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EFFECT OF TAX REVENUE ON STRUCTURAL CHANGE: A PANEL THRESHOLD ANALYSIS OF AFRICAN COUNTRIES

KANDO SERGE GBAGBEU[i]

Abstract: *This research paper investigates the effect of tax revenue on structural change for 46 African countries from 2000 to 2022. The empirical research results show that the relationship between structural change and tax revenue is not linear, and the entire sample can be split into three regimes, where tax revenue as a percentage of GDP is used as the threshold. In all three regimes, tax revenue has a positive effect on structural change. The direction of the effect does not change, but the effect becomes weaker upon reaching the double threshold value of 1.18%. and 4.62%. Yet, the findings of this study may provide useful guidelines for policymakers in African countries. They should pay attention to tax revenue, which theoretically has a significant impact on structural change. They need to consider a maximum rate to increase the benefit of tax revenue to structural change towards the positive transformation of Africa.*

Keywords: *structural change; tax revenue; panel threshold; Africa*

JEL Classification: *O47; H20; C33; O55.*

1. INTRODUCTION

In any transition economy, the modern sector is the engine of growth and a key tool for structural transformation (Cantore et al., 2017), even though agriculture sector is still direct or indirect key for economic growth or transformation in some countries (Zhang and Diao, 2020). Structural transformation or structural change is defined as the transition of an economy from low productivity and labor-intensive economic activities to higher productivity and skill-intensive activities that are dominated by manufacturing and services (UN-HABITAT, 2016). The transformation level of a country can be captured by the change in sectoral value-added or sectoral employment. Globally, most African economies have weak and narrow non-agricultural sectors, even with sizeable domestic markets and abundant resources. This means that Africa

[i] Department of economics, Peleforo Gon Coulibaly University (Côte d'Ivoire), kandoserge@gmail.com

must emphasize the development of its industrial and service sectors for the desired economic transformation.

Many areas can sustain Africa's structural transformation. However, fundamental to addressing the challenges of structural transformation is domestic resource mobilization through tax revenue as the only powerful tool to support economic development, diversification, and transformation in all economies (African Development Bank, 2024). In recent years, Africa has witnessed an encouraging domestic revenue mobilization trend. However, the level of transformation in African countries remains low.

This study investigates the relationship between domestic resources and structural change for selected African countries, specifically analyzing the threshold contribution of tax revenue to enhancing structural change. Thus, our study is motivated by the need to determine the level of tax revenue required to enhance structural transformation in Africa. In this way, we make a substantial contribution to the missing literature that evaluates the threshold effect of tax revenue on structural change in African countries. To achieve the aforementioned objective, this study draws upon the endogenous public policy growth models (Barro and Sala-i-Martin, 1992) suggesting that taxation can have permanent effect on economic growth, rather than the neoclassical models suggesting a temporary effect.

The paper is organized as follows: the first section introduces our topic. It briefly presents the background, aims, and motivation of the study. The second section focuses on the theoretical framework and the literature review. In the third section, we present the empirical analysis and results. The final section provides concluding remarks.

2. THEORIES AND LITERATURE REVIEW

The theoretical model in our study is based on endogenous public policy growth models (see Barro and Sala-i-Martin, 1992; Stokey and Rebelo, 1995; Mendoza et al., 1997). They provide mechanisms by which fiscal policy can determine both the level of production and the growth rate at equilibrium. These endogenous growth models suggest that taxation can have a negative or positive effect on the growth rate through five possible mechanisms (Engen and Skinner, 1996). The model is appropriate in African contexts given the ongoing structural transformation and the need for effective revenue mobilization strategies. Applying this framework to our research, the models suggest that tax revenue can have positive or negative effect on structural change. By analyzing the threshold contribution, we test the hypothesis that, under a certain tax

revenue level, the process of shifting economic structures toward more productive and diversified activities is limited.

Empirically, the impact of taxation on economic growth has been examined in several studies. Accordingly, the literature on the relationship between taxation and structural change is extensive. On the one hand, some important literature reviews of empirical studies on the relationship between taxation and economic growth are done by Myles (2000) and Arnold (2008). On the other hand, Alinaghi and Reed (2020) and Gechert and Heimberger (2022), among others, have provided interesting meta-analysis on the subject matter. Overall, the empirical literature on the taxation-growth nexus concludes with various and sometimes contradictory results. Recent studies, such as those by Maganya (2020), Klein and Ventura (2021), Arvin et al. (2021), Buterin et al. (2023), Ho et al. (2023), Cornevin et al. (2024), Zhang et al. (2025), and Kubaje et al. (2025) showed either positive or negative, significant or non-significant, linear or nonlinear relationships between taxation and growth.

One main source of controversy lies on the type of taxation measurement used in the studies. While Lee and Gordon (2005) and Arnold (2008) found a negative effect of corporate tax revenues on economic growth, Miller and Russek (1997) and Canavire-Bacarreza et al. (2013) found rather a positive effect of corporate tax revenues on economic growth. In the same fashion, Tanchev (2016) assessed the impact of personal income tax on economic growth and found positive impact where Widmalm (2001) discovered priorly a detrimental effect. Tax on consumption seems to have a positive effect on economic growth in the study of Arnold (2011) and Szarowska (2013) but a negative effect with Kaneko and Matsuzaki (2009). For Kneller et al. (1999) and Acosta-Ormaechea and Yoo (2012), tax on income or property is found to have a significant negative impact on economic growth. In contrast, Xing (2012) suggests that shifts in tax revenues towards property taxes are associated with higher level of the economy. About capital taxation, Arachi et al. (2015) and Kate and Milionis (2019) have also provided non-consensual findings. According to the former, capital taxation is negatively related to growth. In sum, regardless of the variable used in these studies, the impact of taxation on economic growth or sectoral growth remains controversial. However, the hypothesis of our study is that tax revenues positively affect economic transformation.

A second main source of controversy lies on the sample of countries and the time span under investigation. For instance, research focusing on OECD countries such as Widmalm (2001) found no robust relationship between taxation and economic growth. In contrast, Arnold et al. (2011) found a negative effect whereas Tosun and Abizadeh (2005) concluded with a positive effect. Szarowska (2013) also found statistically

significant positive effect of taxation on economic growth but for EU-24 member states. Bringing together developed and developing countries in the sample, the controversy remains. For example, Lee and Gordon (2005) show a negative impact on growth for 70 countries over the period 1980-1997. But Kate and Milionis (2019), with a sample of 77 countries, report a strongly positive association for high-income countries and weak and even insignificant for low-income countries. Yet, even within developing countries' contexts, and more specifically in African contexts, the findings are inconsistent. The study of Babatunde et al. (2017) focusing on 16 African countries and, those of Ho and al. (2023) on 29 developing countries came out with the results that tax revenue positively affects economic growth in general. However, previous study revealed that higher taxes are strongly correlated with reduced economic growth in Côte d'Ivoire (Keho, 2010) or in Nigeria and South Africa (Saibu, 2015). But it seems that distortionary tax has a negative and insignificant effect and non-distortionary tax has a positive and insignificant effect on the economic growth of sub-Saharan African countries (Ugwunta and Ugwuanyi, 2015). Moreover, there is evidence of a non-linear (U-shaped) relationship between taxation and economic growth of WAEMU countries (N'Yilimon, 2014) while there is also evidence of an inverted-U relationship between tax and growth in African countries contexts (Adedeji, 2025). In sum, regardless of the sample of countries according to the level of development that the authors highlighted in their studies, the impact of taxation on economic growth or sectoral growth remains controversial. However, the hypothesis of our study is that there is a non-linear (U-shaped) relationship between tax revenue and economic transformation.

A third main source of controversy lies on the use of different techniques at the econometric level to catch up the impact of taxation on sectoral or aggregate growth. Ordinary least squares (Sekou, 2015), two-stage least squares (Stoilova, 2017), pooling (Kneller et al., 1999), fixed effects (Andrašić et al., 2018), random effects (Tosun and Abizahed, 2005), autoregressive distribution (Maganya, 2020), vector auto-regression (Kofi Ocran, 2011), vector error correction (Eze and Ogiji, 2013), instrumental variable (Brückner, 2012), generalized method of moments (Hakim et al., 2016), cointegration (Wisdom, 2014), and threshold regression (Aydin and Esen, 2019) are some examples of commonly used approaches. Starting from the basic ordinary least squares models toward more advanced model like panel threshold regression, the authors reported results that contribute to the absence of consensus in the literature even if these divergent methodological choices are not merely technical.

In sum, the consensus on the effect of taxation on economic growth or on the link between these variables is missing due to the variable's measurement, the wide

scope and methodologies, the characteristics specific to countries, and the time periods. This makes the topic open for further investigation, especially in African countries.

3. EMPIRICAL ANALYSIS AND RESULTS

3.1. Model Specification

To investigate the threshold effect of domestic resources on structural change for our sample, this study adopts the multiple threshold regression approach from Hansen (1997, 2000), which takes the following form:

$$sc_{it} = \omega_0 + \omega_1 sc_{it-1} + \omega_2 X_{it} + \omega_3 tax_{it} d(tax_{it} < \gamma_1) + \omega_4 tax_{it} d(\gamma_1 \leq tax_{it} < \gamma_2) + \omega_5 tax_{it} d(tax_{it} \geq \gamma_2) + \varepsilon_{it} \quad (1)$$

In the models, sc stands for the structural change of value added that refers to the reallocation of value added across three broad economic sectors, and tax stands for the tax revenue share of gross domestic products as a measure of domestic resources. Four measures of structural change have been used: the modified Lilien index (mli), norm of absolute value (nav), structural change index (sci), and effective structural change (esc). We control for a set of variables X, including gross capital formation (gcf), labor force participation (lfp), trade openness (trade), change in inflation (infl), urbanization (urb), and government effectiveness (geff). Here, $d(\cdot)$is the indicative function with tax as a threshold variable; ω is the set of parameters; γ is the threshold value; and ε_{it} is the error term with 0 mean and not serially correlated. Unlike a simpler quadratic model, a threshold model is more suitable for our study because it can identify specific inflection points where the relationship between tax revenue and structural change fundamentally changes.

3.2. Data Description

This study uses panel data from 46 African countries from 2000 to 2022. Table 1 presents the description of the variables in our model. Research data were provided by the International Monetary Fund (IMF), United Nations Statistics Division (UNDESA), and World Bank through its Development and Governance Indicators (WDI, WGI).

Table 1. Variable description

Variable	Measurement	Data source
mli	$mli = \sqrt{\sum_{t=1}^{n} x_{it}.x_{is}\left(ln\frac{x_{it}}{x_{is}}\right)^{2}}$ x is the value-added share of GDP of sector *i* at times *s* and *t.*	UNDESA
nav	$nav = 0.5\sum_{i=1}^{n}\lvert x_{it} - x_{is}\rvert$ x is the value-added share of GDP of sector *i* at times *s* and *t*	UNDESA
sci	$sci_t = \sqrt{\sum_{i}\left(\Delta x_{i,t}\right)^{2}\left(x_{i,t-1}/100\right)}$ x is the value-added share of GDP of sector *i* at times *s* and *t*	UNDESA
esc	$esc = 0.5\sum_{i\in X}\lvert x_{it} - x_{is}\rvert \;\; X = \{i\}\; such\; that\; C_i > 0$ x is value-added share of GDP of sector *i* at times *s* and *t* *X* is the set of sectors with a positive contribution to labor productivity growth	UNDESA
tax	tax revenue (% GDP)	IMF
gcf	Gross fixed capital formation (% GDP)	UNDESA
lfp	Labor force participation rate, total (% of total population ages 15+)	WDI
trade	Trade of goods and services (% GDP)	UNDESA
infl	Inflation rate, average consumer prices (Annual percent change)	IMF
urb	Urban population (% of total population)	WDI
geff	Government Effectiveness: Estimate	WGI

Source: Author

The descriptive statistics of the variables are presented in Table 2. For all variables, the gap between the maximum and minimum values is much larger, indicating significant heterogeneity across African countries.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
mli	1058	3.34	3.57	0.0	31.7
nav	1058	2.57	2.74	0.0	23.6
sci	1058	2.09	2.37	0.0	22.7
esc	1058	1.35	1.40	0.0	11.8
tax	1058	13.05	7.13	0.6	51.9
gcf	1058	23.57	10.15	2.9	85.1
lfp	1058	62.70	13.88	23.1	88.3
trade	1058	71.07	39.86	20.7	376.2
infl	1058	8.14	23.96	-14.4	550.0
urb	1058	43.07	18.66	8.2	90.7
geff	1058	-0.76	0.57	-1.9	1.2

Source: Author

Pearson's correlations between the related variables in this study are presented in Table 3. The results do not show any significant strong correlation among variables, indicating that it will lead to the stability of the panel threshold regression model.

Table 3. Pearson Correlation

	mli	**tax**	**gcf**	**lfp**	**trade**	**infl**	**urb**	**geff**
mli	1.00							
tax	-0.18***	1.00						
gcf	0.05*	0.16***	1.00					
lfp	0.06*	-0.19***	-0.12***	1.00				
trade	0.01	0.39***	0.39***	-0.31***	1.00			
infl	0.21***	-0.11***	-0.06*	0.10***	-0.03	1.00		
urb	0.14***	-0.03	0.26***	-0.53***	0.36***	-0.04	1.00	
geff	-0.19***	0.52***	0.26***	-0.17***	0.14***	-0.09***	0.08***	1.00
	nav	**tax**	**gcf**	**lfp**	**trade**	**infl**	**urb**	**geff**
nav	1.00							
tax	-0.18***	1.00						
gcf	0.05	0.16***	1.00					
lfp	0.06**	-0.19***	-0.12***	1.00				
trade	0.00	0.39***	0.39***	-0.31***	1.00			
infl	0.21***	-0.11***	-0.06*	0.10***	-0.03	1.00		
urb	0.12***	-0.03	0.26***	-0.53***	0.36***	-0.04	1.00	
geff	-0.20***	0.52***	0.26***	-0.17***	0.14***	-0.09***	0.08***	1.00
	sci	**tax**	**gcf**	**lfp**	**trade**	**infl**	**urb**	**geff**
sci	1.00							
tax	-0.17***	1.00						
gcf	0.07**	0.16***	1.00					
lfp	0.03	-0.19***	-0.12***	1.00				
trade	0.04	0.39***	0.39***	-0.31***	1.00			
infl	0.20***	-0.11***	-0.06*	0.10***	-0.03	1.00		
urb	0.19***	-0.03	0.26***	-0.53***	0.36***	-0.04	1.00	
geff	-0.18***	0.52***	0.26***	-0.17***	0.14***	-0.09***	0.08***	1.00
	esc	**tax**	**gcf**	**lfp**	**trade**	**infl**	**urb**	**geff**
esc	1.00							
tax	-0.17***	1.00						
gcf	0.07**	0.16***	1.00					
lfp	0.07**	-0.19***	-0.12***	1.00				
trade	0.03	0.39***	0.39***	-0.31***	1.00			
infl	0.20***	-0.11***	-0.06*	0.10***	-0.03	1.00		
urb	0.11***	-0.03	0.26***	-0.53***	0.36***	-0.04	1.00	
geff	-0.18***	0.52***	0.26***	-0.17***	0.14***	-0.09***	0.08***	1.00

***, ** and * indicate the 1, 5, and 10% significance levels, respectively

Source: Author

3.3. Methodology and Results

3.3.1. Panel threshold effect test

The main purpose of this study is to use a threshold variable to investigate whether the relationship between tax revenue and structural change differs based on certain thresholds. Before estimating the threshold regression model, we used the panel threshold regression method developed by Hansen (1999) to test the null hypothesis of a linear formulation against a threshold alternative hypothesis. This study uses the bootstrap method to approximate the F statistic, calculate the bootstrap p-value, and find the number of thresholds and regimes. Table 4 presents the empirical results of the test for single, dual, and triple threshold effects.

Table 4. Panel Threshold Effect test

Model	Threshold	F-statistic	Bootstrap P.value	Critical Value (10%, 5%, 1%)		
mli	Single	38.48	0.000	13.21	16.72	20.96
	Double	18.32	0.027	13.18	15.79	19.97
	Triple	7.01	0.847	21.22	24.79	28.33
nav	Single	33.46	0.007	14.09	15.64	25.05
	Double	19.81	0.013	13.43	15.85	20.04
	Triple	7.41	0.823	22.00	24.23	34.38
sci	Single	45.04	0.000	12.91	15.07	21.03
	Double	16.11	0.043	14.10	15.94	20.93
	Triple	7.55	0.847	20.21	23.47	30.10
esc	Single	27.86	0.003	12.62	16.38	22.00
	Double	19.16	0.020	13.44	16.08	22.23
	Triple	11.82	0.620	24.78	30.52	39.71

Source: Author

The test statistics for the single-threshold and double-threshold models are significant at 5%. However, the test statistics for triple thresholds do not pass the significance test at 5% confidence level. Thus, we conclude that there is strong evidence of a double-threshold effect of tax revenue on structural change. The results show that the relationship between structural change and tax revenue is not linear, and the whole sample can be split into three regimes, where tax revenue as a percentage of gross domestic product (GDP) is used as the threshold with two endogenous cut-off points. Figure 1 shows the likelihood ratio function plot which gives us a better picture of the accuracy of the threshold estimates and the confidence intervals.

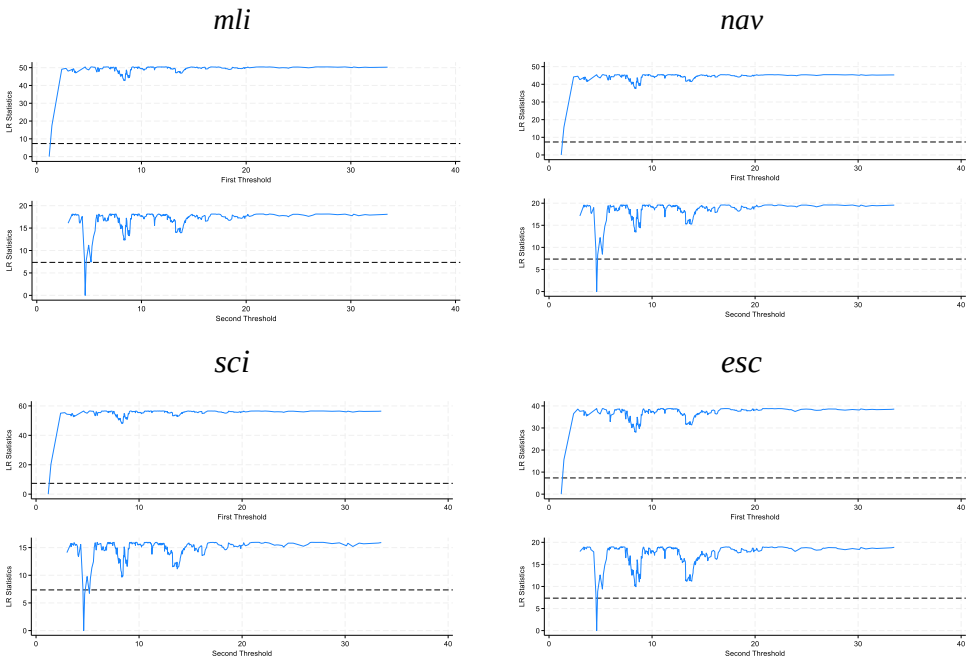


Figure 1. Likelihood ratio function plots

Source: Author

3.3.2. Panel threshold estimation

Once the single threshold is found, we adopt the fixed-effect panel threshold model developed by Hansen (1999) to analyze the relationship between structural change and tax revenue. The equation is estimated with tax revenue acting as a threshold variable and condition variable by controlling for some variables. Table 5 reports the empirical results of the estimations of the panel threshold model with three regimes.

Table 5. Panel Threshold estimations

Dependent variables	mli	nav	sci	esc
Estimated Threshold values				
$\hat{\gamma}_1$	1.18	1.18	1.18	1.18
$\hat{\gamma}_2$	4.62	4.62	4.62	4.62
Threshold variable				
tax < $\hat{\gamma}_1$	4.81***	3.65***	3.03***	1.85***
$\hat{\gamma}_1 \leq$ tax < $\hat{\gamma}_2$	0.81***	0.66***	0.47***	0.37***
tax ≥ $\hat{\gamma}_2$	0.13**	0.10**	0.09**	0.07**
Independent variables				
sc(-1)	0.22***	0.22***	0.22***	0.20***
gcf	0.01	0.01	0.01	0.01

Dependent variables	mli	nav	sci	esc
lfp	0.04	0.03	0.03	0.00
trade	0.00	0.00	0.00	0.00
infl	0.02**	0.01**	0.01**	0.01*
urb	-0.01	-0.01	0.00	-0.01
geff	0.92	0.69	0.61	0.40*
cons	-0.27	0.07	-0.67	0.70
R^2	0.10	0.09	0.10	0.06
F	8.96***	8.96***	8.30***	8.10***

***, ** and * indicate the 1, 5, and 10% significance levels, respectively; tax $<\hat{\gamma}_1$, $\hat{\gamma}_1 \leq$ tax $< \hat{\gamma}_2$, and tax $\geq \hat{\gamma}_2$ denote the marginal effect of tax revenue on the increase in structural change in the low and high-tax revenue regimes, respectively.

Source: Author

As mentioned above, the estimated tax revenue threshold levels are 1.18% and 4.62%. In all three regimes, tax revenue has a positive effect on structural change. When tax revenue is below, between, or above the double threshold values, it will increase the value of structural change. The direction of the effect does not change, but the effect becomes weaker upon reaching the threshold values. The signs of the estimated coefficients are in line with the tax revenue-growth nexus theory, and existing empirical studies on African countries, such as Kabaje et al. (2025), have also found a double threshold effect of tax revenue on economic growth but indicate an inverted U-shaped relationship, as Zhang et al. (2024). However, our results are consistent with those of Ho et al. (2023), who showed that tax revenue positively affects growth. Since tax revenue maintains the same impact direction and trend and passes the significance test regardless of the measure of structural change, the research conclusions are reliable and robust.

Therefore, we suggest that with the current issue of domestic resource mobilization in African countries, the best level of tax revenue is 1.18% of GDP. Beyond this threshold, the benefit of tax revenue to structural change declines.

This study also arrived at some interesting findings regarding the impact of the control variables. In the models, only the initial structural change and the change in inflation rate are statistically significant determinants of structural change. They are positively linked to structural change. This suggests that initial structural change and change in inflation rate promote structural change in Africa.

4. CONCLUSION

This study investigates the effect of tax revenue on structural change for 46 African countries from 2000 to 2022. It analyzes the threshold contribution of tax revenue to enhancing structural change. This study adopts the models of endogenous

public policy growth (Barro and Sala-i-Martin, 1992; Stokey and Rebelo, 1995; Mendoza et al., 1997) as scope and the threshold model from Hansen (1997, 2000) as methodology.

The empirical research results show that the relationship between structural change and tax revenue is not linear, and the whole sample can be split into three regimes, where tax revenue as a percentage of GDP is used as the threshold with two endogenous cut-off points, namely, 1.18% and 4.62%. In all three regimes, tax revenue has a positive effect on structural change. When tax revenue is below, between, or above the double threshold values, it will increase the value of structural change. The direction of the effect does not change, but the effect becomes weaker upon reaching the threshold values. Our results regarding the effect of the threshold level tax revenue on growth do not support many existing empirical studies but are also consistent with others. Concerning the impact of the control variables, this study concludes that initial structural change and change in inflation rate promote structural change in Africa.

Yet, the findings of this study may provide useful guidelines for policymakers and for further research on the impact of tax revenue on structural change. African countries are striving to generate sustainable revenue streams to fund economic transformation while the IMF stresses the urgent need for African countries to strengthen domestic resource mobilization. In light of our findings, we recommend that African policymakers pay attention to tax revenue, which theoretically has a significant impact on structural change. They should work toward broadening the tax base, eliminating inefficient exemptions, digitalizing tax systems, capturing revenue from emerging sectors, and enforcing capacity-building for tax administration. However, they need to consider a maximum rate to increase the benefits of tax revenue to structural change towards the positive transformation of Africa. The study faced the challenge of missing data for some African countries, and we did not consider heterogeneity among the sample countries. Future research should focus on overcoming these limitations. In addition, researchers can consider the threshold effect of export diversification or economic variables on structural change.

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