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ELOMO ZOGO THERESE

University of yaounde II

MOUGNOL A EKOULA HERVE WILLIAM

University of yaounde II

HAMOA OUMAROU

hamoaoumarou@gmail.com

university of yaounde 2

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Does fiscal policy influence industrialization in Sub-Saharan Africa? An explanation using the staggered lag autoregressive (ARDL) panel approach

ELOMO ZOGO THERESE¹

MOUGNOLA EKOULA HERVE WILLIAM²

HAMOA OUMAROU³

Abstract

This paper empirically studies the effect of fiscal policy on industrialization in Sub-Saharan Africa. Over the period 1994-2018, using data from the World Bank (WDI, 2021), on a sample of 24 countries using a panel ARDL (autoregressive lag) model, we obtain two main results. First, fiscal policy has a positive influence on industrialization in sub-Saharan Africa, and the same is true for financial openness, which appears to have a positive coefficient in the short run than in the long run. Secondly, on the other hand, variables such as services and agriculture deteriorate manufacturing value added. Thus, it would be necessary to focus on obtaining a return on investment in service provision, especially on investment in public sector infrastructure, which receives the largest share of the budget such as education and health.

Keywords: Fiscal policy; Industrialization; Sub-Saharan Africa; ARDL

¹ University of Yaounde 2, Cameroon, zogoastrid@yahoo.fr

² University of Yaounde 2, Cameroon, wmougnol@yahoo.com

³ University of Yaounde 2, Cameroon, hamoaoumarou@gmail.com

1. INTRODUCTION

Derived from the Latin word "industria"⁴, industrialization refers to a structural change undergone by countries lagging behind in their development process, moving from an agricultural economy to an industrial economy, with the profound changes in society that this implies (Kuznets, 1973). Thus, industrialization represents a major force for structural change and is a crucial step for the future growth of developing economies (UNIDO, 2016). Thus, we find that all developed and emerging countries today have gone through industrialization (UNIDO, 2013). Some theoretical studies (Cornwall, 1977; Sangosanya, 2011, etc...) and empirical studies (Ogunleye and Olorunfemi, 2006; Adejumo et al., 2013 etc...), have set out to show that no country in the world has achieved prosperity and a decent socio-economic status for its citizens without going through a robust industrial base (Szirmai, 2012). In this context, the governments of developing countries in general, and those of Africa in particular, have repeatedly emphasised the importance of industrialization in the process of economic growth. For example, the Action Plan for the Accelerated Industrial Development of Africa (AIDA), approved by all AU member states in 2008 and recently renewed on the occasion of Agenda 2063, in which these countries once again reiterate the importance of industrialization as one of the major pillars likely to stimulate economic and social structural transformation in Africa.

Two indicators are mainly used in the literature to measure industrialization: the share of manufacturing value added in GDP and the share of manufacturing employment in total employment (UNIDO, 2013). Like Dodzin and Vamvakidis (2004), Kang and Lee (2011), Guidiby and Renard (2015) we use the share of manufacturing value added in GDP to measure the level of industrialization.

⁴ Which means activity

Over the last three decades, Manufacturing Value Added (MVA) has grown at a very high rate, reaching a peak of 19% (as a proportion of GDP) in North Africa and 14% in Sub-Saharan Africa (SSA). On the other hand, between 1995 and 2016, this trend declined from 12.36% to 10.36% (World Bank, 2016). This decline is largely explained by the collapse of manufacturing production in Central Africa, where it fell from 13.79% to 6.52%; in West Africa, the share of manufacturing production in GDP rose from 5.9% in 2005 to almost 9% in 2015. Excluding Nigeria, however, this share fell from 11.2% to 8.5% (AfDB, 2015). Furthermore, the best performances are recorded in East Africa and Southern Africa (ACET, 2017). Indeed, more than 80% of African MVA is linked either to natural resources or to traditional "low-tech" activities, which generally have limited levels of productivity.

Despite the fact that developed countries have respected the process of structural transformation, i.e. the migration of resources from the primary sector to the secondary and tertiary sectors, they seem to have "sidetracked" the secondary sector in Africa (Cadot et al. 2016). In this respect, fiscal policy has been identified as an essential catalyst that can lead to the industrialization of sub-Saharan African countries (UNIDO, 2020).

As an instrument for regulating economic activity, fiscal policy is one of the instruments of economic policy based essentially on the manipulation of public spending and/or State revenues to influence economic activity (Yunanto and Medyawati, 2020). It is constrained by tax revenues, which are most often affected by exogenous shocks to economies (Avom, 2011). Fiscal policy is mainly measured by public expenditure, tax revenue, debt and budget deficits (Coady and Patel, 1997; Masson, 1996; Debrun and Kapoor 2010; Fatás and Mihov, 2001). The sustainability of public spending in sub-Saharan Africa depends entirely on revenue collection and management systems. The revenue base is made up of three main categories: tax revenues, non-tax revenues and subsidies. Tax revenues are classified as customs and excise, mining revenues, non-mining revenues (property, vehicle and licences) and value added tax (VAT).

Non-tax revenues include property income, interest, fees, charges and refunds. Subsidies are funds received from donors and development partners; but in this contribution we will use public expenditure as a proxy for fiscal policy (De Boissieu and Gubian, 1984; Abomaye-Nimenibo and Samuel, 2020; Duboz et al., 2021). We are interested in public spending because it has become a major source of governance around the world (Sow et al, 2019).

Historically, governments in developed countries have stimulated the structural transformation of their economies through public spending that increases worker productivity, in particular by improving and building infrastructure (roads, ports, energy, etc.). Over the past 15 years, tax revenues have increased in sub-Saharan Africa, rising from an average of 15% of GDP in 2000 to a peak of 17.5% of GDP in 2012 (IMF, 2017). However, in recent years, the fall in international prices of extractive products (energy, minerals and metals) has led to a significant drop in public revenues in the group of resource-rich countries in sub-Saharan Africa, reducing the amount of resources available to finance public spending (World Bank, 2018).

Different views have continued to emerge on how fiscal policy can affect the growth of the economy through the manufacturing sector. Theoretically, the controversies surrounding the influence of fiscal policy on industrialization stem from three schools of thought listed by Tchokote (2001) in Omitogun and Ayinla (2007). For the classics (Feldstein, 1982; Barro, 1990), public debt has no effect on private sector savings, i.e., the debt-financed budget deficit crowds out private sector investment and also lowers the level of development and economic growth. Keynesians (Arrow and Kurz, 1970; Cheng and Lai, 1997) believe that there is a positive relationship between deficit financing and investment, i.e., that fiscal policy is a tool used to overcome fluctuations in the economy. The neoclassical school of thought (Devarajan et al., 1996; Collier, 2007) contextualises the position of the Keynesian school of thought because they believe that the way in which budget deficits are financed is capable of influencing the level of investment, consumption and economic growth. Two theoretical frameworks then

emerge from these controversies (Eze and Ogiji, 2014) namely on the one hand the saver-spender theory (Mankiw, 2000; Matsen et al. 2008) and on the other hand the managerial theory of the firm (Bumole, 1967; Sangosanya, 2011).

The idea that fiscal policy is an effective economic policy tool for stimulating industrialization does not enjoy unanimous support among economists. On the one hand, there are those who argue that fiscal policy has a positive influence on industrialization (Oktaviani et al. 2010 Sangosanya, 2011; etc...) on the other hand, some believe that fiscal policy has a negative influence on industrialization (Ajayi, 2011; Loto, 2012; Tomola et al., 2012; Fogang and Tchitchoua, 2020; etc...) and finally we have those who claim that fiscal policy has a mixed effect on industrialization (Fedotenkov and Gupta, 2020; Yunanto and Medyawati, 2020; etc...).

Nevertheless, sub-Saharan Africa has a lot of potential and opportunities to use its fiscal policy more effectively and efficiently to promote industrialization, in order to achieve sustainable economic growth. This study enables us to raise the situation of fiscal policies in sub-Saharan African countries and also to assess their effects on industrialization from an econometric point of view. Certain arguments form the basis of the motivation for this article. Firstly, from a theoretical point of view, the relationship between fiscal policy and industrialization has attracted a great deal of interest in the economic literature. However, very few studies have taken public spending into account in explaining industrialization, especially for sub-Saharan African countries. Far from being a study of the determinants of economic growth, it fuels the debate on the links between fiscal policy and industrialization.

Secondly, empirically, unlike previous work, this study is estimated using a new cointegration technique proposed by Pesaran et al (2001), namely Autoregressive Distributed Lag (ARDL), which has several advantages. Moreover, compared to the empirical literature on the effects of economic policy, fiscal policy has so far received much less attention in economic research than monetary policy (Yunanto and Medyawati, 2020). Thirdly, from an operational point of view,

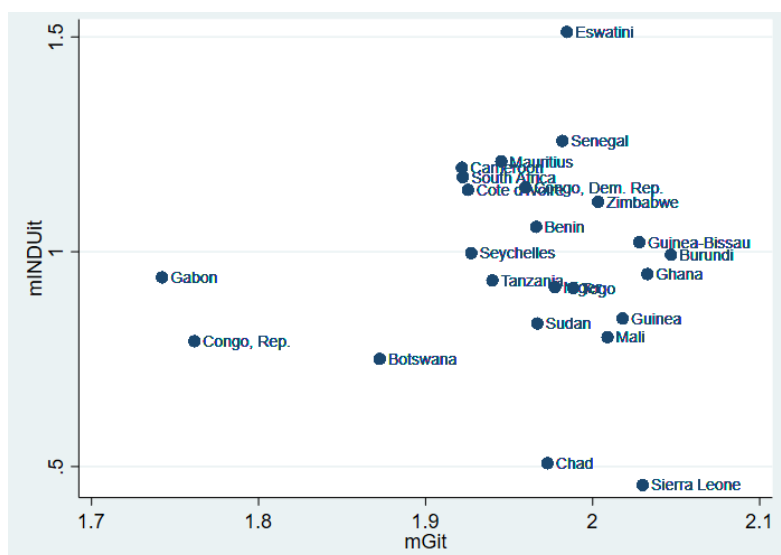
this study seems timely for the authorities, especially since the effects of fiscal policy on industrialization reveal additional management elements with important implications for economic policy formulation.

The rest of the article is organised as follows: section 2 presents some stylised facts; section 3 focuses on the data and methodology; section 4 analyses the results and discusses their sensitivity and the robustness of the results. Finally, the last section presents the conclusion.

2. Stylized facts in Sub-Saharan Africa

The two graphs in Figure 1 show the spatial distribution of SSA countries according to their average MVA and their level of public spending⁵. It can be seen that the countries are spatially dispersed, and the countries with the highest MVA (Eswatini) also have excessive levels of public spending.

Figure 1: *Spatial distribution of SSA countries by degree of industrialization and level of public spending*

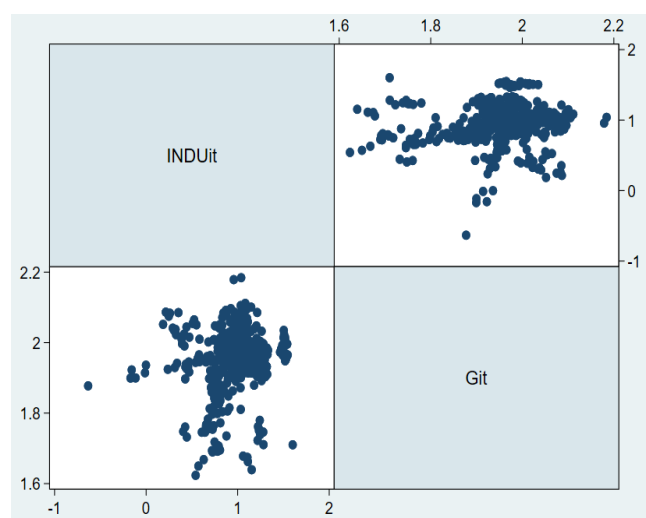


Source: Authors based on data from the World Bank (WDI).

⁵ This is the average value between 1994 and 2018.

Figure 2 shows the scatterplot matrix for two variables, industrialization (MVA) and public expenditure, represented as pairs of variables in an inverted axis matrix format. The visual analysis allows us to say that there are outliers in the data and some points are superimposed on the others (so there is also clustering in the data), but these points do not behave in the same way along the different axes.

Figure 2: Matrix of point clouds

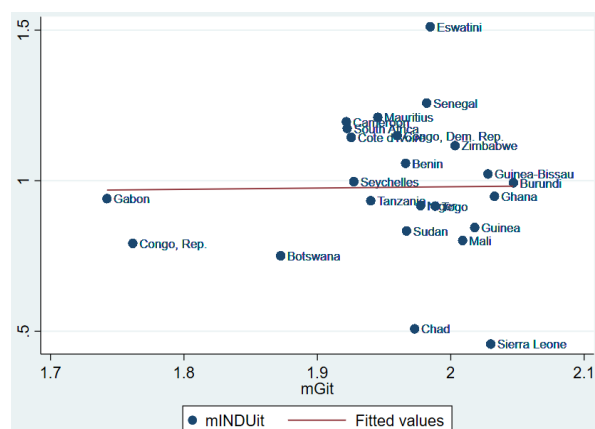


Source: Author based on World Bank (WDI) data.

Figure 3 shows the scatterplots linking fiscal policy (public spending) to the level of industrialization in SSA. A simple observation of these scatter plots indicates a positive correlation⁶ between these two phenomena (or variables), which provides us with the beginnings of an answer as to the link between fiscal policy and industrialization in SSA. The graph also reveals a nuanced relationship between the two variables within unstable countries (extreme point).

⁶ Two phenomena (represented by variables) are "correlated" when they have a common trend over time, i.e. a positive correlation (simultaneous increase or decrease or constancy) in the values of the two variables, or a negative correlation (when the two variable values move in opposite directions) (Bourbonnais, 2015).

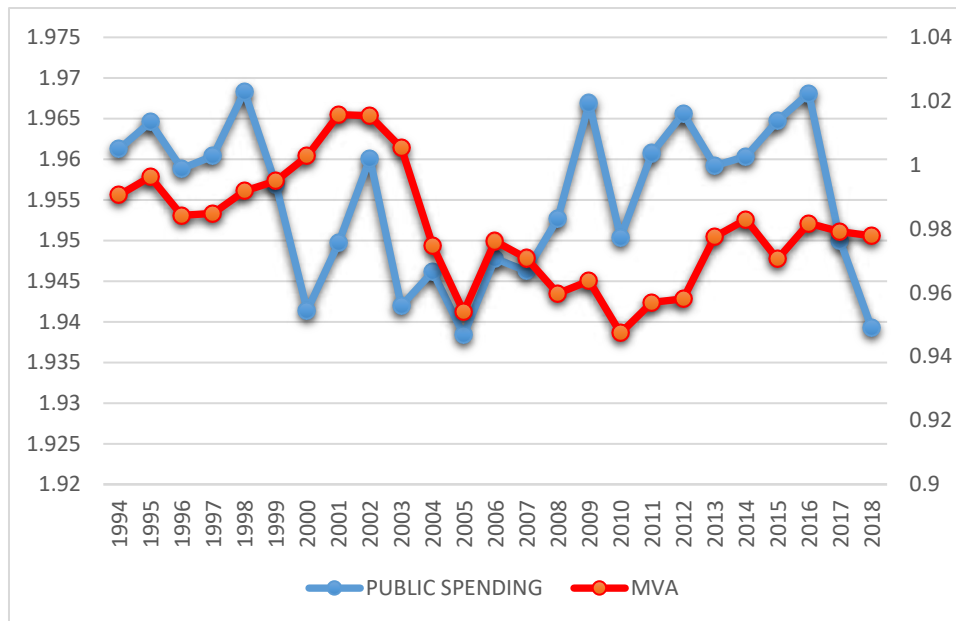
Figure 3: *Relationship between public spending and industrialization in SSA*



Source: *Author based on World Bank (WDI) data.*

Figure 4 below shows the joint evolution of the 2 variables (public spending and MVA) over the period 1994-2018. This graph shows that, overall, there is a positive correlation between these two variables. In other words, as public spending falls, industrial value added also tends to fall, and vice versa. We can also see that industrial value added has been declining overall, which perfectly illustrates the process of deindustrialisation that these countries have faced.

Figure 4: *Joint trend in public spending and MVA in SSA*



Source: Author based on World Bank (WDI) data.

Nevertheless, as the conclusions drawn from the descriptive analysis are only presumptive, the analysis of the effect of fiscal policy on industrialization cannot be limited to a simple statistical analysis. It is therefore important to carry out an econometric analysis in order to properly and robustly examine the effect of fiscal policy on industrialization.

3. Methodology

Inspired by the panel ARDL model of Alsaleh and Abdul-Rahim (2019), our study empirically analyses the impact of fiscal policy on industrialization over the period 1994 to 2018, for 24 sub-Saharan African countries. Data availability guided the choice of this sample in terms of size and study period. In this section, we first describe the econometric model used before presenting its specification and the variables used, as well as the data sources.

3.1. Description of the econometric model used

The model will be estimated using a new cointegration technique proposed by Pesaran et al (2001), namely Autoregressive Distributed Lag (ARDL), to overcome the limitations of conventional cointegration methods (Engle and Granger, 1987 and Johansen, 1991). The

advantage of the ARDL method, unlike the latter, is twofold. On the one hand, it can be applied to any degree of integration of the variables used: purely I (0), purely I (1) or mixed. Secondly, it has superior statistical properties for small samples (Cheung and Lai, 1993). The ARDL method is relatively more efficient for small samples, as is the case for most empirical studies of developing countries. This is because the ARDL test does not require the model variables to be purely I (0) or I (1). It is also a technique that offers the possibility of dealing jointly with long-term dynamics and short-term adjustments. We have therefore adopted this approach to analyse the dynamic relationship between the factors explaining industrialization.

To this end, unit root tests are performed for the variables using the Im, Pesaran and Shin (2003) test to study the stationarity of the variables in their degree of integration. Then, the model is analysed using the Autoregressive-Distributed Lag procedure, because of the need to take stock of the long-run and short-run consequences of our analysis. ARDL modelling with appropriate lags will correct the two problems of correlation and endogeneity of the series. Another reason for using this technique is that it is more robust and performs better for small sample sizes than other cointegration techniques. The number of lags of the dependent variable and the explanatory variables is selected using the AKAIKE information criterion (AIC) in this article⁷.

3.2. Specification of the econometric model

To test our hypothesis that fiscal policy hinders industrialization in sub-Saharan Africa, we drew on the panel ARDL model of Alsaleh and Abdul-Rahim (2019), the empirical formulation of the model is as follows:

⁷ The ARDL model (2, 1, 1, 1, 1) is chosen as the optimal model because it has the smallest AIC value (see table 5 in the appendix).

$$\Delta INDU_{it} = \beta_1 + \sum_{i=1}^K a_{ij} \Delta INDU_{i,t-j} + \sum_{i=0}^K \beta_{ij} \Delta G_{i,t-j} + \sum_{i=0}^K X_{ij} \Delta AGRI_{i,t-j} + \sum_{i=0}^K \delta_{ij} \Delta SERV_{i,t-j} + \sum_{i=0}^K \vartheta_{ij} FDI_{i,t-j} + \theta_1 INDU_{i,t-1} + \theta_2 G_{i,t-1} + \theta_3 AGRI_{i,t-1} + \theta_4 SERV_{i,t-1} + \theta_5 FDI_{i,t-1} + \varepsilon_{it}$$

With Δ : first difference operator ; β_1 : constant ; a_{ij} , β_{ij} , X_{ij} , δ_{ij} et ϑ_{ij} : short-term effects ; $\theta_1, \theta_2, \theta_3, \theta_4$ et θ_5 : long-term model dynamics ε_{it} : the error term, where i represents the country index with i=1, ...,24 and t the time index with t=1, ..., 25.

3.3. Presentation of study variables and data source

The variables used in our study are: Industry (INDU), Public expenditure (G), Agriculture (AGRI), Financial openness (FDI) and Service (SERV).

➤ Presentation of study variables and data sources

Variables	Definition	Source
Public expenditure (G)	Total public expenditure = public consumption expenditure + public investment expenditure. With public investment expenditure = total investment - private investment.	WDI (2021)
Industrialisation (INDU)	Measured here by the share of manufacturing value added in GDP (as a rate)	WDI (2021)
Financial opening (FDI)	Net Foreign Direct Investment as a percentage of GDP	WDI (2021)
Service (SERV)	Value added of the services sector in GDP	WDI (2021)
Agriculture (AGRI)	Value added of the agricultural sector in GDP	WDI (2021)

4 - PRESENTATION OF RESULTS AND ROBUSTNESS

Following our discussion of the methodology, this subsection presents the main results of our econometric estimates and their interpretations, and the empirical verification of the robustness of our results.

4-1-ANALYSIS OF MODELLING RESULTS

To assess the order of integration of the variables, we used the Im, Pesaran and Shin (IPS) panel unit root tests. This test shows us that all our variables are stationary in level, except industrialization (INDU_{it}) which is integrated of order one I (1). Since the variables studied are both integrated of order (0) and order (1) (see Table 3 in the appendix). The panel of variables cannot be estimated using a VECM (Vector Error Correction Model), where the variables must be integrated of the same order.

Table 1. Stationarity test for the different variables in the model

Variables	Stat. d'Im-Pesaran-Shin	Prob.	Order of integration
INDU _{it}	-1.3072*	0.00956	I(1)
G _{it}	-4.8452***	0.0000	I(0)
Agri _{it}	-0.5550***	0.0130	I(0)
Serv _{it}	-1.3425*	0.0897	I(0)
Fdi _{it}	-9.0878***	0.0000	I(0)

Source: Authors, based on World Bank data.

*** significant to 1%; ** significant to 5%; * significant to 10%

The descriptive statistics⁸ and correlation⁹ matrix for all the variables used are presented in the appendices (tables 1 and 2).

⁸ The descriptive statistics cover a sample of twenty-four (24) SSA countries between 1994 and 2018, and the table lists the mean, standard deviation, minimum and maximum values of the variables.

⁹ This table shows that there is no strong correlation (Analysis of correlations is useful because a strong correlation between variables could cause a problem of multi-colinearity and make econometric estimates difficult or make it difficult to interpret the results (Erkel-Rousse, 1995)) between the different variables of the model because all the values are lower than 0.75 (This threshold is not consensual, certain authors estimate that there is a correlation starting from 0.60 whereas for other, this value must be higher or equal to 0.80 for there to be correlation).

Table 3: Descriptive statistics for variables

VARIABLE	Nbre Obs	Moyenne	Dev.Std.	Min	Max
Indu _{it}	566	0.980105	0.2818146	-0.6333759	1.601117
G _{it}	598	1.95526	0.084505	1.623515	2.184251
Agri _{it}	600	1.211456	0.4201144	0.2620666	1.788283
Serv _{it}	600	1.633045	0.1131487	1.094654	1.886604
Fdi _{it}	600	3.280074	5.423132	-8.70307	57.83755

Source: Authors based on World Bank data

Table 4: ARDL (2, 1, 1, 1, 1) panel estimates

		Relation à long terme		
Variables	Coefficients	Std. Error	t-Statistic	Prob. *
INDUS _{it}				
G _{it}	0.444242***	0.160364	2.770218	0.0059
AGRI _{it}	-0.691298***	0.075643	-9.138956	0.0000
SERV _{it}	0.060885	0.106134	0.573664	0.5665
FDI _{it}	0.003355*	0.002148	1.561787	0.1191
Short-term relationship				
COINTEQ01	-0.249081***	0.085751	-2.904694	0.0039

D (INDUit (-1))	0.147688***	0.060319	2.448452	0.0148
D(Git)	0.170487*	0.105014	1.623468	0.1053
D(AGRIit)	-0.044151	0.170734	-0.258594	0.7961
D(SERVit)	-0.194264	0.167624	-1.158927	0.2472
D(FDIit)	0.000420	0.001358	0.309603	0.7570
C	0.236491	0.078372	3.017521	0.0027

Source: Constructed by the author from World Bank data.

Note: ***, **, * indicate significance levels of 1%, 5% and 10%.

The results of our model describing the relationship between industrialization and its determinants are presented in Table 4 (see Appendix). The results of the ARDL estimation suggest that fiscal policy has a positive and significant effect at 1% on industrialization in the long run, while in the short run this effect is significant at 10%. This result strongly corroborates those of Eze and Ogiji, (2014) and Ejiike (2021). Indeed, public spending to create infrastructure such as a motorway, a railway line or a telecommunications network makes firms' productive activity more efficient (Barro, 1990).

Agriculture has a negative and insignificant impact on the value added of the manufacturing sector in the SSA economies in the short term, but in the long term this effect is significant at 1%. This can be explained by the fact that the increase in the price of agricultural products has a negative effect on industrial value added in the sense that the cost of production is higher than the cost of sale. This result is in line with that of Rottso and Torvik (2003). Services have a negative and insignificant effect on industrialization in the short term. This can be explained by the fact that industrial labour has migrated to services and mainly informal sectors whose

productivity is no different from that of traditional agriculture (Mensah et al., 2016). However, in the long term, services have a positive and insignificant effect on industrial value added.

Financial openness has a positive and significant coefficient of 10% on industrialization in the long term, whereas in the short term this effect does not appear to be significant. In fact, the inflow of foreign investment plays a positive role in the modernization of the industrial sector, but this process can take a long time. This result corroborates that obtained by Anyanwu (2017)¹⁰.

4-2-ROBUSTNESS

In order to strengthen our results, as a dependent variable we take into account another proxy for industrialization, namely Potentially Relevant Industrial Employment, which was not included in our basic regressions. This gives us table 6 (see appendix).

Table 6: ARDL robustness (1, 1, 1, 0, 0)

		Long-term relationship		
Variables	Coefficient	Std. Error	t-Statistic	Prob. *
EMPL				
EMPL(-1)	0.947415***	0.013888	68.21790	0.0000
Git	0.160493*	0.090829	1.766986	0.0778
Git(-1)	-0.220521***	0.089897	-2.453043	0.0145
AGRIit	-0.691298***	0.075643	-9.138956	0.0000

¹⁰ Who have shown that many SSA countries discriminated against agriculture to promote industry after independence, but this discrimination had a negative effect on industrialization.

In the case of Nigeria and North Africa respectively, these authors have shown that FDI contributes favourably to industrialization.

AGRIit(-1)	0.422878***	0.027733	15.24845	0.0000
SERVit	-0.003958	0.037697	-0.105006	0.9164
FDIit	-0.000007	0.000706	-0.103862	0.9173
C	0.183055**	0.094711	1.932769	0.0538

Source: Constructed by the author from World Bank data.

Note: ***, **, * indicate significance levels of 1%, 5% and 10%.

Analysis of this result confirms that fiscal policy has a positive and statistically significant effect on industrialization (measured here by industrial employment) over the period 1994-2018. In addition, the other explanatory variables in the model have approximately the same coefficients as those estimated in the main model. We note that all other things being equal, a 1% increase in public spending increases industrial employment by 0.160%. This once again confirms our hypothesis that fiscal policy boosts industrialization in SSA.

5- CONCLUSION

In summary, the main objective of this paper was to analyse the effect of fiscal policy on industrialization in a sample of 24 sub-Saharan African countries over the period 1994-2018 using the panel ARDL model of Alsaleh and Abdul-Rahim (2019). To do so, we first carried out a descriptive analysis of the evolution of these variables in sub-Saharan Africa. To confirm the

results of these graphs, we then carried out econometric estimations. Analysis of this result shows that fiscal policy has a positive and statistically significant effect on industrialization (measured here firstly by manufacturing value added and secondly by industrial employment) during the period 1994-2018.

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APPENDICES

Table 1 : Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
INDUit	566	.980105	.2818146	-.6333759	1.601117
Git	598	1.95526	.084505	1.623515	2.184251
AGRIit	600	1.211456	.4201144	.2620666	1.788283
SERVit	600	1.633045	.1131487	1.094654	1.886604
FDIit	600	3.280074	5.423132	-8.70307	57.83755

Table 2: Correlation

	INDUit	Git	AGRIit	SERVit	FDIit
INDUit	1.0000				
Git	0.0899	1.0000			
AGRIit	-0.2581	0.5377	1.0000		
SERVit	0.3643	0.0255	-0.5042	1.0000	
FDIit	-0.0801	-0.0166	-0.1442	0.0296	1.0000

Table 3: Stationarity test

Im-Pesaran-Shin unit-root test for INDUit

Ho: All panels contain unit roots Number of panels = 24
Ha: Some panels are stationary Avg. number of periods = 23.58

AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included

ADF regressions: 0 lags

	Statistic	p-value
W-t-bar	-0.2384	0.4058

Im-Pesaran-Shin unit-root test for INDUit

Ho: All panels contain unit roots Number of panels = 24
Ha: Some panels are stationary Avg. number of periods = 23.58

AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included

ADF regressions: 1 lags

	Statistic	p-value
W-t-bar	-1.3072	0.0956

Im-Pesaran-Shin unit-root test for Git

Ho: All panels contain unit roots Number of panels = 24
Ha: Some panels are stationary Avg. number of periods = 24.92

AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included

ADF regressions: 0 lags

	Statistic	p-value
W-t-bar	-4.8452	0.0000

Im-Pesaran-Shin unit-root test for SERVit

Ho: All panels contain unit roots Number of panels = 24
Ha: Some panels are stationary Number of periods = 25

AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included

ADF regressions: 0 lags

	Statistic	p-value
W-t-bar	-1.3425	0.0897

Im-Pesaran-Shin unit-root test for FDIit

Ho: All panels contain unit roots
Ha: Some panels are stationary

Number of panels = 24
Number of periods = 25

AR parameter: Panel-specific
Panel means: Included
Time trend: Not included

Asymptotics: T,N -> Infinity
sequentially

ADF regressions: 0 lags

	Statistic	p-value
W-t-bar	-9.0878	0.0000

Im-Pesaran-Shin unit-root test for AGRIit

Ho: All panels contain unit roots
 Ha: Some panels are stationary

Number of panels = 24
 Number of periods = 25

AR parameter: Panel-specific
 Panel means: Included
 Time trend: Not included

Asymptotics: T,N -> Infinity
 sequentially

ADF regressions: 1 lags

	Statistic	p-value
W-t-bar	-0.5550	0.2895

Table 4 : ARDL panel estimates

Dependent Variable: D(INDUIT)
 Method: ARDL
 Date: 10/08/21 Time: 20:21
 Sample: 1994 2018
 Included observations: 513
 Maximum dependent lags: 4 (Automatic selection)
 Model selection method: Akaike info criterion (AIC)
 Dynamic regressors (1 lag, automatic): GIT AGRIT SERVIT FDIIT
 Fixed regressors: C
 Number of models evaluated: 4
 Selected Model: ARDL (2, 1, 1, 1, 1)
 Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
GIT	0.444242	0.160364	2.770218	0.0059
AGRIT	-0.691298	0.075643	-9.138956	0.0000
SERVIT	0.060885	0.106134	0.573664	0.5665
FDIIT	0.003355	0.002148	1.561787	0.1191
Short Run Equation				
COINTEQ01	-0.249081	0.085751	-2.904694	0.0039
D (INDUIT (-1))	0.147688	0.060319	2.448452	0.0148
D(GIT)	0.170487	0.105014	1.623468	0.1053
D(AGRIT)	-0.044151	0.170734	-0.258594	0.7961
D(SERVIT)	-0.194264	0.167624	-1.158927	0.2472
D(FDIIT)	0.000420	0.001358	0.309603	0.7570
C	0.236491	0.078372	3.017521	0.0027
Log likelihood	1055.113			

*Note: p-values and any subsequent tests do not account for model selection.

Table 5: Choosing the optimal ARDL model

Model Selection Criteria Table
 Dependent Variable: INDUIT
 Date: 10/08/21 Time: 20:29
 Sample: 1994 2018
 Included observations: 564

Model	LogL	AIC*	BIC	HQ	Specification
2	1010.473888	-3.621917	-2.084792	-3.016794	ARDL(2, 1, 1, 1, 1)
3	1027.600755	-3.592228	-1.840620	-2.902668	ARDL(3, 1, 1, 1, 1)
4	1049.186183	-3.581798	-1.615707	-2.807802	ARDL(4, 1, 1, 1, 1)
1	962.689863	-3.519179	-2.196536	-2.998491	ARDL(1, 1, 1, 1, 1)

Choosing the optimal model

Akaike Information Criteria

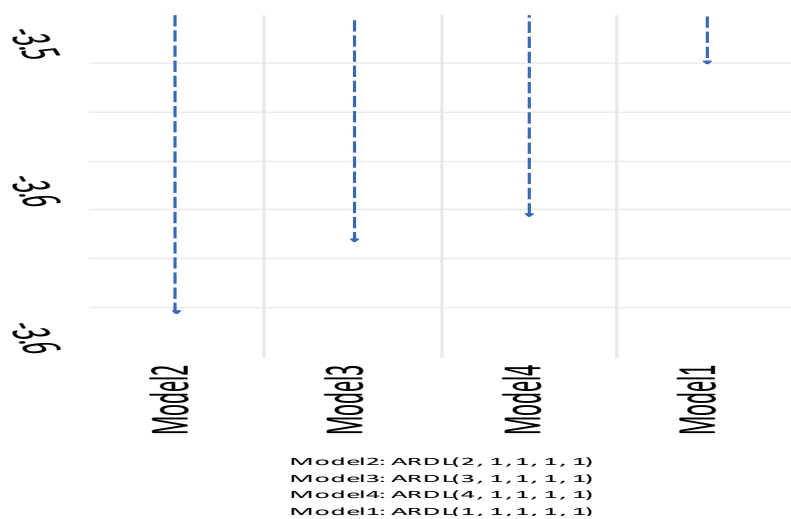


Table 6 : Robustness

Dependent Variable: EMPL
 Method: ARDL
 Date: 10/10/21 Time: 17:28
 Sample (adjusted): 2 600
 Included observations: 573 after adjustments
 Maximum dependent lags: 4 (Automatic selection)
 Model selection method: Akaike info criterion (AIC)
 Dynamic regressors (4 lags, automatic): GIT AGRIT SERVIT FDIIT
 Fixed regressors: C
 Number of models evaluated: 2500
 Selected Model: ARDL(1, 1, 1, 0, 0)
 Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EMPL(-1)	0.947415	0.013888	68.21790	0.0000
GIT	0.160493	0.090829	1.766986	0.0778
GIT(-1)	-0.220521	0.089897	-2.453043	0.0145
AGRIT	-0.428012	0.028271	-15.13962	0.0000
AGRIT(-1)	0.422878	0.027733	15.24845	0.0000
SERVIT	-0.003958	0.037697	-0.105006	0.9164
FDIIT	-7.33E-05	0.000706	-0.103862	0.9173
C	0.183055	0.094711	1.932769	0.0538
R-squared	0.933835	Mean dependent var	1.020918	
Adjusted R-squared	0.933015	S.D. dependent var	0.305974	
S.E. of regression	0.079190	Akaike info criterion	-2.220061	
Sum squared resid	3.543180	Schwarz criterion	-2.159316	
Log likelihood	644.0474	Hannan-Quinn criter.	-2.196365	
F-statistic	1139.183	Durbin-Watson stat	1.948110	
Prob(F-statistic)	0.000000			

*Note: p-values and any subsequent tests do not account for model selection.

Table 7: List of countries in the sample

South Africa	Ivory Coast	Mali	Sierra Leone
Bénin	Eswatini	Mauritius	Sudan
Botswana	Gabon	Niger	Tanzania
Burundi	Ghana	DRC	Chad
Cameroon	Equatorial Guinea	Senegal	Togo
Congo	Guinea-Bissau	Seychelles	Zimbabwe

Source : Authors