



Alternating Heads of State And Structural Transformation In Sub-Saharan Africa: A Panel VAR Analysis

Tourere Zenabou¹ , Nzepang Fabrice²

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Corresponding Author(s):

Nzepang Fabrice

Cameroon Economics Society and University of Douala, Cameroon.
Email: fabricenzepang@gmail.com

Abstract: This study examines the dynamic interaction between head-of-state alternation and structural transformation in sub-Saharan Africa (SSA), an issue that has received limited attention compared with the established literature on political alternation and economic growth. Using data from Limi Kouotou and Epo (2019), the Africa Sector Database, and World Development Indicators for 17 SSA countries over 1970–2015, the study estimates a panel vector autoregression (pVAR) model. The study examines structural transformation through two components: structural change and intra-industry productivity. The results show that innovations in head-of-state alternation are more strongly associated with structural change than with intra-industry productivity. The impulse-response analysis further indicates that head-of-state alternation responds positively to structural-change shocks and negatively to intra-industry-productivity shocks. Forecast-error variance decomposition shows that innovations in head-of-state alternation explain 25.5% of the variance in structural change and 13.4% of the variance in intra-industry productivity, while FDI accounts for 51.2% of the forecast-error variance in head-of-state alternation. The study contributes to the literature by moving beyond the conventional growth–politics relationship and demonstrating the dynamic association between political alternation and the components of structural transformation in SSA.

Keywords: Alternation of Heads of State, Intra-Industry Productivity, Structural Change, Panel VAR, Sub-Saharan Africa

JEL Classification: K00, O10, O11, O55

1. Introduction

Alternation of power is a principle of democracy, and as an institutional factor, it likely affects the structural transformation of developing economies. Structural transformation means reallocating economic resources from low- to high-productivity sectors. Broadly, it's a redistribution of economic activities and labor to major sectors such as manufacturing and services (Marcolino, 2022). The shift involves migrating labor and other resources to the modern sector. McMillan et al. (2014, 2017) understand it in its two components: intra-industry and structural change. The intra-industry component reflects each sector's capacity to generate internal productivity, while structural change reflects the diffusion of productivity across the economy. Structural transformation is therefore a necessity for developing countries, particularly those in sub-Saharan Africa (SSA), as it can generate sufficient employment, reduce poverty and inequality, and sustain growth (African Development Bank Group [AfDB], 2020, 2017; ECA, 2016). For Lin (2012), an economy's structure is endogenous to its factor endowments, and sustainable economic development depends on changes in factor endowments and continuous technological innovation. These changes are multidimensional and include the production matrix, social structure, institutional framework, and relationship with the natural environment (Nissanke, 2019; Armah and Baek, 2019). Thus, recent literature focuses more on the factors that drive productivity and economic growth. Among many other determinants, political institutions generally and alternation of power specifically are cited in the literature as explanatory variables (Limi Kouotou and Epo, 2019).

More than 20 years after the start of democratic renewal in Africa, stylized evidence shows that country practice offers a mixed record (Senou, 2016). Indeed, many rulers don't intend to leave power once they acquire it and refuse to apply texts that favor alternation at the top of the state. We're thus witnessing those in power manipulating the constitution to keep the president of the Republic in place for life. The unconstitutional desire to remain in power, despite internal pressure and interference from the international community, proves that the alternation of leaders remains a problem for democracy in Africa. The question remains: How does the alternation of heads of state interact with structural transformation, particularly structural change and intra-industry productivity, in sub-Saharan Africa?

However, if alternating heads of state can affect economic variables, the reverse may also be true. For example, strong economic performance can incentivize some countries to avoid alternating heads of state. Poor economic performance could also promote alternating heads of state through, for example, a coup d'état. According to the modernization hypothesis, democratic change depends on a level of economic development (Acemoglu et al., 2018). In a society characterized by poor economic performance, the transition to a more democratic political regime may be accompanied by political instability in the form of strikes,

^{1,2} Faculty of Economics and Applied Management of the University of Douala, Cameroon

^{1,2} Cameroon Economics Society, Cameroon

riots, and abrupt changes of government that negatively affect economic growth. In this context, alternating heads of state is likely to lead to social unrest, riots, and violence. This view contrasts with another approach in political economy, the critical junctions hypothesis, which holds that institutional change affects both economic and political growth. According to Acemoglu et al. (2018), most previous work on the determinants of democracy uses cross-sectional regression analysis to study the causal relationship between income and democracy. These authors argue that it's important to control for common variables that affect both income and democracy. The simplest way to do this is to study the relationship between income and democracy in a panel of countries and control for country fixed effects.

This paper analyzes the interaction between alternating heads of state and structural transformation in SSA. This paper contributes by highlighting the effects of alternating heads of state on structural transformation in SSA, an aspect that remains poorly understood in the literature. This paper has a triple interest. Firstly, it positions the alternation of heads of state at the heart of development policies and the democratic process. Indeed, the alternation of heads of state is essential for renewing political institutions and public administrations, which are sources of political and managerial innovations likely to affect the structural transformation of sub-Saharan economies. Second, it supports the argument that democracy drives economic growth. Although the idea that the benevolent dictator facilitates economic growth remains well established in the economic literature (Easterly, 2011), autocratic leaders are often credited with strong economic performance (e.g., the recent success of Asian economies). The recent literature increasingly casts serious doubt on the benevolent autocrat hypothesis and shows that positive-growth autocrats are rare, and sometimes even rarer, while negative-growth autocrats abound (Acemoglu et al., 2018; Madsen et al., 2015; Easterly and Pennings, 2017). The fragility of the benevolent dictator hypothesis, particularly in sub-Saharan Africa, justifies the push for democracy as an engine of economic growth. In this context, alternating heads of state, a key modality of democracy, becomes a key lever for better economic outcomes. Finally, it reinforces the idea that structural transformation, essential for the economic development of sub-Saharan economies, can't be achieved without improved political institutions, and it adds to the literature on the determinants of structural transformation. Our results suggest that alternation of heads of state is likely to promote structural transformation in SSA and recommend that sub-Saharan economies promote systematic alternation of their heads of state.

2. Literature Review And Theoretical Background

Neoclassical analysis has relegated institutions to the background. Institutions refer to the set of formal and informal norms or socio-political structures, as established by laws or customs. Coase (1937) was one of the first to incorporate institutions into his analyses and show that they affect firm functioning and economic performance. Institutional and political factors are now seen as the main explanatory variables of productivity and economic development. As a result, a vast literature examining institutions' effects on economic development has emerged. North (1990) focused on political regimes and showed that democracy is an important factor in development, while Easterly (2001) went further, pointing out that these institutional factors also help explain the backwardness of underdeveloped economies. Political alternation usually takes the form of rotating the head of the executive or the composition of the parliamentary majority (Lodge, 2013). Event Fosu (2008) recognizes that this aspect of democracy is problematic because developing countries, particularly those in SSA, are characterized by the permanence of the head of the executive and the party with the majority in parliament.

The relationship between alternation of power and structural transformation is situated in the framework of institutional economic theory. Indeed, political alternation, which is the orderly rotation of executive power between political parties and their leaders during elections, is increasingly seen as a determining and indispensable factor of democracy (Ruel, 2021; Otjes and Willumsen, 2019; Kpegli and Bator, 2019). The alternation of heads of state is a principle that, when violated, provides tangible evidence of non-democracy. The alternation of heads of state influences national development strategies through individuals and institutions that may actively devalue areas of development that don't appear important to national development goals. Influential individuals, for example, drive change through government policies and collective action by developing ideas for change. Thus, key actors' ideas, followed by the formation of a reform discourse, mediate new institutional change. Often, the formation of a new institution then weakens the legitimacy of change processes and, as a result, enables institutional change.

Furthermore, institutional changes in emerging economies pressure organizations to decide whether and how to respond in volatile, dynamic environments through strategic change (Choi et al., 2021). Under uncertainty, organizations may find it harder to assess the potential impact of changes and may be less motivated to develop alternative strategies. Julio and Yook (2012) and Zhong et al. (2019) suggest that politician turnover generates policy uncertainty or unpredictability, as successors enjoy a large degree of autonomy. Environmental uncertainty increases the value of expectations for firms and therefore discourages firms from changing strategy. An increase in political uncertainty may therefore reduce the extent of strategy change by firms. In the context of political rotation, this reduction suggests that firms will be reluctant to change strategy before possible negative shifts in the political environment. However, the outcome of a political change is sometimes interpreted as good news, regardless of the successor's identity (Julio and Yook, 2012).

The empirical literature is silent on the interaction between alternating heads of state and structural transformation. Existing works study the effects of alternation in power on economic growth. Limi Kouotou and Epo (2019), for example, analyze the impact of alternating leaders on economic growth in SSA, using a panel of 42 countries between 1970 and 2016. Using generalized least squares, they conclude that alternating leadership affects economic growth in an ambivalent way. Indeed, the authors find that the number of leadership alternations positively affects long-term growth. However, effects vary by language and geography, reflecting cultural differences. Although Limi Kouotou and Epo (2019) conclude that alternation of heads of state positively affects economic growth, they stress that SSA countries should seek a good balance in the pace and conditions of leader alternation. In contrast, most studies examine the effects of democracy in general on economic growth or other economic indicators. These studies also produce contrasting results; some find a positive effect of democracy on economic growth (Kpegli and Bator, 2019; Acemoglu et al., 2018; Ben Doudou and Rahali, 2018; Gründler and Krieger, 2015) while others find a negative, ambiguous, or no effect (Boll and Sidki, 2021; Gandjon Fankem, 2018). These studies usually use a measure of democracy, but this approach doesn't specify which factor or element of democracy matters. One way is to distinguish the different realities or practices encompassed by the term democracy, and here some authors prefer to focus directly on the effects of alternations.

These studies distinguish leadership alternation (a change in personnel in control of the executive) from ideological

alternation (a rotation of power between parties or coalitions with different ideologies) (Hoff et al., 2005). Regarding the context of developing economies, more specifically SSA, studies that analyze the effects of alternation of power on economic growth ignore the structural aspect because although SSA has experienced strong growth for more than twenty years, this growth doesn't bring about structural transformation (AfDB, 2020; Cadot et al., 2016; Cadot and Melo, 2016). It's necessary to consider economic structure rather than growth. This article follows this path and highlights the effects of alternating heads of state on the structural transformation of sub-Saharan economies.

2.1. Alternation Of Heads Of State And Structural Transformation: Definitions And Measurements

The data needed to measure the alternation of heads of state are primary data collected by Limi Kouotou and Epo (2019). These authors derive the explanatory variable describing leader alternation by reviewing the political history of 42 African countries. This variable indicates the number of leadership alternations since 1960. Indeed, history records this year as the start of the independence era for most countries. This alternation variable therefore takes the value 0 each year before a country's first accession of a new head of state to power. It takes the value 1 from the year of this first accession to the year preceding the second. It takes the value 2 from the second accession to the year before the third accession and so on. This variable reaches its highest value between the year of the last accession to power and 2016. A second variable is a dummy equal to 1 if the year of alternation considered is a year of planned alternation or an election to renew the head of state, and 0 otherwise. This last variable is exogenous because it correlates with the number of alternations, but not with structural transformation. It captures unplanned changes of government, such as coups d'état, and the ensuing unrest, such as civil wars. Annex 1 presents detailed figures on these variables. We will adjust this variable so the reference year is 1970, as this work covers 1970-2015.

The data on structural transformation come from the Africa Sector Database (ASD) by Mensah and Szirmai (2018), an extension of the Groningen Growth and Development Center (GGDC) by Timmer and de Vries (2009). The ASD covers 11 sectors in 18 SSA countries, but Zambia is excluded because the source used by Limi Kouotou and Epo (2019) does not include it. The ASD provides value-added and employment data on 11 key sectors in SSA economies over a long period, but it does not provide data beyond 2016. We extracted the two components of structural transformation from these data using the Fabricant (1942) method. This is the most widely used and appropriate method for extracting the two components of structural transformation from sectoral data on employment and value added (McMillan et al., 2014; McMillan and Rodrik, 2011). Details of Fabricant's (1942) method are as follows:

$$\Delta Q = \sum_t (q_t^1 - q_t^0) s_t^0 + \sum_t (s_t^1 - s_t^0) q_t^1$$

Where ΔQ is the change in productivity between two periods, q_t^k and s_t^k represent the value added and employment rate in industry t in period k , respectively. The first term refers to intra-industry productivity, which McMillan et al. (2017) call the "fundamentals" of the economy. The second term, which captures the reallocation of workers across industries, is the structural change. Having shown how we obtained our variables, we now provide an overview of these variables in SSA.

2.2. Alternation of Heads Of State And Structural Transformation In SSA: An Overview

We then present the relationship between the alternation of heads of state and each component of structural transformation, namely intra-industry productivity and structural change. Table 1 ranks countries by the number of changes in heads of state and by the contribution of structural change to total productivity growth in SSA. The superscript numbers in the country names indicate the rank, in ascending order, by contribution to total productivity growth.

Table 1: Ranking of countries by number of changes of heads of state and contribution of structural change to total productivity growth in SSA

Countries	Number of alternations from 1960 to 2015	Average contribution of structural change to total productivity growth
Nigeria ¹¹	12	-3.43e-06
Ghana ⁴	11	-0.1481
South Africa ³	11	7.55e-06
Uganda ¹⁰	7	-1.41e-06
Burkina Faso ¹⁵	6	-6.99e-07
Ethiopia ⁸	6	-5.76e-05
Malawi ⁷	5	-4.88e-05
Mauritius ⁹	5	-9.16e-05
Rwanda ¹²	5	-3.63e-06
Tanzania ¹⁶	5	-7.29e-07
Botswana ⁵	4	-0.00591
Kenya ¹³	4	-9.62e-06
Lesotho ¹	4	0.00361
Mozambique ²	4	0.000458
Senegal ¹⁴	4	-1.80e-07
Namibia ⁶	3	-0.000153
Cameroon ¹⁷	2	-1.02e-08

Sources: authors with data from Limi Kouotou and Epo (2019) and ASD

Table 1 shows that head-of-state turnover is highly heterogeneous in SSA. Nigeria, Ghana, and South Africa have had the most changes in heads of state, with 12 for Nigeria and 11 for the other two. Among the worst-ranked countries are Senegal, Mozambique, Lesotho, Kenya, and Botswana, with 04 alternations; Namibia, with 03 alternations; and Cameroon, which closes the ranking with 02 alternations. It also emerges from this ranking that the non-Francophone countries, Senegal and Cameroon, occupy the last places in the ranking and are responsible of the contribution of structural change to total productivity growth, the three French-speaking countries of Senegal, Burkina Faso and Cameroon are ranked 14th, 15th and 17th respectively. The Anglo-Saxon countries rank first, with Lesotho in first place, Mozambique in second place, and

South Africa in third place. When looking at the number of shifts and the contribution of structural change to total productivity growth together, it becomes clear that, apart from Burkina Faso and Uganda, countries that rank high in shifts also rank high in the contribution of structural change to productivity growth. The same holds for countries that rank poorly in shifts, which also rank poorly in the contribution of structural change to total productivity growth, apart from Namibia and Lesotho. Regarding the number of changes in heads of state and the contribution of intra-industry productivity to total productivity growth, Table 2 shows SSA countries ranked by the number of changes in heads of state and by the contribution of intra-industry productivity to total productivity growth. As in Table 1, the superscript numbers in the country names indicate the rank in ascending order of the contribution of intra-industry productivity to total productivity growth.

Table 2: Country rankings by number of alternating heads of state and contribution of intra-industry productivity to total productivity growth in SSA

Countries	Number of alternations from 1960 to 2015	Average contribution of intra-industry productivity to total productivity growth
Nigeria ⁷	12	-0.299
South Africa ⁶	11	-0.2534
Ghana ⁸	11	-0.7295
Uganda ¹⁷	7	-6.9098
Burkina Faso ²	6	1.5555
Ethiopia ¹⁶	6	-6.4153
Mauritius ⁵	5	0.0753
Malawi ⁹	5	-0.801
Tanzania ¹	5	2.8886
Rwanda ¹⁴	5	-3.5146
Senegal ¹⁰	4	-1.3779
Kenya ¹¹	4	-1.6266
Mozambique ¹²	4	-1.933
Lesotho ¹³	4	-3.2816
Botswana ¹⁵	4	-3.8709
Namibia ³	3	0.4028
Cameroon ⁴	2	0.3079

Sources: authors with data from Limi Kouotou and Epo (2019) and ASD

The relationship between alternations of heads of state and the contribution of intra-industry productivity is ambiguous in Table 2. Indeed, the two countries with the fewest alternations, Cameroon and Namibia, have a high intra-industry productivity contribution, while the effect is the opposite for some countries with the most alternations, such as Ethiopia and Uganda. Nevertheless, the three countries with the most shifts rank in the top half for intra-industry productivity. For the other countries, intra-industry productivity ranks are close to those for alternations because the difference between the two is small or zero. Beyond this country-specific presentation, we can provide a general overview of the evolution of head-of-state alternation and structural transformation in SSA. Figure 1 presents the evolution of the average number of head-of-state alternations and the average contributions of intra-industry productivity and structural change to total productivity in SSA jointly. Each variable in Figure 1 has its own scale for visibility. We focus only on the dynamics here, and the fact that the structural change curve is generally above the intra-industry productivity curve doesn't always reflect reality.

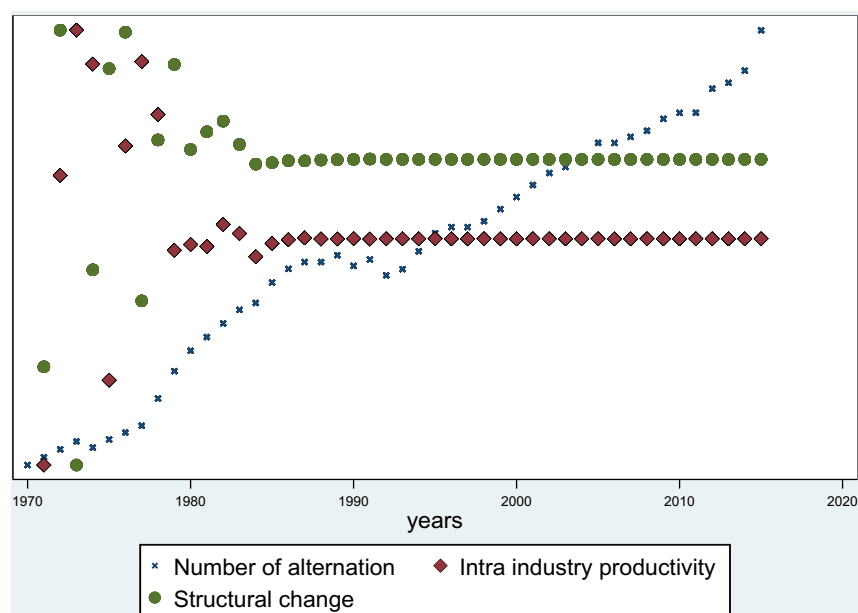


Figure 1: Evolution of the average number of alternating heads of state and the average contributions of intra-industry productivity and structural change to total productivity in SSA. **Sources:** authors with data from Limi Kouotou and Epo (2019) and ASD

Figure 1 shows that intra-industry productivity and structural change evolve similarly. The dynamics of these two

variables, which were ambiguous from 1970 to 1984, remained stagnant for the rest of the period. In contrast, the average number of alternations of heads of state increased over the entire study period. These observations show that the relationship between the alternation of heads of state and the structural transformation of SSA countries remains complex and warrants further analysis.

3. Methodology

The methodology focuses on two points: the first presents the data sources and variables, while the second covers the model specification and estimation method.

3.1. Data Sources And Variables Used

This study draws on three data sources. The first is Limi Kouotou and Ep (Appendix 1), which provides data on the number of times heads of state were elected and the year of election; it covers 1970 - 2016. We extracted data for the 1970 - 2015 period covered by this study. The second source is the ASD by Mensah and Szirmai (2018), which is an extension of the Groningen Growth and Development Center (GGDC) by Timmer and de Vries (2009). The ASD covers 11 sectors in 18 SSA countries, but Zambia is excluded because Limi Kouotou and Epo (2019) omit it from the source they use. The ASD allows us to capture intra-industry productivity and structural change, the two components of structural transformation, using Fabricant's (1942) method.⁹⁴² Finally, the World Development Indicators (WDI) of the World Bank provide additional explanatory variables. In summary, our data cover 17 SSA countries from 1970 to 2015. Intra-industry productivity and structural change are the two variables to be explained, while the number of changes in heads of state is our variable of interest. Control variables include net foreign direct investment (FDI) inflows, gross domestic product (GDP) growth rate per capita, public debt as a percentage of GDP, natural resource profits as a percentage of GDP, and the expected year of changeover. FDI captures external capital flows and is measured as a percentage of GDP. Massive capital inflows stimulate intra-industry productivity. GDP, by contrast, initially reflects a country's economic size. Natural resource profits as a percentage of GDP expresses the specificity of SSA countries as natural resource exporters. Finally, public debt captures SSA countries' level of indebtedness. Indeed, public debt increases following a change of government when the new head of state wants to carry out major works.

3.2. Model Specification And Estimation Method

Our model follows Moussir and Chatri (2019) and is based on the framework of endogenous growth theory. This framework supports the idea that technical progress depends on several factors likely to sustain long-term growth. Institutional theory is part of this framework and argues that institutional quality can influence the productivity of factors of production. These institutions, which generate the system of governance, are based on various values, one of the most important being democracy (North, 1990). Moreover, the literature is unanimous that structural transformation, a dynamic phenomenon, must be assessed with a dynamic model (Lectard, 2016). According to the panel structure of our data, the specification of the model is as follows:

$$y_{it} = \tau_0 + \beta y_{it-1} + \omega x_{it} + v_{it} \quad (1)$$

avec $i = 1 \dots N, \quad t = 1 \dots T$

Where y_{it} is the dependent variable (intra-industry productivity in the first equation and structural change in the second, y_{it-1} is the lagged dependent variable, τ_0 is a constant, ω is an $N \times 1$ vector of estimated parameters, i is the country, t is the period, and x_{it} is the (i, t) observation on K explanatory variables (including the alternating variables and the control variables). β is the parameter that measures the weight of the lagged dependent variable, and v_{it} is the error term. As McMillan and Rodrik (2011) point out, at the beginning of the structural transformation process, intra-industry productivity first improves. After this improvement, labor reallocates from low- to high-productivity sectors. This precision means intra-industry productivity explains structural change, so we cannot estimate the two equations separately. We thus obtain a system of two equations where the first equation is included in the second equation of the following form:

$$\begin{cases} y_{ait} = \tau_{a0} + \beta_a y_{ait-1} + \omega_a x_{ait} + v_{ait} \\ y_{bit} = \tau_{b0} + \beta_b y_{bit-1} + \omega_b x_{bit} + \theta y_{ait} + v_{bit} \end{cases} \quad (2)$$

In this system of equations, y_{ait} represents intra-industry productivity, y_{bit} represents structural change, and θ represents the share of structural change explained by intra-industry productivity. The other variables and parameters retain the same meaning as in equation (1), provided that the equation for estimating intra-industry productivity is differentiated from the equation for estimating structural change marked by the subscripts a and b . The fact that y_{bit} depends on y_{ait} creates endogeneity and implies that the error terms of the equation system must be correlated.

The literature offers several methods to assess the interaction between institutions and countries' economic performance. Instrumental variables make it possible to estimate such a system in reduced form. While it allows for endogeneity in some variables, it cannot correct for heteroscedasticity in the system error variance. Methods exist that address both problems simultaneously, although this depends on the system's identification. If the equation is correctly identified, indirect least squares (ILS) or two-step least squares (2SLS) are applicable. However, only 2SLS applies if the model is over-identified (Bourbonnais, 2015). The 2SLS method corrects for endogeneity problems and thus allows the effects of economic performance on institutions to be considered. Voigt and Gutmann (2013) also used this method to analyze the effect of judicial independence and property rights on economic growth. However, 2SLS doesn't allow for all directions of causality between variables, nor does it capture long-run effects. To address these shortcomings, we use a panel vector autoregression (pVAR) model to analyze the interaction between alternating heads of state and structural transformation in SSA. The pVAR model is justified by the fact that it doesn't impose a priori restrictions on the exogeneity et endogeneity of variables (Gossé et Guillaumin, 2014). It also captures both static and dynamic interdependencies. The specification of the pVAR model is as follows:

$$Y_{it} = A_0 + A_1 Y_{it-1} + A_2 Y_{it-2} + \dots + A_p Y_{it-p} + v_{it}$$

Where Y_{it} is the vector of dependent variables (this is all the variables presented in the first point of the methodology), $Y_{it-1}, \dots, Y_{it-p}$ are vectors of the lagged variables of Y_{it} at periods $t-1, \dots, t-p$. A_0 is the vector of constant parameters,

$A_{j \neq 0}$ is the vector of parameters associated with the lagged variables, i represents the country, t the period, and v_{it} the error term. Moreover, the pVAR allows estimation of parameters that are consistent and robust to variable omission, simultaneity, and endogeneity (Ahmad, 2024). We determined the number of lags by comparing the various information criteria known in the literature, as shown in Table 3. Specifically, we used the three selection models. First, we used the MMSC-Bayesian information criterion (MBIC), followed by the MMSC-Akaike information criterion (MAIC) and, finally, the MMSC-Hannan and Quinn information criterion (MQIC). We selected the optimal lag order for the panel VAR rather than for each panel member separately. Table 3 shows that the one-lag model is the most appropriate. We estimated these parameters using the Arellano-Bond GMM procedure via the 'pvar' command in STATA (StataCorp LP, 2009). We also add time fixed effects, country-specific fixed effects, and a binary instrument indicating whether a change of government occurred during a presidential election year. This variable allows us to account for democratic changes of government in the estimates. We used Cholesky's recursive identification in the following order of variables (Table 3), from most to least endogenous. The most endogenous variable is the structural change resulting from intra-sectoral productivity and economic growth. Next come natural resource rents, which may be affected by public debt and foreign direct investment. The number of changes in government is therefore the most exogenous variable, as it is an institutional indicator that does not necessarily depend on the other variables.

The parameters of the pVAR process can only be estimated on stationary series. Thus, we first examine the stationarity of the different variables. The current literature is developing around the idea that dependencies between individuals in the panel should be explicitly considered. For this reason, we first perform the Pesaran (2015) test to check for cross-sectional dependence in the panel for each variable. Rejecting the null hypothesis indicates that individuals in the panel are dependent. Table 3 below shows the results of the Pesaran (2015) tests for our different variables.

Table 3: Lag selection, cross-sectional dependency tests, order of variables

Lags selection (A)			
Number of lags	AIC	BIC (MBIC)	HQIC
1	-2.845	-2.612	-2.592
2	-2.731	-2.384	-2.751
3	-2.654	-2.194	-2.470
4	-2.587	-2.015	-2.358
Cross section dependency tests (B)			
Variables		Probability	Conclusion
Structural change		0.000	Dependent
Intra industry productivity		0.000	Dependent
The number of alternating heads of state		0.002	Dependent
The year of alternation		0.000	Dependent
GDP per capita growth rate		0.018	Dependent
Value of natural resources as a percentage of GDP per capita		0.007	Dependent
Public debt		0.000	Dependent
Order of variables for Cholesky decomposition			
Order (endogeneous to exogeneous)		Variables	
(1)		Structural change	
(2)		Intra-industry productivity	
(3)		GDP per capita growth rate	
(4)		Natural resource as a percentage of GDP	
(5)		Public debt as a percentage of GDP	
(6)		Foreign direct investment	
(7)		Number of alternations	

Sources: authors with data from Limi Kouotou and Epo (2019), WDI, and ASD.

Pesaran's (2015) tests show that all individuals in the panel are dependent for our variables over the selected study period. Indeed, all statistics are significant at the 1% level. This means we can use second-generation unit root tests without compromising the results. We carry out the second-generation unit root test proposed by Pesaran (2007), known as the Cross-sectionally Augmented IPS test (CIPS test). This test is particularly well-suited to heterogeneous panels in which units may be interdependent. The alternative hypothesis is that at least one panel variable is stationary. Table 4 presents the CIPS unit root test results. The test results show that all variables are stationary at the 5% level except for the number of alternations.

Table 4: Unit root tests

Variables	Conclusion
Structural change	I (0)
Intra industry productivity	I (0)
The number of alternating heads of state	I (2)
The year of alternation	I (0)
GDP per capita growth rate	I (0)
Value of natural resources as a percentage of GDP per capita	I (0)
Public debt	I (0)

Sources: authors with data from Limi Kouotou and Epo (2019), WDI, and ASD.

4. Results

This section has two subsections. The first subsection presents descriptive statistics and econometric results, while the second tests the robustness of our econometric analysis.

4.1. Descriptive Statistics And Econometric Results

Table 5 shows the means and standard deviations of the different variables:

Table 5: Descriptive statistics

Variables	Means	Student errors	Min	Max
Between 1970 and 2000				
Intra-industry productivity	0.1231	2.8089	-0.0311	1.0133
Structural change	-0.0133	0.6294	-0.0092	0.0012
Number of alternations	2.94	2.30	1	10
Foreign direct investment	1.15	1.898	-10.77	15.59
GDP per capita growth rate	1.423	6.059	-3.503	7.535
Public debt as a percentage of GDP	35.19	16.05	0	92.50
Natural resource as a percentage of GDP	1.88	1.714	0	10.45
Between 2000 and 2015				
Intra-industry productivity	-1.86e-05	0.000143	-0.0371	0.0763
Structural change	-7.04e-06	6.10e-05	-0.0131	0.0068
Number of alternations	4.796	2.734	1	12
Foreign direct investment	3.369	4.436	-0.59	39.45
GDP per capita growth rate	3.116	2.792	0.44	7.45
Public debt as a percentage of GDP	36.06	9.56	5.74	67.34
Natural resource as a percentage of GDP	1.48	1.12	0.0002	7.22
All the period				
Intra-industry productivity	0.0823	2.2965	-0.0311	1.8294
Structural change	-0.00886	0.5145	-0.0092	0.0059
Number of alternations	3.6	2.6	1	12
Foreign direct investment	1.897	3.21	-10.77	39.45
GDP per capita growth rate	2.012	5.29	-3.503	7.535
Public debt as a percentage of GDP	35.42	14.32	0	92.50
Natural resource as a percentage of GDP	1.75	1.56	0	10.45

Sources: authors with data from Limi Kouotou and Epo (2019), ASD, and WDI

We delimit the sub-periods to 2000 because SSA countries experienced strong economic growth around this date (AfDB, 2020; Cadot et al., 2016; Page, 2015). Table 5 shows that, regardless of the sub-period considered, structural change has, on average, always contributed negatively to total productivity growth, whereas intra-industry productivity had a negative effect only in 2000 - 2015. Moreover, the average number of shifts is higher in 2000 - 2015 than in 1970 - 2000 and in the whole period studied (4.8, 2.9, and 3.6, respectively). The minimum number of alternations is 1, regardless of the period, notably because of a country such as Cameroon, which experienced only one alternation. In contrast, the maximum number of alternations, at 10 over 1970 - 2000, is due to South Africa, which had 10 alternations before 2000 and only two between 2000 and 2015. Moreover, the standard deviations of the number of alternations are very high, confirming a large disparity between countries that can be explained by different colonial-history trajectories. For FDI and GDP growth rates, we find higher average values over 2000–2015, indicating improved economic activity and attractiveness in some SSA countries during this period. Similarly, several SSA economies still rely on public debt, which, on average, accounts for 35% of GDP, regardless of the period considered. To show the direction of the relationships among our variables, Table 6 presents the correlation matrix.

Table 6: Pairwise correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Intra-industry productivity	1.000						
(2) Structural change	-0.249	1.000					
(3) Number of alternations	0.028	0.012	1.000				
(4) Foreign direct investment	0.016	-0.064	-0.016	1.000			
(5) GDP per capita growth rate	-0.029	0.002	0.030	0.128	1.000		
(6) Public debt as a percentage of GDP	-0.103	-0.008	-0.017	-0.067	-0.074	1.000	
(7) Natural resource as a percentage of GDP	-0.008	0.015	0.105	-0.014	0.010	0.207	1.000

Sources: authors with data from Limi Kouotou and Epo (2019), ASD, and WDI

Table 6 reports a negative correlation between intra-industry productivity and structural change (-0.249). The number of head-of-state alternations is weakly positively correlated with intra-industry productivity (0.028) and structural change (0.012). Public debt is negatively correlated with both components of structural transformation, while FDI is positively correlated with intra-industry productivity and negatively correlated with structural change. These pairwise correlations are descriptive and do not, by themselves, establish causality. The subsequent impulse-response analysis examines the dynamic responses among the variables within the identified pVAR model.

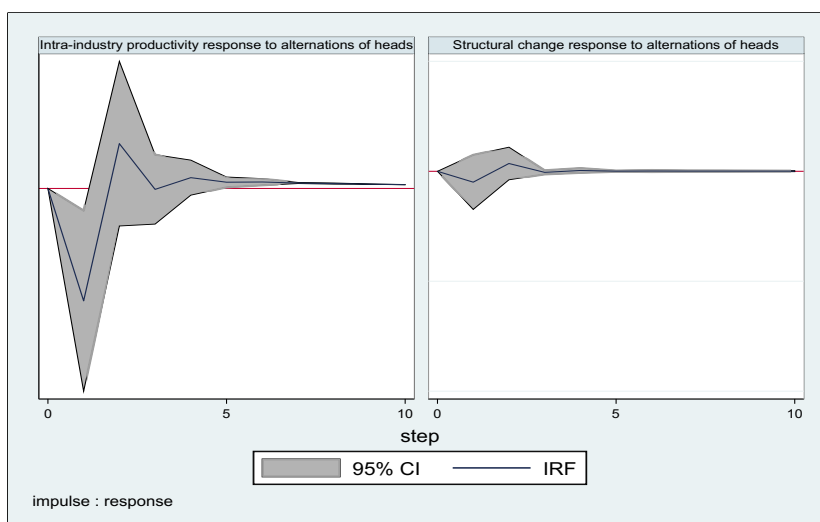


Figure 2: Response functions of structural change and intra-industry productivity to alterations in the head-of-state shock. Source: Authors (red reference line = 0)

Figure 2 shows that a change in head of state is followed by an immediate negative response in both intra-industry productivity and structural change. The initial response is larger for intra-industry productivity. Both responses subsequently turn positive approximately 2.5 to 3 years after the shock and appear to stabilize around the fourth year. These patterns describe the estimated dynamic responses in the pVAR model; the Discussion section develops their substantive interpretation.

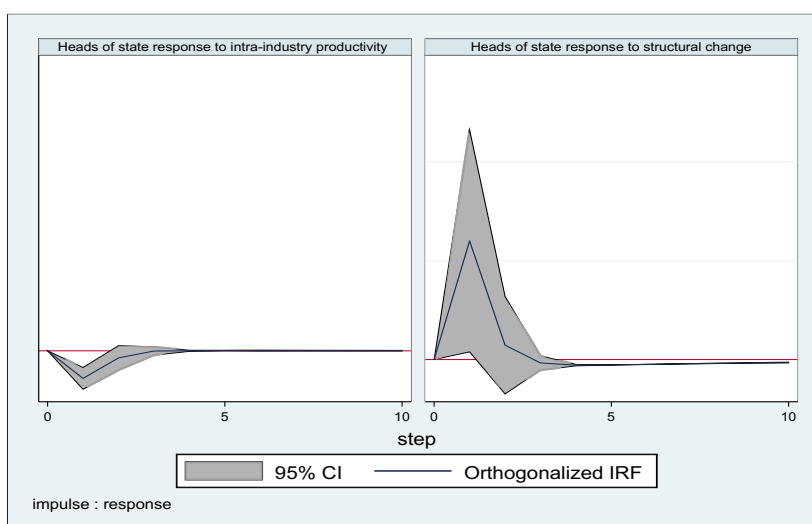


Figure 3: Response functions of head-of-state alternations to a structural-change shock and an intra-industry productivity shock. Sources: authors (red reference line = 0)

Figure 3 shows that the number of head-of-state alternations responds positively to a structural-change shock and negatively to an intra-industry-productivity shock. Following a structural-change shock, the positive response rises initially and then declines toward zero after about four years. The negative response to an intra-industry-productivity shock indicates a different dynamic pattern. The Discussion section considers the possible institutional and economic mechanisms underlying these responses.

Table 7: Forecast-error variance decomposition

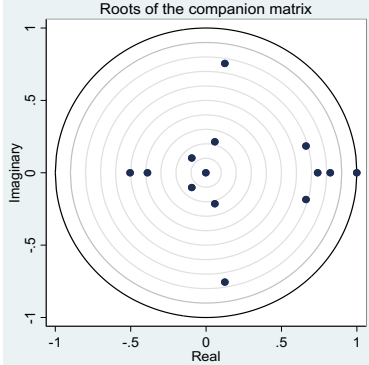
Response	Impulsion	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Structural change		0.177	0.330	0.255	0.009	0.178	0.027	0.024
(2) Intra-industry productivity		0.200	0.493	0.134	0.058	0.090	0.117	0.107
(3) Number of alternations		0.002	0.012	0.340	0.019	0.512	0.079	0.036
(4) GDP per capita growth rate		0.005	0.007	0.331	0.244	0.346	0.045	0.021
(5) Foreign direct investment		0.002	0.012	0.355	0.018	0.507	0.073	0.034
(6) Public debt as a percentage of GDP		0.002	0.005	0.231	0.020	0.504	0.194	0.044
(7) Natural resource as a percentage of GDP		0.001	0.016	0.331	0.018	0.451	0.067	0.116

Sources: authors with data from Limi Kouotou and Epo (2019), ASD and WDI

Table 7 shows that 25.5% of the forecast-error variance of structural change and 13.4% of the forecast-error variance of intra-industry productivity are associated with innovations in the number of head-of-state alternations. In addition, 33.0% of

the forecast-error variance of structural change is associated with intra-industry productivity, while 20.0% of the forecast-error variance of intra-industry productivity is associated with structural change. The decomposition also indicates that 51.2% of the forecast-error variance of head-of-state alternation is associated with FDI innovations. We interpret these values in the Discussion section. The stability test reported in Table 8 shows that all eigenvalues lie inside the unit circle, indicating that the estimated pVAR satisfies the stated stability condition.

Table 8: Eigenvalue stability condition

Real	Imaginary	Modulus	
0.999	0.000	0.999	
0.824	0.000	0.824	
0.124	0.755	0.765	
0.124	-0.755	0.765	
0.740	0.000	0.740	
0.662	0.185	0.688	
0.662	-0.185	0.688	
-0.504	0.000	0.504	
-0.389	0.000	0.389	
0.058	-0.214	0.222	
0.058	0.214	0.222	
-0.095	-0.102	0.139	
-0.095	0.102	0.139	
-0.002	0.000	0.002	

All the eigenvalues lie inside the unit circle. pVAR satisfies stability condition

Sources: authors with data from Limi Kouotou and Epo (2019), ASD and WDI

4.2. Sensitivity Analysis

To test the robustness of our results, we decompose the variance of the forecast errors at year 10 for all variables by official foreign language and by participation in a currency area in Table 9.

Table 9: Forecast-error variance decomposition by countries sub-group

Response \ Impulsion		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Anglo-Saxon countries								
(1) Structural change		0.329	0.347	0.403	0.011	0.002	0.004	0.004
(2) Intra-industry productivity		0.141	0.528	0.204	0.116	0.002	0.001	0.008
(3) Number of alternations		0.001	0.049	0.829	0.019	0.017	0.034	0.051
(4) GDP per capita growth rate		0.020	0.010	0.131	0.756	0.040	0.008	0.034
(5) Foreign direct investment		0.001	0.004	0.188	0.011	0.763	0.019	0.014
(6) Public debt as a percentage of GDP		0.003	0.050	0.011	0.021	0.016	0.852	0.047
(7) Natural resource as a percentage of GDP		0.001	0.022	0.097	0.062	0.012	0.050	0.757
French, Portuguese and Spanish speaking countries								
(1) Structural change		0.579	0.340	0.049	0.007	0.018	0.003	0.003
(2) Intra-industry productivity		0.413	0.505	0.049	0.009	0.017	0.002	0.006
(3) Number of alternations		0.001	0.026	0.437	0.020	0.496	0.010	0.012
(4) GDP per capita growth rate		0.008	0.003	0.238	0.656	0.080	0.001	0.013
(5) Foreign direct investment		0.001	0.011	0.485	0.006	0.476	0.019	0.001
(6) Public debt as a percentage of GDP		0.001	0.002	0.282	0.023	0.410	0.264	0.017
(7) Natural resource as a percentage of GDP		0.001	0.016	0.053	0.008	0.038	0.004	0.880
Countries in a monetary union								
(1) Structural change		0.473	0.327	0.166	0.006	0.018	0.006	0.003
(2) Intra-industry productivity		0.101	0.581	0.080	0.006	0.020	0.103	0.009
(3) Number of alternations		0.003	0.012	0.491	0.014	0.421	0.042	0.018
(4) GDP per capita growth rate		0.009	0.002	0.316	0.534	0.128	0.003	0.009
(5) Foreign direct investment		0.003	0.008	0.510	0.010	0.433	0.025	0.011
(6) Public debt as a percentage of GDP		0.003	0.003	0.286	0.018	0.424	0.244	0.021
(7) Natural resource as a percentage of GDP		0.000	0.015	0.201	0.010	0.152	0.019	0.603
Country with own currency								
(1) Structural change		0.236	0.323	0.363	0.008	0.059	0.007	0.004
(2) Intra-industry productivity		0.287	0.274	0.268	0.009	0.050	0.002	0.110
(3) Number of alternations		0.000	0.026	0.695	0.076	0.130	0.036	0.037
(4) GDP per capita growth rate		0.006	0.009	0.260	0.509	0.195	0.007	0.014
(5) Foreign direct investment		0.000	0.023	0.370	0.019	0.547	0.024	0.017
(6) Public debt as a percentage of GDP		0.001	0.006	0.215	0.026	0.511	0.201	0.041
(7) Natural resource as a percentage of GDP		0.000	0.032	0.205	0.022	0.340	0.017	0.384

Sources: authors with data from Limi Kouotou and Epo (2019), ASD and WDI

The subgroup analysis produces broadly similar variance-decomposition patterns across the country classifications. The contribution of FDI innovations to the forecast-error variance of head-of-state alternation differs across the language-based groups, with 1.7% reported for the Anglo-Saxon group and 49.6% for the French-, Spanish-, and Portuguese-speaking group. Differences are also observed between countries in a monetary union and countries with their own currency. Given the relatively small and overlapping subgroup compositions, we treat these differences as sensitivity evidence rather than direct evidence of a particular political mechanism.

5. Discussion

The impulse-response results indicate that the relationship between political alternation and structural transformation is dynamic rather than uniformly positive or negative. The initial decline in intra-industry productivity and structural change after a leadership change is consistent with the possibility of short-run adjustment costs, project discontinuity, and policy uncertainty associated with political turnover, mechanisms discussed in the literature on strategic and investment responses to political change (Julio and Yook, 2012; Choi et al., 2021). These positive responses broadly align with studies linking political institutions and leadership alternation to economic and structural outcomes in sub-Saharan Africa (Limi Kouotou and Epo, 2019; Nguenda Anya and Nzepang, 2022; Gandjon Fankem, 2018). The asymmetric response of head-of-state alternation to structural change and intra-industry productivity also deserves a cautious interpretation. A structural-change shock represents economy-wide reallocation across sectors, whereas intra-industry productivity reflects improvements within sectors. From an institutional perspective, broader improvements in economic opportunities and living standards may increase the resources available for institutional development and political reform (North, 1990; Laffont and Meleu, 2001). At the same time, sector-specific productivity gains may be concentrated and need not translate into the same political dynamics. The pVAR results identify these dynamic associations, but they do not directly identify the political mechanism driving the responses. The forecast-error variance decomposition further shows that head-of-state alternation accounts for a larger share of the variation in structural change than in intra-industry productivity. The substantial contribution of intra-industry productivity to structural change is consistent with the argument that improvements within sectors can precede the reallocation of labor and other factors toward more productive activities (McMillan and Rodrik, 2011; McMillan et al., 2014, 2017). The finding that FDI innovations account for 51.2% of the forecast-error variance of head-of-state alternation indicates an important dynamic association in the estimated system. However, this statistic alone does not establish that multinational firms or foreign powers cause political change, and the interpretation should therefore remain limited to the statistical relationship identified by the model. The sensitivity analysis suggests that the strength of these relationships varies across language-based and currency-based country groups. These differences are informative because SSA countries' institutional and economic structures are heterogeneous. Nevertheless, the subgroup samples are relatively small and partly overlap. The observed differences should therefore be interpreted as evidence of heterogeneity rather than as proof that language background, foreign influence, or currency arrangements independently determine political alternation. This cautious interpretation is consistent with the broader literature, which emphasizes variation in the conditions and forms of leadership alternation across African countries (Hoff et al., 2005; Lodge, 2013; Limi Kouotou and Epo, 2019).

6. Conclusion

This paper examines the interaction between alternation in the head of state and structural transformation in sub-Saharan economies. In line with institutional economic theories, alternation in the head of state is an institutional tool that can be interpreted as a policy innovation. It's likely to foster the reallocation of labor, innovation, and human capital, thereby promoting structural transformation. Data from Limi Kouotou and Epo (2019), ASD, and WDI allow us to test our claims using a panel of 17 SSA economies over 1970 - 2015. The results show that head-of-state alternations positively affect intra-industry productivity and structural change. These results suggest that head-of-state alternation likely promotes structural transformation in SSA economies. The study also shows that head-of-state alternation appears less dependent on global economic powers in Anglo-Saxon countries and in countries with their own currencies than in other countries. The paper recommends that sub-Saharan economies should promote a constitutional and peaceful transition of power between Heads of State. The paper also recommends that institutions and researchers account for the socio-political consequences of alternation in their measurements to improve the accuracy of results.

7. Future Research

Future research should extend the analysis beyond 2015 and, where comparable sectoral data are available, include more sub-Saharan African economies. An expanded dataset would allow researchers to examine whether the relationships identified in this study remain stable across more recent political and economic episodes. Future studies should also distinguish more explicitly between constitutional or electoral alternation, ideological alternation, and non-electoral changes of government because these forms of political turnover may have different implications for institutions and structural transformation (Hoff et al., 2005; Lodge, 2013; Limi Kouotou and Epo, 2019). A second research direction is to investigate the mechanisms behind the observed relationships. In particular, the association between FDI and head-of-state alternation could be examined using direct measures of multinational-firm exposure, sectoral concentration, natural-resource dependence, and political connections rather than inferring these channels from variance decomposition alone. Further work could also test alternative pVAR identification orders, lag structures, and political-turnover measures to assess the robustness of the dynamic responses. Such extensions would help distinguish the effects of broad institutional change from the policy uncertainty and firm-level responses that can accompany political turnover (Julio and Yook, 2012; Choi et al., 2021).

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About the Author (s):

Zenabou TOURERE: She holds a PhD in Economics and is a Lecturer at the Faculty of Economics and Applied Management of the University of Douala. She is currently working at the Ministry of Scientific Research.

Fabrice NZEPANG: He holds a PhD in Economics, and he is the Founder and Chair of the Cameroon Economics Society (CES). He is also a Lecturer at the Faculty of Economics and Applied Management of the University of Douala.

Appendices

Appendix 1: Data from Limi Kouotou and Epo (2019) on the alternation of heads of state in SSA. Data on the number of alternations of heads of state in SSA from 1970 to 1993

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
South Africa	3	3	3	3	3	4	4	4	5	6	6	6	6	6	7	7	7	7	7	8	8	8	8	8
Benin	8	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	10	10	10
Botswana	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
Burkina Faso	1	1	1	1	1	1	1	1	1	1	2	2	3	4	4	4	4	5	5	5	5	5	5	5
Burundi	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4
Cabo Verde						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
Cameroon	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
Comores						1	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4
Congo Rép. D.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Congo Rép.	2	2	2	2	2	2	2	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5
Ivory Coast	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Djibouti								1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Eritrea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Éthiopia					1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
Gabon	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Gambia	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Ghana	4	4	5	5	5	5	5	5	6	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8
Equatorial Guinea	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Guinea-Bissau					1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3
Kenya	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Lesotho	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
Madagascar	0	0	1	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Malawi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mali	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	4	4
Mauritius																							1	1
Mozambique						1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Namibie																					1	1	1	1
Niger	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	4
Nigeria	2	2	2	2	2	3	4	4	4	5	5	5	5	5	6	6	7	7	7	7	7	7	7	8
Uganda	2	3	3	3	3	3	3	3	3	4	5	5	5	5	5	6	7	7	7	7	7	7	7	7
Central African Republic	2	2	2	2	2	2	2	2	2	3	3	4	4	4	4	4	4	4	4	4	4	4	4	5
Rwanda	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Senegal	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Seychelles							1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Sierra Leone		1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
Somalia	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
Swaziland	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	3	3	3	3	3	3	3	3
Tanzania	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
Chad	1	1	1	1	1	2	2	2	3	3	3	4	4	4	4	4	4	4	4	5	5	5	5	5
Togo	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Zimbabwe	1	1	1	1	1	2	3	3	4	5	6	6	6	6	6	6	6	7	7	7	7	7	7	7

Sources: Limi Kouotou and Epo data (2019)

Data on the number of alternations of heads of state in SSA from 1994 to 2016

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
South Africa	9	9	9	9	9	10	10	10	10	10	10	10	10	10	10	11	11	11	11	11	11	11	11
Benin	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	13
Botswana	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4
Burkina Faso	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6
Burundi	5	5	6	6	6	6	6	6	6	7	7	8	8	8	8	8	8	8	8	8	8	8	8
Cabo Verde	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4
Cameroon	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Comores	4	5	6	6	7	7	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9	10
Congo Rép. D.	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Congo Rép.	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Ivory Coast	2	2	2	2	2	3	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5
Djibouti	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Eritrea	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Éthiopia	3	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6
Gabon	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
Gambia	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ghana	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	10	10	10	11	11	11	11	11
Equatorial Guinea	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Guinea-Bissau	3	3	3	3	3	4	5	5	5	6	6	7	7	7	7	8	8	8	9	9	10	10	10
Kenya	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Lesotho	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Madagascar	4	4	5	6	6	6	6	6	7	7	7	7	7	7	7	8	8	8	8	8	9	9	9
Malawi	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	5	5	5
Mali	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	6	7	7	7	7

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mauritius	1	1	1	1	1	1	1	1	2	3	3	3	3	3	3	3	3	3	4	4	4	5	5
Mozambique	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4
Namibie	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3
Niger	4	4	5	5	5	6	6	6	6	6	6	6	6	6	6	6	7	8	8	8	8	8	8
Nigeria	8	8	8	8	8	9	9	9	9	9	9	9	9	10	10	10	11	11	11	11	11	12	12
Uganda	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Central African Republic	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	7	8	8	9
Rwanda	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Senegal	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4
Seychelles	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4
Sierra Leone	3	3	4	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6
Somalia	3	3	3	3	3	3	4	4	4	4	5	5	5	5	5	6	6	6	7	7	7	7	7
South Sudan												1	1	1	1	1	1	1	1	1	1	1	1
Swaziland	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Tanzania	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5
Chad	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Togo	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Zimbabwe	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

Sources: Limi Kouotou and Epo data (2019)

Data from 1970 to 1993 on the alternation year (1 in an alternation year and 0 otherwise)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
South Africa	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Benin	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Botswana	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Burkina Faso	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0
Burundi	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Cabo Verde						1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Cameroon	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Comores						1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Congo Rép. D.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Congo Rép.	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ivory Coast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Djibouti								1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eritrea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Éthiopie					1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Gabon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gambia	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ghana	1	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Equatorial Guinea	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guinea-Bissau				1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Kenya	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesotho	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Madagascar	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Malawi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Mauritius																							1	0
Mozambique						1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Namibie																				1	0	0	0	0
Niger	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Nigeria	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1
Uganda	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Central African Republic	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Rwanda	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senegal	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Seychelles						1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sierra Leone		1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Somalia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
South Sudan																								
Swaziland	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0
Tanzania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Chad	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zimbabwe	1	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0

Sources: Limi Kouotou and Epo data (2019)

Data from 1994 to 2016 on the sandwich year (1 in a sandwich year and 0 otherwise)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
South Africa	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Benin	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Botswana	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Burkina Faso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Burundi	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Cabo Verde	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cameroon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comores	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
Congo Rép. D.	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Congo Rép.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ivory Coast	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Djibouti	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eritrea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Éthiopie	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Gabon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Gambia	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ghana	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Equatorial Guinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guinea-Bissau	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	1	0	1	0	0
Kenya	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesotho	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Madagascar	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Malawi	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Mali	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Mauritius	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0
Mozambique	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Namibie	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Niger	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Nigeria	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0
Uganda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central African Republic	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1
Rwanda	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senegal	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Seychelles	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Sierra Leone	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Somalia	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0
South Sudan											1	0	0	0	0	0	0	0	0	0	0	0	0
Swaziland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanzania	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Chad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Togo	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Zimbabwe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sources: Limi Kouotou and Epo data (2019)

Appendix 2: Countries included in the study

Countries		Countries	
1	Botswana	9	Mauritius
2	Burkina Faso	10	Mozambique
3	Cameroon	11	Namibia
4	Ethiopia	12	Nigeria
5	Ghana	13	Rwanda
6	Kenya	14	Senegal
7	Lesotho	15	South Africa
8	Malawi	16	Tanzania
		17	Uganda

Sources: authors with data from Limi Kouotou and Epo (2019) and ASD