_{it}$ in Equation (6)) and gkl (i.e., $\Delta lnkl_{it}$ in Equation (6)), respectively. The Institutional Quality Index is denoted as IQ.

8. EMPIRICAL RESULTS

8.1. Cross-sectional Dependency Tests

We first examine whether there is cross-sectional dependence is our data. As shown in Table 2, all four cross-sectional dependence tests in the upper panel (i.e., Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM and the Pesaran CD tests) strongly reject the null hypothesis of no cross-sectional dependence for all variables at 1% of significance level. The Pesaran (2021) test of cross-sectional independence in the lower panel further confirms the above results with a rejection of the null hypothesis. The results in Table 2 lend credence to the argument that the economic conditions and institutional quality of countries in the SSA region have underlying interdependencies. It motivates the unit root and structural break tests that accommodate cross-sectional dependence in the next sections.

8.2. Panel Unit Root Tests

Having confirmed the presence of cross-section dependency, we apply the Pesaran (2007) CIPS Unit Root Test which allows such dependency. The results are presented in Table 3. The null hypothesis of unit root is rejected for all three series gyl, gkl and IQ, indicating that they are stationary. As this study considers the effect of structural breaks in the production function, we conduct further stationary/unit root tests that account for structural breaks as well as cross-sectional dependency, namely the CBL (2005) and ILT (2010) tests as discussed in Section 6.2. The results are presented in Table 5. Two breaks in level and trend are allowed in both tests. For the CBL test, both the Bartlett and the Quadratic spectral kernel (in the first four columns) reject the null hypothesis of stationarity regardless of the assumption concerning the heterogeneity in the long-run variance estimate apart from gkl under the homogeneous variance which is stationary. The ILT (2010) test in the last column strongly rejects the null hypothesis of unit root, implying that all three series (i.e., gyl, gkl and IQ) are stationary.

As such, results in Tables 3 and 4 show that whilst gyl, gkl and IQ are stationary when structural breaks are not accounted for, their stationarity is confirmed under the ILT (2010) test and rejected under the CBL (2005) test (except for gkl under the homogeneous variance) when considering structural breaks. This condition highlights the advantage of the KNW (2022) method as it allows for both stationary and non-stationary variables in the panel.

8.3. KNW (2022) Structural Break Tests

This section identifies structural breaks in the production function (Equation (6)) adopting the KNW (2022) method where multiple breaks at unknown dates could be tested. This method can accommodate cross-sectional dependence and does not require stationarity of the variables. As discussed in Section 6.3., given that our primary interest is on how institutional quality affects TFP growth, we adopt a partial structural break model within the KNW (2022) specification where the coefficient for the growth rate of the real capital stock per labour (gkl)

(i.e., α) is fixed for the whole sample period whilst the constant (which indicates the growth rate of the exogenous technological progress (i.e., λ) and the coefficient for IQ_{it} (i.e., γ) can vary across different regimes. Given the length of our sample period, i.e., 34 years (1986 to 2019), we allow for a maximum of 3 breaks although more breaks can be allowed in the KNW (2022) method.

The results are summarised in Table 5. The initial $UDmax(tau)$ test (6.93) is highly significant at 1% significance level, confirming the presence of at least one structural break in the production function (Equation (6)). Given this, we carry out the sequential test where we test for 1 break against no break (i.e., $SupF_T(1|0)$), 2 against 1 (i.e., $SupF_T(2|1)$) and 3 against 2 breaks (i.e., $SupF_T(3|2)$). $SupF_T(1|0)$ test statistic (4.57) is significant at 10% significance level, rejecting no break in favour of 1 break. $SupF_T(2|1)$) test statistic (5.62) is significant at 5% level, and hence one break is rejected for the alternative of 2 breaks. The $SupF_T(3|2)$ test has a value of 8.07, which rejects 2 breaks in favour of 3 breaks at 1% significance level. Therefore, the number of detected breaks is 3 at 1% significance level. The validity of these three breaks will also be further examined in the following section.

Next, the break dates are estimated by minimising the SSR when there are three breaks. The results are presented in Table 6. The test result indicates that the break points are in year 1993, 2002 and 2007. The 95% confidence levels are between 1992 and 1994, 2001 and 2003, and 2006 and 2008, respectively. The $SupW(tau)$ test statistic (5.80) is higher than the 1% critical value (4.05), confirming the validity of the three estimated break dates above.

For the first break date in year 1993, the Structural Adjustment Programs (SAPs), which have dominated policy making in Africa since the 1980s, had largely come to an end after 1993. The second break date in 2002 corresponds to the aftermath of the terrorist attack to the US on 11th September 2001 which included many Muslim countries in SSA experiencing strained relations with the West. Places such as Kano in Nigeria and Mombasa in Kenya held pro-Taliban demonstrations that were often bloody and violent. Many SSA nations were involved in tribal wars and political unrest between 2001 and 2003 (Tayler and Epstein, 2022). The third break in year 2007 coincides with the recent global financial crisis which sent a shock wave around the world.

8.4. Estimation of the Production Function

Based on the estimated break dates above, we incorporate these breaks in year 1993, 2002 and 2007 into the production function (Equation (6)) and estimate the coefficient using fixed effect panel regression following KNW (2022) and DKW (2021). As discussed above, we adopt a partial structural break model where the coefficient for gkl is fixed for the whole period and coefficient of other regressors (i.e., the constant and the institutional quality) are allowed to vary across regimes. The results are shown in the right panel of Table 7. Note that according to the three breaks dates, there are four corresponding regimes of 1986-1993, 1994-2002, 2003-2007 and 2008-2019. The left panel of Table 7 (Columns (1) and (2)) are estimates without considering structural breaks for comparison.

In Table 7, the capital share is 0.3832 when there are no breaks and 0.3900 (Columns (3) and (4)) when breaks are considered. Both are highly significant (at 1% level). Their values are lower than many previous estimates of capital share for the SSA region such as 0.68 in Zelleke and Sraiheen (2012), 0.608 in Basegmez (2021), around 0.5 in Seetanah and Rojid (2011) and 0.43 in Senhadji (1999). Our result suggests that the contribution of capital to output growth becomes lower, once the institutional quality fostered productivity growth is accounted for. Furthermore, the capital shares are almost identical in both cases, suggesting that their estimates are not affected by the incorporation of breaks.

In Columns (3) and (4), $IQ_{2008-2019}$ and $D_{2003-2007}$ are insignificant. Given this, we re-estimated Equation (6) excluding these two variables, as Kutner et al. (2004) and Montgomery et al. (2012) suggest that removing insignificant variables in regression analysis can improve model simplicity and enhance interpretability. The results are presented in Columns (5) and (6). The capital share has hardly changed in Column (6) compared to that in Columns (2) and (4), and it remained significant at 1% level. For other variables in Columns (5) and (6), while the estimates are slightly different, they are overall similar to those in Column (4) and the level of significance improved compared to Column (4). Columns (5) and (6) in Table 7 will be the main results discussed in the remainder of the paper.

Exogenous Technological Progress in the Four Regimes

Based on Equation (6), the exogenous growth rate of the technology is λ which is measured gby the constant in Table 7. In the left panel (i.e., Columns (1) and (2)) in Table 7, the constant is -0.0626 at 1% significance level. It implies that there had been negative exogenous technological growth in the SSA region during the period 1986-2019. In the right panel (i.e., Columns (5) and (6)), when we incorporate the three structural breaks in institutional quality and the constant, the coefficients of the latter have shown noticeable changes in different periods.

During the first regime 1986-1993, the coefficient for the growth rate of the exogenous technological progress is found to be negative (-0.0556) and significant at 1% level[2], implying that there had been 'technological regress' rather than progress. As the SAPs have dominated policy making in Africa since the 1980s, this finding indicates that the SAPs has had limited impact in directly enhancing technological advancement in the SSA region. This could be due to inappropriate local economic policies, including price distortions, poor investment choices, increasing budgetary deficits and a proliferation of loss-making public enterprises (Calamitsis, 1999). The already challenging economic situation was further worsened during the first half of the 1990s by deterioration in the terms of trade and sharply reduced access to international finance (Noorbakhsh and Paloni, 1999).

In the following regime 1994-2002, there was an upward elevation of 0.0251 (at 5% significance level) in the growth rate in the exogenous technological progress. However, as the technological progress had negative growth rate of -0.0556 at the start of this regime, the uplift was not sufficient to raise it to the positive territory. Hence, the growth rate of technology in this period remained negative in the second regime. During the 1990s, many African countries moved to implement important structural reforms, abolishing or liberalising price control, dismantling inefficient public sector monopolies, privatising state enterprises, eliminating nontariff barriers, lowering import duties, reforming exchange rate management, eliminating direct controls on bank credit and establishing market-determined interest rates (Hernandez-Cata, 1999). However, these efforts were overshadowed by civil wars and conflicts, economic and financial crises as well as natural disasters that occurred during this period. The SSA region experienced a relatively higher number of conflicts in this period (Joireman, 2000; Bellows and Miguel, 2009; Meierhenrich, 2020). Civil wars reduce labour and TFP through the destruction of existing physical and human capital (Thies and Baum, 2020). Furthermore, any economic recovery was adversely affected by the 1998 Asian financial crisis (Hernandez-Cata, 1999) and to a much larger extent by the 9/11 terrorist attack in 2001 which triggered the rising of terrorism in the region (Ilyas et al., 2017). During financial crises, the constriction of credit tends to generate adverse effects on technological advancement (Redmond and Van

[2] The $cons_{1986-2019}$ is a constant for the whole sample period and reflects the growth rate of the exogenous technological progress in the first regime1986-1993. For the second regime 1994-2002, a dummy variable $D_{1994-2002}$ is incorporated to capture any changes in the growth rate in the second period. Hence the growth rate of the of the exogenous technological progress in the second regime equals the $cons_{1986-2019}$ adjusted by the value of the dummy variable (if it is statistically significant). For instance, based on Columns (5) and (6) in Table 7, it is -0.0556+0.0251=-0.0305. The same applies to the fourth regime 2008-2019 (i.e., -0.0556+0.0661=0.0105). For the third regime 2003-2007, however, the estimate was insignificant (as shown in Columns (3) and (4)), implying that there is no significant change in the growth rate of the exogenous technological progress during this period and it equals to $cons_{1986-2019}$ (i.e., -0.0556). See more details under Table 7.

Zandweghe, 2016, Oulton and Sebastiá-Barriel, 2017). Finally, the number of reported disasters in the region experienced an increasing trend in this period (World bank, 2010), reducing agricultural production (Arora, 2019) – the main economic activity for the region (OECD-FAO, 2016) – and productivity in general (Felbermayr and Gröschl, 2014). Therefore, any possible opportunity for halting the technological regress was stifled by unstable and unfavourable domestic environment and external shocks.

There was no improvement in the backwards progress in technology in the third regime 2003-2007 given that the change in its growth rate (0.0005) is statistically insignificant as shown in Columns (3) and (4) in Table 7, which led to its removal in Columns (5) and (6). Shortly after 2001, many SSA nations continued to be involved in tribal wars and political unrest (Hartig and Doherty, 2021). Natural disasters remained severe in this region during this period (Bhavnani et al., 2008). Several epidemic diseases (e.g., cholera, yellow fever, meningitis, and HIV/AIDS) spread across West Africa (United Nations Environment Programme, 2004; Lukamba, 2010). Locust invasions in West Africa from 2003 to 2005 and torrential rains and flooding in 2007 are a few events which reduced agricultural and food production drastically and hence productivity. To make matters worse, the 2007/8 global crisis sent a shock wave to the global financial markets. Although Africa's financial system was relatively shielded from the direct impact of the financial crisis due to its low level of financial integration, its real economy did not escape the adverse effect from significant drops in trade and capital inflows in 2007 and 2008 (Kasekende et al., 2009). The Great Recession which began at the end of 2007 and beginning of 2008 saw a sharp decline in the level of labour productivity in the region (Berman and Martin, 2012). As such, any chance of ceasing the technological regress during 2003-2007 was impeded by the volatile local environment and the disruptive 2007/8 crisis.

In the fourth regime 2008-2019, the upward lift in the growth rate of technological progress is 0.0661 and is significant at 1% level. It had finally turned around the growth rate of exogenous technological progress from negative to positive (i.e., -0.0556+0.0661=0.105). Looking at the general economic condition, Africa recovered relatively well from the 2007/8 global financial crisis, reaching an average GDP growth rate of 4.3% during 2009-2014 (based on World Bank data). The economic growth slowed down in the commodity super-cycle in 2015-2016 (averaged at 2.0%), and then rose to an average of 2.6% during 2017-2019. Several factors contributed to the overall steady growth in SSA during this sub-period. They include macroeconomic stability, intra-regional economic integration and trade, better business environment, FDI inflows (e.g., greenfield investments from emerging economies), and a gradual shift of growth fundamentals from private consumption toward investment and exports (African Economic Outlook (AEO), 2019, 2020). Under such favourable conditions, technological development has returned to the region. It is particularly aided by strong government support, infrastructure investment and human capital improvement. Governments in Africa have been accelerating investments in experimental research and development to push forward the knowledge frontier (AEO, 2018). Infrastructure investments in high-speed internet and the spread of smartphones make it possible for Africa to innovate on the digital and mobile fronts (Azolibe and Okonkwo, 2020). Infrastructure in urban areas has also enabled informal enterprises to adopt new technologies and reduce transactions costs (AEO, 2020). There is also a growing working age population (15-64 years old) in SSA (based on World Bank data) since 2016. As discussed in IMF (2015), this demographic transition means enhanced human capital as the new generation of labour force is typically better educated than the old generation, which boosts technological achievements over time.

The Contribution of Institutional Quality to TFP Growth in the Four Regimes

The most important finding of our study lies in the coefficients of the institutional quality index, IQ. They are consistently positive (0.0568, 0.0617 and 0.1191) and significant (at least at 5% significance level) throughout the first three regimes (1986-1993, 1994-2002 and 2003-2007, respectively). It strongly confirms that in these three regimes, institutional quality fostered productivity growth has been a powerful engine for TFP growth in the SSA region. However, in the fourth regime (2008-2019), the effect of institutional quality on TFP growth was insignificant.

In the first regime 1986-1993, the coefficient has a positive value of 0.0568 at 5% level of significance. Although it is typically viewed as being ineffective in raising income in SSA nations, the SAPs of the late 1980s and 1990s have facilitated democratisation of political systems in the region (Williams, 1994; Ndulo, 2003; Abouharb and Cingranelli, 2007). For instance, in 1992 alone, presidential elections were held in 10 countries: Mauritania, Mali, Gambia, Congo, Angola, Cameroon, Central African Republic, Madagascar, Ghana and Kenya. For many SSA countries, these were the first presidential and parliamentary election they had ever witnessed (Fosu and Gafa, 2020). In 1993, the region again witnessed the renewal of political, economic and peacekeeping cooperative bodies such as Economic Community of West African States. Many SSA countries began to liberalise their banking and exchange rate systems and move from import substitution industrialisation to focus on attracting foreign direct investment as well as forming an export-oriented economy (Schneider, 1999). Therefore, the overall strengthening in the institutional quality in the first regime provided noticeable support to TFP growth, especially when there had been technological regress in SSA during this period.

In the second regime 1994-2002, the coefficient remains positive (0.0617) at 1% significance level. There were continuous events aimed at raising institutional quality in SSA, an example being that 1994 saw the end of the apartheid in South Africa and Nelson Mandela's election to Presidency (US Department of State, 2022). Many countries in this region also went through various forms of constitutional referenda, presidential elections, and parliamentary elections from 2000 to 2001. In addition, although the SAPs had largely been completed after the mid-1990s, many initiatives commenced under the programmes had started to reach fruition in the second regime, strengthening the overall institutional framework through democratisation, privatisation, trade openness, liberalisation of financial systems, macroeconomic stabilisation and the development of free markets (Schneider, 1999; Okano 2016). Democratisation and improvements in the governance structures is widely suggested to be linked to higher levels of productivity (Rodrik, 2004, Colagrossi et al, 2020; Doces, 2020). Therefore, the positive coefficient of IQ suggests that, faced with continuous technological regress in the period, enhanced institutional quality played an instrumental role in fostering productivity growth and was the sole driver of TFP growth during 1994-2002.

In the following regime 2003-2007, the coefficient of IQ increased to 0.1191, the highest across all four regimes, and is significant at 1% significance level. Shortly before 2003, many countries registered and strengthened their democratic governance through largely peaceful changes in governance structures such as Zambia in 2001 and Sierra Leone in 2002 (IMF, 2013), profoundly improving the institutional quality in the region in the following years. Michael (2018) further shows that in this period, macroeconomic stability had a positive impact on TFP growth in a panel of 43 SSA countries. In addition to the continuation of democratisation of economies in this region, an interesting phenomenon that marked this regime was the increase in the level of social insurance programmes concentrating on the provision of universal and quasi-universal health care in many SSA countries. Some of these countries include Ghana, Nigeria, Rwanda and Burkina Faso in 2003, 2005, 2004 and 2007, respectively. Hofmarcher (1999) demonstrates that the expansion of social insurance coverage led to the enhancement of productivity as it increased the productive capacity and expanded the production possibilities of individuals. Therefore, productivity growth induced by better institutional quality again had been the sole engine of TFP growth in this period.

In the final regime 2008-2019, the coefficient of IQ (-0.0926) is insignificant as indicated in Columns (3) and (4) which leads to its removal in Columns (5) and (6). Despite the 2007/8 global financial crises, many countries in the region continued to pursue macroeconomic stability through the reforms of central banks and the establishment and restructuring of regulatory agencies and fiscal measures. However, the shock and aftermath of the global financial crises may have eroded any significant gains in institutional quality made by some SSA countries in this period (Ekeocha et al., 2023). Furthermore, the resource-grabbing behaviour by many SSA economies also weakened the development in institutional quality. According to Mehlum et al. (2006), the propensity for the benefits of oil and gas to go to a few instead of the whole economy tends to undermine the level and impact of institutional quality in these countries. Asiamah et al. (2022) further illustrate that the rent-seeking behaviour in resource rich countries in SSA led to the negative effect of institutional quality in SSA. Countries like Ghana, Niger, Tanzania, Liberia, Kenya, Senegal, Sierra Leone and Uganda, among others, became victims of resource-grabbing and suffered from the resource curse and its subsequent adverse effect on the quality of institutions (Graham and Ovadia, 2019). Indeed, as demonstrated in Figure 2, after the 2007/8 crisis, many SSA economies (e.g., Kenya, Mozambique, South Africa) have experienced decline in their institutional quality. Thus, the lack of substantial advancement in institutional quality in this regime muted its positive contribution to TFP growth that was observed in the first three regimes.

Therefore, our result clearly confirms our expectation that good institutional quality directly supports TFP growth in the SSA region. It underscores the pivotal role played by institutional quality in powering productivity growth (Bonnen's, 1987; Hall and Jones, 1999; Biggs, 2007; Hounkonnou et al., 2012), particularly within the context of the SSA region, where growth in technological progress only emerged after 2008. Notably, improvement in institutional quality constituted the sole source of TFP growth of the SSA region from 1986 to 2007. It also provides strong rationale for the unreserved emphasis on institutional quality in the Agenda 2063 set out by the African Union. Although the institutional quality in SSA is still relatively weak compared with other regions in the world (Aron, 2000; Wandeda et al., 2021), our finding demonstrations its significant contribution towards TFP growth, echoing the recent call of the World Bank regarding institutional quality as an important channel of boosting productivity growth in SSA (Calderón, 2022) and that of the IMF encouraging SSA nations to strengthen institutional quality for stronger economic growth (IMF, 2017, 2021).

It is also worth noting that although Kpognon et al. (2022) find that institutional quality has positive influence on productivity in SSA during 1996-2016, we consider cross-sectional dependence and multiple endogenous structural breaks, enabling us to reveal dynamic information on the evolution of contributions made by institutional quality and technological progress across difference regimes (as contrasted between the left and right panel in Table 7). Furthermore, the novel institutional quality indicator of Rodrik (2000) closely matches the six institutions-related areas in the Agenda 2063. Finally, we incorporate institutional quality as a fundamental driver of TFP growth, an important effect in a long-run perspective that extends beyond the analysis of level effects as explored by Kpognon et al. (2022).

TFP Growth, Institutional Quality Fostered Productivity Growth, and the Growth of the Exogenous Technological Progress

Based on estimates in Table 7, we calculate the growth rate of TFP, the institutional quality fostered productivity growth, and the growth rate of the exogenous technological progress[3]. Table 8 presents the cross-county average of the three series and summarises the cross-country and period average according to the four regimes 1986-1993, 1994-2002, 2003-2007 and 2008-2019.

Despite the positive influence of institutional quality, the regional average TFP growth had been negative (-3.10%) during the first regime 1986-1993 due to the technological regress experienced in the region. The positive (albeit small) TFP growth (0.36%) in the second regime 1994-2002 was entirely attributed to the positive effect of intuitional quality as technological regress continued. The TFP growth (2.14%) has accelerated its pace (albeit at a moderate rate) in the third regime (2003-2007), driven exclusively by enhancements in institutional quality, as backward development in technology persisted in this period. During the most recent regime spanning from 2008 to 2019, propelled by the final ignition of positive technological progress, the average TFP in the region continued to grow (at 1.04%). However, this growth rate was slower compared to the preceding regime (2003-2007), primarily owing to the lack of advancements in institutional quality.

9. CONCLUSIONS AND IMPLICATIONS

This study examines the direct contribution of institutional quality to the growth rate of TFP for 31 SSA economies during the period 1986-2019. Improved institutions have the potential to accelerate technological change and facilitate knowledge accumulation, thereby

[3] See notes under Table 8 for information on the calculation of TFP Growth, Institutional Quality Fostered Productivity Growth, and the Growth of the Exogenous Technological Progress.

influencing the trajectory of TFP growth. Therefore, we propose and examine that the TFP growth is not entirely determined by the exogenous technological progress, it is also dependent on institutional quality. To capture the institutional quality, we employ Rodrik's (2000) concept of market-supporting institutions that include both market and non-market institutions. It considers a) property rights; b) regulatory institutions; c) institutions for macroeconomic stabilisation; d) institutions for social insurance; and e) institutions of conflict management, plus democracy as a meta-institution for building good institutions. It provides a close match to the institutions emphasised in the African Union's Agenda 2063 Goals & Priority Areas (Figure 1). We then apply PCA to obtain a composite Institutional Quality Index for each SSA nation. At the empirical level, we consider cross-sectional dependence and take structural breaks into account. Specifically, we first employ the Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM and the Pesaran CD tests, all of which confirms the presence of cross-sectional dependence. Then we adopt the KNW (2022) method which not only accommodates cross-sectional dependence in a panel but also allows and tests for the presence of multiple unified structural breaks at unknown dates.

Three significant structural breaks are identified in year 1993, 2002 and 2007, corresponding to the time of the ending of SAPs, the aftermaths of 9/11 terrorist attack, and the recent global financial crisis, respectively. Incorporating these three breaks into the production function demonstrates that improvement in institutional quality has made consistently positive contribution to the growth rate of TFP in all first three regimes (1986-1993, 1994-2002, and 2003-2007). Lacking significant development in the final regime, institutional quality's contribution to TFP growth turned insignificant during 2008-2019. In contrast, technological progress in this region has been negative (i.e., technological regress) during the first three regimes, and it only turned positive in the last period. The regional average growth rate of TFP in SSA shows that, despite positive contribution from institutional quality, TFP declined in the first regime as a result of technological regress. It started to grow slowly in the subsequent regime (1995-2002) and accelerated its pace (albeit still exhibiting a moderate rate of growth) in the third regime (2003-2007), both powered entirely by enhancements in institutional quality. In the most recent regime (2008-2019), driven by the final ignition of positive technological progress, TFP continued to grow but at a rate slower than the previous regime (2003-2007) due to the absence of contribution from institutional quality.

Our study has several implications. First, not accounting for structural breaks may lead to inaccurate conclusions when analysing TFP growth in the SSA region. For instance, when structural breaks are considered and incorporated, it reveals information on the regime-specific contribution of institutional quality and technological progress to TFP growth.

Second, our results show that the institutional quality is an important driver of the growth rate of TFP for SSA nations. It provides direct empirical evidence supporting the emphasis on stronger institutions as a means to achieve inclusive and sustainable economic growth and development in the African Union's Agenda 2063. It echoes calls by Banks (2015), Calderón (2022), Cavassini et al. (2022) and IMF (2017, 2021) for stronger institutions to promote productivity growth in Africa. In addition, in the final regime (2008-2019) when there had been no substantial development in institutions, the region has missed the opportunity of benefiting from the productivity growth induced by enhancements in institutional quality. It indicates to governments in the SSA regions the urgency to strengthen the five types of marking-supporting institutions and democracy described in Rodrik (2000) in order to accelerate technological change and knowledge accumulation and subsequently raise the growth rate of TFP.

Finally, technological progress has become an important driver of productivity growth in the SSA region after the 2008 global financial crisis. To keep this momentum, policies such as encouraging investment in technological innovation (Diop, 2017) and digital infrastructure (African Economic Outlook, 2021) and 'South-South' cooperation/investment (UNCTAD, 2019; Hu et al., 2021) need to be further promoted in the region.

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Appendix A. List of countries

The 31 SSA countries included in this study are: Angola, Botswana, Burkina Faso, Cameroon, Central African Republic, Congo Republic, Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.

Appendix B. Institutions for Macroeconomic Stabilisation (1986-2019)

The Institutions for Macroeconomic Stabilisation include the monetary and fiscal institutions that perform stabilising functions in financial markets. Following Rodrik (2000), they are captured in indicators of i) Central bank independence, ii) the presence of automatic stabilisers, and iii) the presence of safeguard measures against self-fulfilling crises.

i) Central bank independence: As pointed out by Adrian et al. (2024), the Cukierman, Webb, and Neyapti (CWN) (1992) index has been the de facto standard for measuring central bank independence since 1992. Romelli's (2022, 2024) Extended Central Bank Independence index extends the CWN (1992) index using information on 42 criteria of central bank institutional design across 6 dimensions: (1) governor and central bank board, (2) monetary policy and conflict resolution, (3) objectives, (4) limitations on lending to the government, (5) financial independence, and (6) reporting and disclosure. The values are between 0 and 1 with numbers closer to 1 indicating a higher level of independence. An alternative comprehensive indicator for central bank independence is Garriga (2016) and Garriga and Rodriguez (2023) which also extends the CWN (1992) index to include 16 criteria across 4 components: (1) the regulation of the central bank's chief executive officer's tenure, (2) the bank's policy formulation, (3) objectives, and (4) the limitations on lending to the public sector – or the central bank fiscal powers. The values are also measured from 0 to 1 with a higher value signalling a higher level of independence.

Both indices are widely employed in the existing literature (e.g., Masciandaro et al (2024) and Ofoeda et al (2024) for the former and Aklin et al (2021) and Gyeke-Dako et al (2022) for the latter). As Romelli (2024) considers more criteria and dimensions than Garriga and Rodriguez (2023), we employ Romelli (2024) in our study. Romelli (2024) covers our whole sample period (1986-2019) but reports 25 out of the 31 SSA countries in our group, while data in Garriga and Rodriguez (2023) goes up to 2014 but covers all 31 SSA countries. For the six economies not covered by Romelli (2024) (i.e., Cote d'Ivoire, Madagascar, Mozambique, Sudan, Zambia and Zimbabwe), we combine the two sets of data. First, we apply an adjustment factor on Garriga and Rodriguez's (2023) data for each of the six markets. The adjustment factor is constructed by first taking the period average of each of the 25 nations of Romelli (2024) and divide it by that of Garriga and Rodriguez (2023) for the overlapping period 1986-2014. We observe that most of the ratios are quite close to one with a moderate range of between 0.8 and 1.3. We then take the average of these ratios which gives us a value of 1.14, which is again fairly close to unity, and use it as the adjustment factor to adjust Garriga and Rodriguez's (2023) data for the six countries (See You and Sarantis (2012) for a similar method of using an adjustment factor). For period 2015-2019, for each of these six nations, we divide its period average from 1986 to 2014 by that of the rest of the 25 sample SSA nations in the same period and obtain a ratio. Next, for each year between 2015-2019, the ratio is then applied to the yearly average of the 25 SSA nations to generate values for these countries[4].

[4] We have also explored using Garriga and Rodriguez (2023) as our base data. As period 2015-2019 is not covered by Garriga and Rodriguez (2023), we combine the study with Romelli (2024) applying the same method described above for the missing data points for 2015-2019. This dataset generates very similar results in terms of its weight in PCA and the indicator for the Institutions for Macroeconomic Stabilisation. Given this, we choose Romelli

ii) the presence of automatic stabilisers and iii) the safeguard measures against self-fulfilling crises: please see Table 9 for information on how they are measured and their relevant data source (i.e., ICRG).

Having obtained the above three sub-indicators, we conducted PCA to create an index for Institutions for Macroeconomic Stabilisation. Only the first principal component showed fitting characteristics with an eigenvalue greater than 1 and exhibiting 61.77% of the initial variance of the considered series (Gries et al. 2009). Given this, we adopt the predicted scores for PC1 as the series generated for Institutions for Macroeconomic Stabilisation.

Appendix C. Real Output Per Labour and Real Capital Stock Per Labour

We employ data from the Penn World Table (PWT) 10.01 for the real GDP per labour (yl) and real capital stock per labour (kl) from 1985 to 2019 (hence their growth rates start from 1986). A key advantage of the PWT database is that it provides measures of real GDP that correct for changing prices over time by employing interpolated price indexes. In addition, as it adopts International Comparison Programme benchmarks from multiple years, all series calculated are in real terms, making it less sensitive to the choice of the base year and minimising the problem associated with using real GDP estimates in non-benchmark years.

1. yl: Real GDP per labour. Real GDP is the Output-side real GDP at chained PPPs (in million 2011 USD). The series is collected from PWT 10.0 under code RGDPO. Labour is the number of persons engaged (in millions) from PWT 10.0 under EMP.
2. kl: Real capital stock per labour. The real capital stock is measured using the capital stock at chained PPPs (in million 2011 USD). To obtain this variable, we follow You et al. (2019), You et al. (2020) and Hu et al. (2021) and first calculate the ratio of capital stock and the output-side real GDP, both expressed at current PPPs (in million 2011 USD). These two series are collected from PWT 10.0 under CGDPO and CN, respectively. We then multiplied this ratio by the output-side real GDP at chained PPPs to obtain capital stock data, expressed in chained PPPs.

For the empirical analysis in Section 7, we take the log difference of yl and kl and refer to them respectively as the growth rate of real GDP per labour, gyl, and the growth rate of the growth rate of real capital per labour, gkl for period 1986-2019.

(2024) as our base data as consider more dimensions and covers the more recent period 2015-2019 which was not considered in Garriga and Rodriguez (2023). We also tried reducing our sample from 31 to the 25 SSA countries covered in Romelli (2024). The findings are again very similar to ones presented in Tables 1-7.

Table 1: Descriptive statistics

Variables	Obs	Min	Max	Mean	Std. Dev
gyl	1,054	-0.6126	0.5700	0.0088	0.1020
gkl	1,054	-0.5061	0.5874	0.0215	0.1009
IQ	1,054	0.0000	1.0000	0.5572	0.1550

Note: gyl, gkl and IQ are the growth rate of real output per labour, the grow rate of the real capital stock per labour, and the institutional quality index, respective, for the panel of 31 SSA countries during the period 1986-2019. The former two series are calculated as the log difference of real output per labour (yl) and real capital stock per labour kl, respectively. See Appendices B and C for variable definitions.

Table 2: Cross-sectional dependency tests

Variables	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
gyl	725.598***	7.52883***	7.05913***	9.22232***
gkl	1903.29***	46.1468***	45.6772***	23.0334***
IQ	5554.82***	165.885***	165.416***	62.5276***
Pesaran (2021) Test				
Statistic	8.205***			
p-value	0.000			

Note: See under Table 1 for variable definitions. The H_0 for the first four tests is no cross-section dependence (correlation). For the last test the null is cross-sectional independence. Tests are conducted following the fixed effect estimation. *** denotes rejection of the H_0 at 1% significance level.

Table 3: Panel Pesaran (2007) CIPS unit root test

Variable	Level	First Difference
gyl	-5.475***	-
gkl	-3.991***	-
IQ	-2.959***	-

Note: See under Table 1 for variable definitions. H_0: Homogenous Non-Stationary. A constant is included. Max Lags=3. Critical values at 1%, 5% and 10% are -2.23, -2.11 and -2.05, respectively. *** denotes rejection of the H_0 at 1% significance level.

Table 4: Panel stationary/unit root test allowing for structural breaks

	CBL (2005) stationarity test				ILT (2010) Unit Root Test
	Bartlet Test		Quadratic Test		CA-LM Statistic
	Homogenous	Heterogeneous	Homogenous	Heterogeneous	
gyl	8.72981***	6.79836***	4.80939***	3.74910***	-75591.500***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	
gkl	0.10774	2.94214 ***	4.65969***	4.21485***	-83242.705***
	(0.45710)	(0.00163)	(0.00000)	(0.00001)	
IQ	1.70232**	4.83728***	3.29457***	2.80588***	-20608.901***
	(0.04435)	(0.00000)	(0.00005)	(0.00251)	

Note: See under Table 1 for variable definitions. CBL (2005) refers to Carrion-i-Silvestre, del Barrio-Castro and López-Bazo (2005) and ILT (2010) refers to the Im, Lee and Tieslau (2010) test. Both tests allow for two structural breaks in level and trend. The H_0 for the CBL (2003) is stationarity while H_1 indicates the presence of unit root. H_0 for the ILT (2010) is unit root. and for the ILT (2010) is a unit root. For the CBL (2003) test, Homogenous and Heterogeneous refer to the constancy of the variance of the error term, and the long-run variance is estimated using both the Bartlett and the Quadratic spectral kernel with automatic spectral window bandwidth selection. Both tests account for cross-sectional dependency and individual country breaks. Max lags=4). p-values are in bracket. *** denotes rejection of the H_0 at 1% significance level.

Table 5: Structural break tests

	Test Statistic	1% CV	5% CV	10% CV
$UDmax(tau)$	6.93***	6.09	4.74	4.13
Sequential test	Test Statistic	1% CV	5% CV	10% CV
$SupF_T(1\|0)$	4.57*	6.09	4.66	4.03
$SupF_T(2\|1)$	5.62**	6.59	5.24	4.64
$SupF_T(3\|2)$	8.07***	6.92	5.61	4.99
Detected number of breaks		3	3	3

Note: The detected number of breaks indicate the minimum and maximum number of breaks for which the null hypothesis of no break is rejected. Trimming=15%. *** denotes statistic significant at 1% and * at 10 % level.

Table 6: Location of the breaks

	Test Statistic	1% CV	5% CV	10% CV
$SupW(tau)$	5.80***	4.05	3.46	3.17
Break dates	[95% Conf. Interval]			
1993	1992		1994	
2002	2001		2003	
2007	2006		2008	

Note: *** denotes statistic significant at 1 % level.

Table 7: Panel regression (fixed effect) analysis with structural breaks

(1)	(2)	(3)	(4)	(5)	(6)
Regressor	Coeff	Regressor	Coeff	Regressor	Coeff
IQ	0.1133*** (0.0325)	$IQ_{1986-1993}$	0.0397* (0.0230)	$IQ_{1986-1993}$	0.0568** (0.0231)
		$IQ_{1994-2002}$	0.0484** (0.0222)	$IQ_{1994-2002}$	0.0617*** (0.0210)
		$IQ_{2003-2007}$	0.1062** (0.0507)	$IQ_{2003-2007}$	0.1191*** (0.0149)
		$IQ_{2008-2019}$	-0.0926 (0.0977)		
$cons$	-0.0626*** (0.0180)	$cons_{1986-2019}$	-0.0482*** (0.0074)	$cons_{1986-2019}$	-0.0556*** (0.0073)
		$D_{1994-2002}$	0.0250** (0.0100)	$D_{1994-2002}$	0.0251** (0.0095)
		$D_{2003-2007}$	0.0005 (0.0293)		
		$D_{2008-2019}$	0.1147** (0.0521)	$D_{2008-2019}$	0.0661*** (0.0083)
gkl	0.3832*** (0.0727)	gkl	0.3900*** (0.0709)	gkl	0.3861*** (0.0684)
N	31	N	31	N	31
No. obs	1054	No. obs	1054	No. obs	1054
R-squared	0.1634	R-squared	0.1848	R-squared	0.1827

Note: Equation (6) is estimated incorporating the three identified breaks. The independent variable is gyl, the growth rate of the real output per labour ($=\Delta lnyl$). gkl is the growth rate of the real capital stock per labour ($=\Delta lnkl$). IQ denotes the institutional quality. $cons$ denotes the constant which captures growth rate of the technological progress (λ). In the middle panel, the three break dates at 1993, 2002 and 2007 are incorporated, forming four regimes of 1986-1993, 1994-2002, 2003-2007 and 2008-2019 where IQ is estimated for each period following KNW (2022). The constant ($cons_{1986-2019}$) is regarded as the growth rate of the exogenous technological progress for the whole sample period, with three dummies ($D_{1994-2002}$, $D_{2003-2007}$ and $D_{2008-2019}$) incorporated to indicate changes in the constant in the respective second, third and fourth regimes. Hence the growth rate of the exogenous technological progress in the first period 1986-2003 is indicated by $cons_{1986-2019}$, and that for period 1994-2002, 2003-2007 and 2008-2019 equal to ($cons_{1986-2019}$ + $D_{1994-2002}$), ($cons_{1986-2019}$+$D_{2003-2007}$) and ($cons_{1986-2019}$+$D_{2008-2019}$), respectively. In the right panel, the equation is re-estimated with the insignificant $IQ_{2008-2019}$ and $D_{2003-2007}$ removed to simplify the model following suggestions by Kutner et al (2004) and Montgomery et al (2012). In other words, as they are insignificant, $IQ_{2008-2019} = 0$ and $D_{2003-2007} = 0$. Standard errors are in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01. See Appendices B and C for variable definitions.

Table 8: Regional average growth rate of TFP and its two components: institutional quality fostered productivity growth and the exogenous technological progress in SSA (1986-2019)

	Regional average growth rate of TFP (%)	Regional average institutional quality fostered productivity growth (%)	Regional average growth rate of the exogenous technological progress (%)
1986	-5.21	2.35	-7.57
1987	-4.33	2.39	-6.72
1988	-0.46	2.53	-2.98
1989	-0.84	2.63	-3.47
1990	-1.69	2.54	-4.23
1991	-2.08	2.44	-4.52
1992	-6.48	2.33	-8.80
1993	-3.72	2.39	-6.11
1994	-1.56	2.68	-4.24
1995	-0.40	2.88	-3.28
1996	2.69	2.99	-0.30
1997	0.36	3.39	-3.03
1998	-4.01	3.76	-7.77
1999	2.92	3.72	-0.80
2000	1.89	3.65	-1.76
2001	0.61	3.91	-3.30
2002	0.72	3.75	-3.03
2003	0.63	7.37	-6.75
2004	2.86	7.63	-4.77
2005	5.85	7.76	-1.91
2006	2.31	7.94	-5.63
2007	-0.96	7.96	-8.92
2008	-1.70	0.00	-1.70
2009	-4.85	0.00	-4.85
2010	3.70	0.00	3.70
2011	3.12	0.00	3.12
2012	4.49	0.00	4.49
2013	0.19	0.00	0.19
2014	2.18	0.00	2.18
2015	0.63	0.00	0.63
2016	2.40	0.00	2.40
2017	1.01	0.00	1.01
2018	1.30	0.00	1.30
2019	0.04	0.00	0.04
Period Average			
1986-1993	-3.10	2.45	-5.55
1994-2002	0.36	3.41	-3.06
2003-2007	2.14	7.73	-5.59
2008-2019	1.04	0.00	1.04

Note: They are averages of the 31 SSA countries. The above are calculated based on estimates in the right panel (i.e., Columns (5) and (6)) in Table 7. As the TFP is the portion of output not explained by the amount of inputs used in production, we follow You and Sarantis (2013) and measure the growth rate of TFP as the residuals of Equation (6) after the impact of the capital stock per labour is removed (i.e., the grow rate of $TFP_{it} = gyl_{it} - \hat{\alpha} gkl_{it}$ where $\hat{\alpha}$ is the estimated coefficient of kl, 0.3861). $\hat{\gamma} IQ_{it}$ is the institutional quality fostered productivity growth, where $\hat{\gamma}$ is the estimated coefficient of IQ and it has different values across regimes one to four (0.0568, 0.0617, 0.1191 and 0, respectively). The gap between the growth rate of TFP (first column in Table 8) and $\hat{\gamma} IQ_{it}$ (second column in Table 8) is the growth rate of exogenous technology (third column in Table 8). In other words, the growth rate of the exogenous technology is the portion of output growth not explained by input growth and institutional quality. Note that its period averages in the last four rows in Table 8 are almost identical to the respective estimates of the constant and dummies in the right panel in Table 7. Specifically, its period average during 1986-1993 is -5.55%, very close to the estimate of $cons_{1986-2019}$ of -0.0556. Its period averages during 1994-2002 (-3.06%), 2003-2007 (-5.59%) and 2008-2019 (1.04%) are nearly identical to that estimated in the right penal of Table 7 (i.e., $cons_{1986-2019} + D_{1994-2002} = -0.0305$, $cons_{1986-2019} + D_{2003-2007} = -0.0556$ as $D_{2003-2007}$ is insignificant and hence equals to 0, and $cons_{1986-2019}$+$D_{2008-2019}$=0.0105, respectively). The differences are due to the error term in the regression and are very small and negligible.

Table 9. Indicators chosen to construct the Rodrik's (2000) Institutions Quality Index and data source

Rodrik's (2000) Institutions	Measures/concepts by Rodrik (2000)	Data source and time ranges	Indicator adopted	Literature supporting the adopted indicator
a): Property rights institutions	The situation where the control rights are upheld by a combination of legislation, private enforcement, and customs and tradition	• ICRG's **Law and Order (1986-2019):** It is an aggregate measure with two elements assessed separately, with each element being scored from zero to six with six being the best score. The "Law" element refers to the strength and impartiality of the legal system while the "Order" element is an assessment of popular observance of the law. • WGI's **Rule of Law (1996-2019):** It captures the perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. ***Comments:*** Both series provide a sound measure for institutions of property rights. However, the ICRG series consists of two granular level of components of "law" and "order", and it starts from the mid-1980s while WGI series mid-1990s, marking it more suitable for our analysis.	ICRG's **Law and Order**	Knack and Keefer (1995); Claessens and Laeven (2003); Rodrik et al (2004); Demetriades and Law (2006); Amini (2014); Fernandez and Tamayo (2015)
b) Regulatory institutions	They refer to adequate prudential regulation and supervision institutions regulating conduct in goods, services, labour, asset, and financial markets such as Securities and Exchange Commission, Environmental Protection Agency, etc.	• ICRG's **Investment Profile (1986-2019):** Busse and Hefeker (2007) and Shan et al. (2018) highlight the importance of investment profile as an appropriate indicator of regulatory quality. It is an assessment of factors affecting the risk to investment that are not covered by other political, economic, and financial risk components. The risk rating assigned is the sum of three subcomponents, namely contract Viability/Expropriation, Profits Repatriation, and Payment Delays. Each has a maximum score of four (Very Low Risk) and a minimum score of zero (Very High Risk). The sum of these subcomponents is collected from ICRG for our sample countries. • WGI's **Regulatory Quality (1996-2019)** captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development ***Comments:*** Both provide a close measure for regulatory institutions. However, the ICRG series consists of four sub-components and it starts from the mid-1980s, earlier than the WGI series. Hence, it is more appropriate for our analysis.	ICRG's **Investment Profile**	Busse and Hefeker (2007); Gazdar and Cherif (2014); Shan et al (2018); Barra and Falcone (2023)
c) Institutions for macroeconomic stabilisation	They refer to the fiscal and monetary institutions that perform stabilising functions. Following Rodrik (2000), they are captured in the following three indicators: i) Central bank independence, ii) The presence of automatic stabilisers, and	i) Central bank independence • The **Extended Central Bank Independence Index (1923-2023)** by Romelli (2022, 2024): it extends the widely adopted central bank independence index of Cukierman, Webb, and Neyapti (CWN) (1992) to include 46 criteria under 6 dimensions. • The **Central Bank Independence Index (1972-2014)** by Garriga (2016), Garriga and Rodriguez (2023): it extends the CWN (1992) index to include 16 criteria under 4 dimensions. • The **Central Bank Independence Index** by Adrian et al (2024) from year 2010 and available for every 3-5 years after 2010: it draws on a comprehensive dataset from the IMF's Central Bank Legislation Database (CBLD) and Monetary Operations and Instruments Database (MOID) and weightings derived from a survey of 87 respondents, mostly consisting of central bank governors and general counsels. ***Comments:*** All three series are suitable indicators for central bank independence. Both first two extend the CWN (1992) index which has been the de facto standard for measuring central bank independence since 1992. The third series proposes a new index, but the relatively limited period it covers makes it less feasible	i) The **Extended Central Bank Independence Index** (1923-2023) by Romelli (2024) supplemented by Garriga and Rodriguez (2023) (see Appendix B)	i) Bergman and Hutchison (2014), Chowdhury et al., (2024)

	iii) Safeguard measures against self-fulfilling crises.	for our study. Therefore, we adopt Romelli's (2024) Extended Central Bank Independence as it encompasses more criteria and dimensions and only refer to Garriga and Rodriguez (2023) for any SSA countries that are not covered by Romelli. See Appendix B for more discussion on how we obtain the central bank independence index. ii) The presence of automatic stabilisers Following Bondzie and Armah (2022), budget balance as a percentage of GDP is used to measure the presence of automatic stabilisers. • ICRG's **Budget Balance as percentage of GDP (1986 - 2019):** The risk points were generated from data on the estimated general government budget balance for the current year and for the preceding five years as percentage of the estimated GDP for the year in question. The risk points which range from zero (deficit balance) to ten (surplus balance). • WDI's **Overall surplus/deficit divided by GDP (1986-2012)** • IMF's **Cyclically adjusted balance, percent of potential GDP (2015-2019)** ***Comments:*** ICRG's data is more appropriate not only because it covers the longest period, but also due to that it converts % into risk points, making it consistent with indicators for other institutions. iii) Safeguard measures against self-fulfilling crises Following Huang and Lin (2021), the current account balance as a percentage to GDP is employed to reflect the safeguard measures against self-fulfilling crises. • ICRG's **Current Account Balance as a percentage of GDP (1984 -2019)**: The risk points range from zero to fifteen with a value closer to fifteen indicating a higher positive current account balance. • WDI's **Current account balance (% of GDP) (1990, 2000, 2014 to 2023)** • IMF's **Current account balance, percent of GDP (1980 to 2019)** ***Comments:*** All three are suitable but ICRG's data works better based on its time coverage and that it converts % to risk points and hence is more consistent with indicators for other institutions.	ii) ICRG's **Budget Balance as percentage of GDP** iii) ICRG's **Current Account Balance as a percentage of GDP**	ii) Clement (1959), Symansky and Baunsgaard (2009), Bondzie and Armah (2022) iii) Obsfeld (2012), Davis et al. (2016), Topal and Gül (2016), Febrero et al., (2018), Huang and Lin (2021)
d) Institutions for social insurance	An expansion of publicly provided social insurance programmes, social security, unemployment compensation, public works, public ownership, deposit insurance, and legislation favouring unions among others	• World Banks's **The Atlas of Social Protection - Indicators of Resilience and Equity (ASPIRE) (1986-2019)**: Specifically, we adopt the public spending on all social assistance programs (PSOSAP) as the most appropriate indicator of the extent and strength of institutions for social insurance. It includes not only social insurance but also all other social assistance programs (SIAP) (Wibbels and Ahlquist, 2011; World Bank, 2023). For our 31 sample countries, in a year that a country reported a spending on all social assistance programmes, a value of one is assigned and zero otherwise (Anderson, 2016). • Social Policy Indicator (SPIN) database's **Social Insurance Entitlements dataset (1930-2015):** It consists of gross and net value variables of the four insurance programs in the 34 countries between 1930 and 2015. Only European countries are included. • International Labour Organisation's **World Social Protection Database** (WSPDB**) (2000-2019):** It includes data on social insurance indicators that incorporate social security systems, adequacy of benefits, social protection expenditure among others.	World Banks's **ASPIRE**	Fiszbein et al., (2013), Bird and Hanedar (2023), Brollo et al. (2024)

		Comments: All three series are suitable in reflecting the institutions for social insurance, but the second does not include any African countries and stops at year 2015 and the third starts in 2000.		
e) Institutions for conflict management	Institutions that prevent social conflict along ethnic or income lines. Examples include rule of law, a high-quality judiciary, representative political institutions, free elections, independent trade unions, social partnerships, institutionalised representation and minority groups.	• ICRG's **Internal Conflict (1986 to 2019):** It is a sub-indicator under the Political Stability and Absence of Violence/Terrorism. It is an assessment of political violence in the country and its actual or potential impact on governance. The subcomponents in this indicator are civil war or coup threat, terrorism or political violence, and civil disorder. The highest rating (four) is given to those countries where there is no armed or civil opposition to the government and the government does not indulge in arbitrary violence, direct or indirect, against its own people. The lowest rating (zero) is given to a country embroiled in an on-going civil war. Internal conflict indicator is the sum of the three subcomponents. • WDI's **Political Stability and Absence of Violence/ Terrorism (1996 -2019)**: Perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. ***Comments:*** Both series show similar definition and are closely linked to Rodrik's concept for the institutions for conflict management. However, the ICRG series is adopted based on time coverage.	ICRG's **Internal Conflict**	Lessmann (2016), Ongo Nkoa et al (2016), Li et al., (2024)
Democracy	Participatory democracy in the form of social and political institutions that encourage participation, negotiation, and compromise.	• ICRG's **Democratic Accountability (1986-2019):** This is a measure of how responsive government is to its people on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one. This indicator focuses on democracy and civil liberty and takes values between zero (weak) to six (strong). The points are awarded depending on the type of governance enjoyed by the country in question. The highest points (lowest risk) are assigned to alternating democracies, while the lowest points (highest risk) are assigned to autarchies. • WDI's **Voice and Accountability (1997-2019)**: It captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. • Polity Database's (Polity V) **Institutionalised Democracy Index (1977-2018):** The operational indicator of democracy is derived from codings of the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. • Economic Intelligence Unit's **Democracy Index (2006-2019)**: The extent to which citizens can choose their political leaders in free and fair elections, enjoy civil liberties, prefer democracy over other political systems, can and do participate in politics, and have a functioning government that acts on their behalf. ***Comments:*** All four measures are closely aligned with Rodrick's (2000) concept of Democracy. Although both ICRG and the Polity Database go back to the mid-1980s, the latter stops at 2018, making ICRG's series more suitable for Democracy given our sample period of 1986-2019.	ICRG's **Democratic Accountability**)	Rodrik (1999), Asiedu and Lien (2011)

Note: ICRG and WGI denote International Country Risk Guide and World Governance Indicators respectively.

Table 10. An overview of ICRG and WGI database

Dataset	Dimensions	Years and Coverage	Data Sources
ICRG	22 dimensions under 3 categories of risk: political, economic and financial. The 22 dimensions include Government Stability, Socioeconomic Conditions, Investment Profile, Internal Conflict, External Conflict Corruption, Military in Politics, Religious Tensions, Law and Order, Ethnic Tensions, Democratic Accountability, Bureaucracy Quality, GDP Per Head, Real GDP Growth, Annual Inflation Rate, Budget Balance as a Percentage of GDP, Current Account as a Percentage of GDP, Foreign Debt as a Percentage of GDP, Foreign Debt Service as a Percentage of Exports of Goods and Services, Current Account as a Percentage of Exports of Goods and Services, Net International Liquidity as Months of Import Cover, and Exchange Rate Stability.	1986 to 2019; the data covers all 31 SSA countries included in our study.	The database collects political information and financial and economic data, converting these into risk points for each individual risk component on the basis of a consistent pattern of evaluation. The political risk assessments are made on the basis of subjective analysis of the available information, while the financial and economic risk assessments are made solely on the basis of objective data
WGI	6 dimensions of Governance Indicator, which include Voice and Accountability, Political Stability and Absence of Violence/ Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption	1996 to 2019; the data covers all 31 SSA countries included in our study.	There are 35 different existing data sources, capturing subjective perceptions of the quality of various dimensions of governance reported by experts and survey respondents worldwide.

Note: ICRG and WGI denote International Country Risk Guide and World Governance Indicators, respectively.

Figure 1. Rodrik's (2000) concept of market-supporting institutions and African Union's Agenda 2063 Goals & Priority Areas.

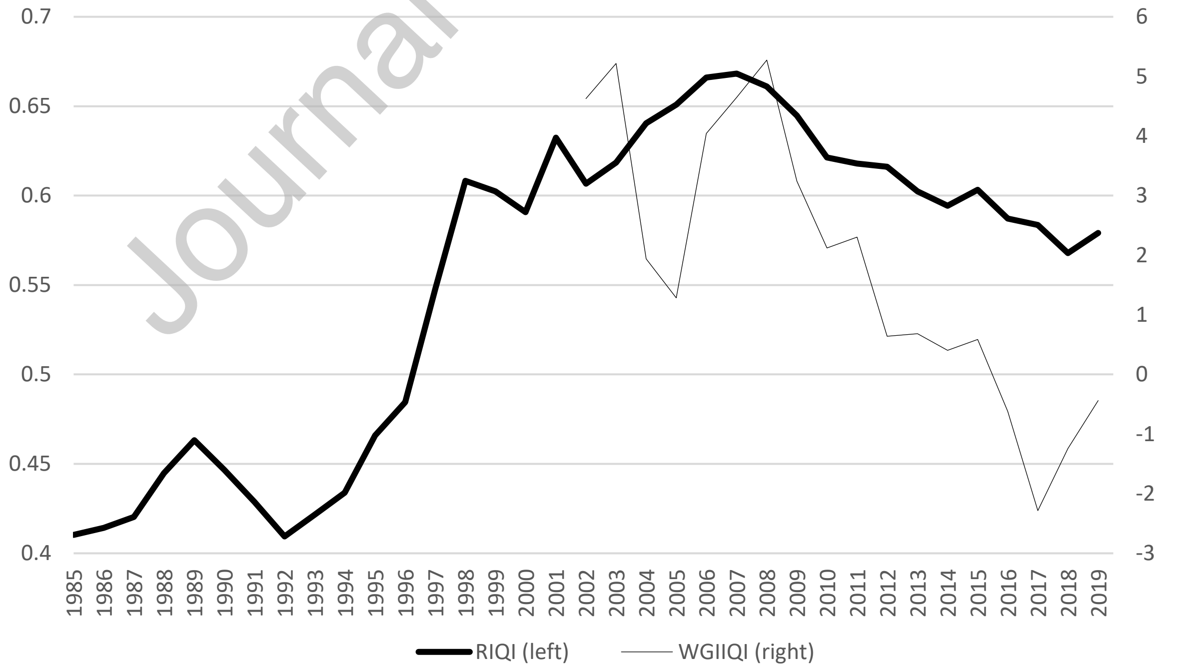
Rodrik's (2000) concept of market-supporting institutions	African Union's Agenda 2063 Goals & Priority Areas
Democracy	**11** Democratic values, practices, universal principles of human rights, justice and the rule of law entrenched. * Democracy and good governance * Human rights, justice and the rule of law
Property Rights	**11** Democratic values, practices, universal principles of human rights, justice and the rule of law entrenched. * Human rights, justice and the rule of law
Regulatory Quality	**12** Capable institutions and transformative leadership in place. * Participatory development and local governance.
Conflict Management	**14** A stable and peaceful Africa. * Institutional structure for AU instruments on peace and security
Macroeconomic Stablisation	**9** Continental financial and monetary institutions established and functional. * Financial and monetary institutions
Social Insurance	**1** A high standard of living, quality of life and well-being for all citizens. * Poverty, inequality and hunger * Social security and protection, including persons with disabilities

Note: The African Union's Agenda 2063 Goals & Priority Areas can be viewed via www.au.int/agenda2063/goals. 1, 9, 11, 12, 14 are the No. of Goals and * denotes the Priority Areas.

Figure 2. Intuitional Quality Index in 31 SSA countries (1986-2019)

Note: See Appendix B for information on the construction of the Intuitional Quality Index.

Figure 3. Our Rodrik's (2000) Institutional Quality Index (RIQI) (left axis) and the Kaufmann et al. (2006) WGI based Institutional Quality Index (WGIIQI) (right axis)



Note: Regional averages of these two series are used in the figure. WGI stands for the World Governance Indicators.

Figure 4. Institutional quality (left axis) and the growth rate of outpour per labour (right axis) of the SSA region

Note: Regional average of these two series are used. The three vertical lines at year 1993, 2002 and 2007 are added for illustration and are based on the estimated break date using the KNW (2002) method.

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