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# Monetary Policy and Governance, Commodity Price Volatility and Tax Revenues in Sub-Saharan Africa

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**Abstract**

This paper investigates the mitigating role of monetary policy and governance in the tax revenue effects of commodity price volatility (CPV) in sub-Saharan Africa. We propose a dynamic panel threshold regression to take into account both the nonlinearity in the relationship between tax revenues and CPV and the endogeneity issues. The estimations show that CPV hurt tax revenues only in the high regime of CPV. Thus, a one-standard-deviation increase in CPV significantly reduces sub-Saharan Africa tax revenues. We also show that low-interest rate, better credits to the economy, and better control of corruption mitigate the detrimental effects of CPV. Sub-Saharan African policymakers should promote accommodative monetary policies, nonconventional monetary policies, and good political governance to tackle the detrimental effects of CPV.

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## Introduction

The mobilization of domestic resources has been one of the major concerns of African countries (Thiao and Ouonogo 2021). Its importance in financing development gained the renewed interest of both policymakers and scholars. Moreover, this problem of financing development with tax revenue has gained notoriety in the context of high dependence on raw materials in these countries, which are frequently vulnerable to this instability of their prices (Ehrhart and Guerineau 2013). From that moment, the relationship between commodity price volatility (CPV) and fiscal performance becomes one of the most debated concerns in Africa.

Recent statistics indicate that the mobilization of tax revenues has been low over the past decades in Africa. Indeed, the share of tax revenue in GDP rose from approximately 11% in the mid-1990s to over 15% in 2016 in Sub-Saharan African countries (Mascagni, Mengistu and Woldeyes 2021). This ratio of tax revenues to GDP increased by 1.5% between 2008 and 2017 in Africa (OCDE 2020). Despite this slight growth, the ratio of tax revenues to gross domestic product (GDP) in Africa is less than those in Latin America and the Caribbean (23%) and the Organization for Economic Co-operation and Development region (34%). In addition, there has been a decrease in tax mobilization (1.8% from the average) over the past two decades in Sub-Saharan Africa (World Bank 2020). Jacquemot and Raffinot (2019) attribute these decreases to the liberalization of trade and the fiscal transition in several economic and monetary zones in Africa such as the West African Economic and Monetary Union (WAEMU), the Central African Economic and Monetary Community (CEMAC), and the African Continental Free Trade Area (AfCFTA), leading to a drop in customs tax revenues. While facing high commodity price fluctuations, this decline in fiscal performance could also be linked to the heavy dependence on commodity exports in the majority of Sub-Saharan African countries. In particular, the CEMAC countries are 90% commodities-dependent (BEAC 2019) and those of WAEMU are 65% commodities-dependent countries (BCEAO 2016).

The current literature on tax performance in developing countries can be grouped into two axes. The first one aims to investigate the determinants of tax potential. These authors argue that the heterogeneity in the level of tax revenue is explained by countries' natural resource endowments tax evasion, and the level of the shadow economy (Thiao and Ouonogo 2021; Zídková 2014). The second and most recent strand of the literature focuses on the fiscal effects of CPV and found heterogeneous effects, depending on countries' characteristics (Da and Diarra 2022; García-Albán, González-Astudillo and Vera-Avellán 2021; Majumder, Raghavan and Vespignani 2022). This contradiction could be due to misspecification and methodological issues. Indeed, failing to take into account the heterogeneity in countries' fiscal efforts, resilience capacity to external shocks, and stabilization policies could lead to biased conclusions.

Thus, the role of monetary policy and corruption are rarely studied in the stabilization policies of shocks due to CPV. Moreover, these two governance parameters could be used to mitigate the fiscal effects of CPV in African commodity-dependent countries. Recall that tax revenues lost from corruption are estimated to be 0.01% of GDP in Africa (L'Initiative Afrique 2020). Moreover, monetary policy, through the central bank interest rate or credits to the economy, is one of the instruments on which monetary authorities could act to mitigate the fiscal impacts of CPV (Majumder, Raghavan and Vespignani 2022). This thesis is based on the assumption that, in the presence of high CPV, the central bank may reduce its interest rate to make lending terms more flexible. The reduction in the cost of investment generated by this monetary policy stimulates aggregate demand and therefore improves the tax base. The relationship between monetary policy and tax revenue mobilization has also been theorized by Tanzi (1992) and is known as the Olivera–Tanzi effect. The latter postulates that the real value of tax revenues is eroded by inflation since there is a lag for certain types of taxes between the date of imposition and that of collection.

Besides, governance through the control of corruption can play a mitigating role. In the context of high CPV, the control of corruption reduces tax evasion. It is known that there are bribes between taxpayers and tax auditors, which motivate taxpayers to increase their work effort. Although an incentive policy based on the negotiation of bribes makes it possible to increase tax revenues in the short term, it does not make it possible to sustain them in the long term (Salhi and Echaoui 2020). Tanzi and Davoodi (1998) provided evidence that the most corrupt countries tend to collect less tax revenue. The implication is that some of the taxes paid by taxpayers are diverted from

public accounts. Tanzi and McCuistion (1967) argued that a distinction should be made between taxes collected by tax managers and taxes collected by the treasury. Thus, only good governance based on the control of corruption can have a structural effect on the ability to mobilize tax revenue in a CPV context. Moreover, it's worth noting that the quality of institutions matters in mitigating the detrimental effect of CPV on tax revenues. Indeed, the positive impacts of institutional quality on revenue mobilization have been well documented in the economic literature (Estrada, Mutascu and Tiwari 2014; Torgler 2005). Equally, there is a growing literature highlighting the mediating role of institutional quality in the achievement of economic outcomes such as economic growth (Duodu and Baidoo 2022 and Houngbedji and Bassongui 2021; Antonakakis et al. 2017) and fiscal policy (Kaya and Kaya 2020). Therefore, new evidence on the role of monetary policy and governance in the relationship between CPV and fiscal performance in the Sub-Saharan African region is needed.

The objective of this research is to analyse the role of monetary policy, corruption control, and political stability in the relationship between CPV and the mobilisation of tax revenues in sub-Saharan Africa (SSA) countries. Although abundant literature has examined the relationship between CPV and tax revenue mobilisation, less attention has been devoted to the role of monetary policy, corruption control, and political stability. The novelty of this research is threefold. On a practical level, we reexamine the effects of CPV on revenues mobilization following existent literature by controlling for governance and institutional variables (Diakite et al. 2019 ; Estrada, Mutascu and Tiwari 2014). Second, we investigate the mediating role of governance and institutional quality in mitigating the detrimental effects of CPV on revenue mobilization. Indeed, the mediating role of governance and institutional quality in the achievement of economic outcomes such as economic growth and tax revenues has been highlighted (Houngbedji and Bassongui 2021; Duodu and Baidoo 2022; Antonakakis et al. 2017). Third and methodologically, we relax the hypothesis of linearity by assuming that the effect of CPV on tax revenues depends on the degree of volatility (Oluseun Olayungbo 2021; Houngbedji 2021). Lastly, we compute a CPV indicator, namely semivariance that holds only the negative extreme values in the distribution of commodity prices (Hong Vo 2021).

The rest of the paper is organised as follows. The first section presents a review of the literature relating to the link between CPV and tax revenues. The second section is devoted to the methods and data. The third section presents and discusses the main findings. The last section concludes.

## Literature Review

### *Theoretical Literature Review*

In this section, we discuss the theoretical nexus between CPV and tax revenues. The main assumption of this study is that the effect of CPV on tax revenues depends on the level of volatility, monetary policy, governance, and quality of institutions. While commodities' net exporters' countries depend on royalties, the importing countries, as for them, are affected via import taxes.

In a demonstration of the differentiated effects of CPV on macroeconomic aggregates, Ongena, Popov and Van Horen (2019) distinguish between the effects of an increase and a decrease in CPV on tax revenues. Indeed, unlike an increase in CPV, which plays a favorable role in the real economy, its decrease is harmful. First, in addition to the decline in tax revenue that generates, this encourages the government to issue debt public and results in an increase in the exposure of banks to sovereign risk through government interference. Agarwal, Duttagupta and Presbitero (2020) point out that the decline in CPV induced a sharp increase in withdrawals of deposits, which has an impact on the funding and liquidity of banks. On the side of commodities' net importers' countries, the CPV increase generates a positive impact on taxes levied on imports. This "price effect" is offset by a "taxation rate effect" and a "tax evasion effect". First, the government can react to this price shock by modifying its tax policy through a VAT exemption on food products, for example. These countries are tempted to develop strategies of tax evasion that negatively affect the level of tax revenues collected. Thus, the more tax rates there are, the larger the incitement to escape taxation.

At the microeconomic level, the price effect refers to the fact that given that import taxes are essentially ad valorem taxes, the relationship between the price of goods and the tax levied on the latter is linear. Thus, instability in prices will not affect tax revenues because the gains made during high-price phases are offset by losses when prices are low. Second, the rate tax effect results from the fact that the tax exemptions granted to imports of necessities in a period of high prices are not compensated by an increase in tax rates in a low-price period. Such asymmetry in the behavior of tax authorities generates a loss net of tax revenues when CPV imported is volatile. Finally, CPV can harm the volume of products traded since it encourages the substitution of imported products for less volatile ones to reduce uncertainties in the invoice for raw material imports. In sum, the effect of CPV has negative

harms on tax revenues in net importing countries. This effect is reinforced when tax policy focuses on tax exemptions. At the macroeconomic level, the volatility of CPV generated the risk of GDP volatility in both net importing and net exporting countries. This reduces the value of GDP and thus reduces the tax base and tax revenues. CPV instability would therefore harm imports and exports through the macroeconomic channel.

For net exporting countries, the effect of CPV on tax revenue is felt for these countries through corporate taxes and nontax revenues. The impact on tax revenues is positive if production is carried out by domestic enterprises or if marketing is managed by a public agency. This effect is reinforced by a tax policy based on ad hoc taxation adopted to deal with cases of export booms (taxation on windfall gains). Furthermore, at the macroeconomic level, the positive shock on net exporting countries' tax revenues leads to a de facto modification of the tax base. Beyond these aspects denoted by the literature, the influence of CPV on tax revenues depends on the share of taxes on foreign trade, the share of import taxes, and the dependence on corporate taxes.

## *Empirical Literature Review*

The literature on the determinants of tax revenues dates back to Lotz and Morss (1970), who mentioned the role of the level of development, openness of trade, the sectoral share of the economy, and the quality of institutions. Subsequently, this literature has been oriented toward two lines of research. The first seeks to study the effect of CPV on macroeconomic variables, while the second highlights that this relationship is conditioned by governance factors.

Within the first group, CPV is not unanimous. While some works use terms of trade indices as a measure of CPV (Subervie 2008), others use separate price indices for exports. Medina (2021) analysed the effects of CPV fluctuations on tax revenues for eight Latino American countries. Using VAR modeling, the results indicated that there is heterogeneity in the effect of CPVs on countries' tax revenues. In particular, a 1% increase in CPV increases tax revenues by 0.35%. Recall that these countries are all net exporters' commodity countries.

Conversely, Kaminsky (2010) argued that tax revenues via fiscal balance deteriorate as a result of CPV. He noted that CPV does not necessarily lead to larger budget surpluses in developing countries. The study argued that positive shocks to CPVs can lead to strong pro-cyclical fiscal policies in these countries, resulting in a lower fiscal balance. This is contrary to the

teaching of Keynesian theory and Barro's fiscal smoothing models that fiscal policy should be countercyclical.

Overall, it has been shown that CPV leads to GDP instability, which can reduce GDP and, in turn, reduce the tax base and therefore income tax for commodities' net exporters' countries. Therefore, the impact of export CPV on tax revenues is ambiguous but expected to be positive or insignificant for oil and mineral exporters (through margin taxation) and negative for other countries (due to GDP volatility). Consistent with the conclusion of previous work, the empirical literature specifically dedicated to commodity-dependent African countries is abundant. These studies devoted to it essentially address individual (country) or panel data on a sample. In the first country study group, Chuku and Simpasa (2018) found a significant response of macroeconomic variables to CPV fluctuations in Africa. Based on Bayesian VAR modeling, García-Albán, González-Astudillo and Vera-Avellán (2021) showed that of oil, significantly affects economic activity and all budgetary variables, including tax revenues in Guinea Equatorial.

For the second study group, which adopted a sample of countries, the literature was well-supplied. First, focusing on a sample of 33 SSA countries, Diarra (2013) indicated that positive shocks to commodity export revenues have no significant effect on the level of tax revenues, while negative shocks reduce the level of tax revenues through the reduction of the tax rate. However, Da and Diarra (2022) assessed the effect of CPV on tax revenues in Africa over the period 1985–2017. Using ARDL modeling, the study revealed a significant effect of CPV on tax revenues in Africa with heterogeneity in the sample, depending on the level of commodity dependence. This result highlights the divergence in the level of tax effort observed within the countries. To explain this observed difference, Thiao and Ouonogo (2021) adopted the Oaxaca–Blinder decomposition and showed that the difference in terms of illicit financial flows explains the differences in tax effort observed within a sample of 30 SSA countries.

However, another axis of the empirical literature supports the idea that the link between CPV and tax revenue mobilization also depends on the economic policies adopted. Thus, Majumder, Raghavan and Vespignani (2022) investigated the relationship between the volatility of CPV and the budget balance within a sample of 108 developing countries (including SSA countries) over the period 1993–2018. Using a dynamic panel model, the study showed that CPV deteriorates the overall budget balance. Indeed, an increase of one point in the volatility of the CPV leads to a reduction of 0.04 units of the overall budget balance. The study provided further

evidence that the negative effect of CPV on the fiscal balance is mitigated in the presence of a low real interest rate. This result highlights the role of monetary policy in the relationship between CPV and fiscal variables.

## Methodology

### The Tax Model

Our empirical approach is based on the previous literature examining determinants of the tax ratio in developing countries. The pioneering work of Lotz and Morss (1967, 1970) developed a model of tax ratio driven by the level of economic development and trade openness. Tanzi (1992) and Stotsky and WoldeMariam (1997) argued that foreign development aid, agricultural value-added, and trade openness play a core role in cross-country tax ratio variations in developing countries. Following Gupta (2007) we specify the model of tax revenues as :

$$TR_{it} = \delta_0 + \delta_1 TR_{it-1} + \delta_2 GDP_{it} + \delta_3 AGRI_{it} + \delta_4 TO_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

TR is the tax ratio to GDP, and $TR_{t-1}$ is its one-year lagged value, indicating that the current values of the tax ratio are affected by their previous values; GDP is the per capita gross domestic product; AGRI is the agricultural value-added ratio to GDP; TO refers to the degree of trade openness; $i$ and $t$ stand for the country and the period, respectively; $\varepsilon$ is the error term that is assumed to be normally distributed; $\delta_0$ is the constant term. Following Lotz and Morss (1970), income per capita is assumed to positively affect the tax ratio through the income and good consumption channels. However, Ghura (1998) showed that the positive effect of income per capita on aggregated tax revenues is ambiguous since an increase in income per capita improves indirect taxes but at the same time will tend to lower trade taxes. In contrast, the share of the agricultural sector in the economy is negatively associated with the tax ratio since governments face difficulties in taxing this sector due to the social and political costs of taxation. Indeed, the income of the majority of the population in developing countries relies on agriculture. In addition, the agriculture sector is a core sector that guarantees food security (Bahl 2004; Bird, Martinez-Vazquez and Torgler 2008). There is no consensus on the effect of trade openness on the tax ratio in developing countries. For some, trade openness improves tax revenues through the productivity channel (Edwards 1998; Melitz 2003; Föllmi et al. 2018). Lotz and Morss (1970) also supported the positive effect of trade openness by the fact that

tax administration has the ease of taxing imports and exports. In addition, imports and exports are characterized by a high degree of monetization. Others argued that trade openness harms tax revenues (Khattry 2003; Cagé and Gadenne 2018).

Regarding the objective of this study and following Medina (2021), Majumder, Raghavan and Vespignani (2022), and García-Albán, González-Astudillo and Vera-Avellán (2021), we modified the equation (1) by adding the CPV as an explanatory variable follows:

$$\begin{aligned} TR_{it} = \ & \delta_0 + \delta_1 TR_{it-1} + \xi CPV_{it} + \delta_2 GDP_{it} + \delta_3 AGRI_{it} \\ & + \delta_4 TO_{it} + \mu_i + \varepsilon_{it} \end{aligned} \tag{2}$$

In line with recent studies in developing countries, governments' tax ratios are affected by the quality of governance (GOV) and the degree of economic digitalization (DIG). Torgler (2005) argued that good quality governance can raise tax revenues since citizens are more likely to improve their tax compliance. Mauro, Medas and Fournier (2019), Vlachos and Bitzenis (2018), and Mallick (2021) empirically confirmed the positive effects of governance on tax revenues in developing countries. Equally, it's well known that monetary policy has an effect on revenue mobilization through the so call Olivera–Tanzi effect (Tanzi 1992). Based on information theory, Jacobs (2017) argues that digitalization improves revenue collection by alleviating information constraints. Indeed, in their contribution to the economics of tax evasion, Allingham and Sandmo (1972) showed that information constraints compel tax authorities to audit taxpayers. However, since audits are costly for tax authorities, it is not possible to systematically audit all taxpayers. Bassongui and Houngbédji (2021) also developed a conceptual model of the tax-digitalization nexus and showed that digitalization improves tax efforts through three main channels. First, digitalization improves the tax base and tax compliance by giving better information to tax authorities on the identification of individuals and economic activities such as bank transactions and interest income. Second, digitalization increases the efficiency of tax administration, implying more cost reduction in tax collection and inspection. Last, digitalization reduces the cost of tax declarations for taxpayers. By doing so, digitalization motivates citizens to be good taxpayers. We thus added these variables as the vector of control variables $Z$ as follows:

$$\begin{aligned} TR_{it} = \ & \delta_0 + \delta_1 TR_{it-1} + \xi CPV_{it} + \delta_2 GDP_{it} + \delta_3 AGRI_{it} + \delta_4 TO_{it} \\ & + \delta_5 Z_{it} + \mu_i + \varepsilon_{it} \end{aligned} \tag{3}$$

Let's collect the explanatory variables of equation 3 excluded CPV into a vector X. . Thus, equation 3 can be rewritten as:

$$TR_{it} = \delta_0 + \xi CPV_{it} + \varsigma X_{it} + \mu_i + \varepsilon_{it} \tag{4}$$

Where $\varsigma$ the vector of the parameter to be estimated is associated with X.

Recall that one of the objectives of this study is to investigate the threshold effect of CPV on tax revenues. Thus, we use the new dynamic panel threshold regression model henceforth (DPTR) introduced by Seo and Shin (2016) and made applicable by Seo, Kim and Kim (2019). The advantage of the DPTR model over the panel threshold regression (PTR) model developed by Hansen (1999) is that the former handles the endogeneity issue that occurs by the lagged value of the dependent variable on the right side of the tax ratio equation. In addition, other variables such as foreign development aid cause and governance are endogenous in the tax ratio equation. Indeed, through the thesis of the Samaritan's dilemma, Gibson et al. (2005) show that foreign development aid recipient countries can strategically maintain poor fiscal performance to continue to receive higher concessional aid indefinitely. In this context, a low tax effort causes foreign development aid inflows. Furthermore, governance quality is endogenous in the tax effort equation. Indeed, oil and mining-dependent countries have low fiscal efforts given the revenues from oil and mining exploitation. Thus, Moore (2007) shows that the rulers of these countries are not beholden to the population since they solicit little from the latter in terms of tax payment. As a result, these rulers care little about the quality of governance. We use lags of foreign development aid as an instrument. The lags and the square of the total population, urban population, and ethnic and cultural diversity index are used as instruments of governance. These instruments are chosen regarding the empirical literature (Diakite, et al. 2019; Mbatia and Ellyne 2017; Tagem 2017).

Following Seo and Shin (2016) the dynamic panel threshold regression model is specified as:

$$\begin{aligned} TR_{it} = \delta_0 &+ (1, CPV'_{it}; X'_{it})\varsigma_L 1(CPV_{it} \leq \Upsilon_1) \\ &+ (1, CPV'_{it}; X'_{it})\varsigma_H 1(CPV_{it} > \Upsilon_1) + \varepsilon_{it} \end{aligned} \tag{5}$$

Where $CPV_{it}$ is the transition variable, 1(.) is an indicator function, $\Upsilon_1$ is the threshold parameter, and $\varsigma_L$ and $\varsigma_H$ are the slope parameters associated respectively with low and high regimes. The error components are defined as, $\varepsilon_{it} = \alpha_i + e_{it}$, where $\alpha_i$ is an unobserved country fixed effect, and $e_{it}$ is a zero-mean idiosyncratic random disturbance. The incidental parameter $\alpha_i$ is removed using the first-difference transformation, and the unknown parameter $\Omega = (\varsigma; \Upsilon_1)$ is then estimated through the GMM procedure (Seo and Shin 2016).

Recall that the second objective of this study is to know whether monetary policy and governance can mitigate the negative effects of CPV in SSA countries. To do so, we create an interactive variable between CPV and monetary policy on the one hand and governance on the other hand. Thus, let MV be the mitigating variable that refers to monetary policy and governance. The DPTR specified in equation 5 becomes:

$$\begin{aligned} TR_{it} = \delta_0 + (1, CPV'_{it} * MV_{it}; W'_{it})\varsigma_L 1(CPV_{it} \leq \Upsilon_2) \\ + (1, CPV'_{it} * MV_{it}; W'_{it})\varsigma_H 1(CPV_{it} > \Upsilon_2) + \epsilon_{it} \end{aligned} \tag{6}$$

Where the interactive variable $CPV_{it} * MV_{it}$ measures the interaction terms between CPV and monetary policy, corruption control, and political stability. W is a vector of explanatory variable that includes the vector of variable X and CPV and MV. $\Upsilon_2$ is the new threshold parameter to be estimated. We assume that $\Upsilon_1 < \Upsilon_2$. The net effect of CPV in equation 6 is determined through the first derivative of equation 6 respective to CPV as follows:

$$\varsigma_{net} = \varsigma_{CPV} + \varsigma_{CPV*MV} \times \overline{MV} \tag{7}$$

Where $\overline{MV}$ is the sample mean of the mitigating variable considered, i.e., mean of credits to the economy, lending rate, political stability, and control of corruption.

## *Computing the Commodity Price Volatility Index*

Contrary to traditional measures of CPV such as standard deviation and variation of the coefficient, we use a novel measure of volatility. In particular, we use the semistandard deviation, which is a one-sided measure of volatility. Similar to the traditional standard deviation, the semistandard deviation measures the deviations of the observations from the mean. However, unlike the conventional variance, the semistandard deviation only takes into account the negative deviations (downside curve) from the mean. Indeed, we assume that the semistandard deviation is more accurate than the conventional variance in this study since our sample study encompasses only net commodity exporters' countries. Consequently, only the negative shocks of commodity prices will hurt their tax revenues. The semistandard deviation was used as a measure of risk in financial markets (Chen et al. 2020; Hong Vo 2021).

Finally, the CPV index is computed using the semistandard deviation as follows:

$$CPV_{iy} = \sum_{j=1}^{3} \left( \frac{\overline{CP} - CP_{jimy}}{M - 1} \right) \begin{cases} CP_{jimy} < \overline{CP} \\ 0 \end{cases} \quad (8)$$

Where $CP_{jimy}$ refers to the commodity price $j$ of country $i$ in month $m$ of year $y$. The number of commodities $j$ considered for each country $i$ varies from 1 to 3. The variable $\overline{CP}$ is the mean of commodity price variation in the considered year. $M$ is the total number of months, so it varies from 1 to 12. Table A1 in the appendix presents the most important commodities considered for each country.

### Sampling and Data Sources

This research focuses on a sample of 37 sub-Saharan African countries over the period 2002–2020. The choice of countries and the period of study are based on data availability. In addition, the choice of this sample has the advantage of having a relatively homogenous sample since all countries included in the sample are commodity-dependent countries by at least 65%. In addition, there are all developing countries with a homogenous geographical location. The tax revenues are measured as the total share of tax revenues to GDP. The monetary policy is measured by the lending interest rate and the credits to the economy as a percentage of GDP. Tax revenue data come from the latest UNU-WIDER Government Revenue Dataset (GRD). Commodity prices are obtained from the IMF primary commodity price data portal. Beyond the traditional two-sided measures of CPV (standard deviation and variation of the coefficient), we used semistandard deviation to measure CPV. This one-sided measure of volatility has the advantage of highlighting the negative part of CPV. The governance is measured through two indicators, namely corruption control and political stability. Data on governance come from the World Governance Indicator (WGI) of the World Bank. Data on all the remaining control variables (GDP per capita, trade openness, the share of agriculture, digital economy) are obtained from the World Development Indicator website (WDI) of the World Bank (Table 1).

## Results and Discussion

### Descriptive Analysis

Table 2 presents the descriptive statistics of the study variables. We note that the average tax ratio to GDP and CPV in the sample is 12.92% and 3.55,

**Table 1.** Data, measurement, and sources.

| Variable | Indicator | Measurement | Source |
|---|---|---|---|
| Tax ratio | TR | Total Tax revenues excluding social contributions as a share of GDP | WIDER, 2021 |
| Commodity price volatility | CPV | Semi standard deviation of the monthly commodity price | International Monetary Fund |
| Income per capita | GDP | Gross domestic product per capita US $ constant | World Bank |
| Share of agriculture | AGR | Ratio of agricultural value-added to GDP | World Bank |
| Trade openness | TO | Ratio of merchandise exports to GDP | World Bank |
| Foreign development aid | FDA | Ratio of Foreign development aid to GDP | World Bank |
| Digital economy | ICT | Digital economy measured by the share of population accesses to mobile phone | World Bank |
| Credits to economy | CE | Credits to economy by the banking sector (% of GDP) | World Bank |
| Lending interest rate | LIR | Lending interest rate the banking sector in percentage | World Bank |
| Political stability | PS | political stability and absence of violence | World Bank |
| Corruption control | CC | Control corruption | Worldwide Worldwide Governance Indicators |
| Total population | POP | Number of habitant | Worldwide Governance Indicators |
| Urban population | URB | Number of habitant | Worldwide Worldwide Governance Indicators |
| Ethnic and cultural diversity index | ETHI | Composite index | ChartsBin.com |

respectively, with distributions positively skewed to the right, indicating that both the median tax ratio (11.05%) and CPV (3.22) are lower than their respective averages in the sample. These suggest that half of the SSA

**Table 2.** Descriptive Statistics.

| Variables | Obs | Mean | Std. Dev. | Min | Max | p1 | p99 | Skew. | Kurt. |
|---|---|---|---|---|---|---|---|---|---|
| TR | 614 | 12.922 | 6.802 | 1.48 | 43.98 | 3.05 | 33.5 | 1.496 | 5.214 |
| CPV | 703 | 3.553 | 1.674 | 0.279 | 15.393 | 1.028 | 8.788 | 2.319 | 14.109 |
| GDP | 703 | 1896.604 | 2393.436 | 258.629 | 16,438.641 | 285.546 | 13,282.943 | 2.877 | 13.025 |
| AGR | 692 | 22.886 | 13.241 | 0.893 | 60.611 | 1.294 | 55.772 | 0.286 | 2.643 |
| TO | 670 | 28.618 | 16.593 | 0.436 | 89.224 | 0.73 | 81.516 | 1.123 | 4.217 |
| FDA | 703 | 0.069 | 0.064 | −0.001 | 0.524 | 0.001 | .304 | 1.891 | 9.361 |
| ICT | 683 | 50.618 | 40.781 | 0 | 165.6 | 0.331 | 159.931 | 0.71 | 2.778 |
| CE | 673 | 16.299 | 12.651 | 0 | 84.812 | 1.201 | 62.617 | 2.12 | 8.267 |
| LIR | 472 | 7.352 | 11.841 | −79.803 | 52.437 | −32.96 | 47.147 | −1.044 | 16.861 |
| PS | 703 | −0.565 | 0.773 | −2.388 | 1.200 | −2.201 | 1.063 | −0.253 | 2.572 |
| CC | 703 | −0.698 | 0.556 | −1.816 | 1.217 | −1.663 | 0.96 | 0.818 | 3.702 |
| POP | 684 | 23,600,000 | 31,500,000 | 569,480 | 2.061e+08 | 657,227 | 1.764e+08 | 3.044 | 14.064 |
| URB | 703 | 8,560,000 | 13,600,000 | 2.7 | 1.071e+08 | 3.16 | 79,214,960 | 3.958 | 22.298 |
| ETHI | 623 | .666 | 0.225 | 0.054 | 0.889 | 0.055 | 0.889 | −1.248 | 3.406 |

**Table 3.** Threshold Effect of Commodity Price Volatility.

| TR | Coefficient | Std. | *z*-statistic | *p* value |
|---|---|---|---|---|
| *Low regime (CPV≤4.13)* | | | | |
| Lag (TR) | 0.721 | 0.084 | 8.580 | 0.000*** |
| CPV | −0.095 | 0.278 | −0.340 | 0.733 |
| GDP | 0.001 | 0.000 | 5.470 | 0.000*** |
| AGRI | 0.049 | 0.069 | 0.700 | 0.483 |
| TO | −0.044 | 0.021 | −2.150 | 0.031** |
| ICT | 0.047 | 0.017 | 2.840 | 0.005*** |
| FDA | 0.203 | 0.293 | 0.690 | 0.488 |
| Constant | 7.915 | 2.886 | 2.740 | 0.006*** |
| *High regime (CPV>4.13)* | | | | |
| Lag (TR) | −0.353 | 0.127 | −2.770 | 0.006*** |
| CPV | −0.845 | 0.343 | −2.470 | 0.014*** |
| GDP | −0.000 | 0.000 | −0.660 | 0.508 |
| AGRI | 0.223 | 0.159 | 1.410 | 0.159 |
| TO | 0.130 | 0.062 | 2.110 | 0.035** |
| ICT | −0.040 | 0.024 | −1.700 | 0.090* |
| FDA | −0.382 | 0.304 | −1.260 | 0.209 |
| CPV Threshold | 4.131 | 1.175 | 3.520 | 0.000*** |
| Linearity test. Chi2(1) | 4.13 | | | 0.042** |

Note: ***; **; * indicate significance at the 1%, 5%, and 10% levels, respectively.

countries have an average tax ratio lower than the sample average of 12.92%. Similarly, 50% of SSA countries experienced average commodity volatility lower than the sample average of 3.55. These results also revealed that SSA countries are characterised by a low level of governance quality in general, as indicated by the negative averages of corruption control (−0.70), and political stability (−0.57). Recall that the domain of these two variables is ranged from −2.5 to +2.5. The monetary policy indicates an average credit to the economy of 16.30% and a lending interest rate of 7.35% which is also skewed, indicating a low level of synchronization between the banking sector and the monetary policy.

Table 3 presents the results of the DPTR model in which CPV is used as the transition variable. Based on the diagnostic tests, the DPTR model is validated, and the coefficients can be interpreted. In particular, the null hypothesis of linearity of the relationship between tax ratio and CPV is rejected, as indicated by the p-value (0.000) of the linearity test. Moreover, the significance of the estimated threshold (4.13) at the 1% level confirms the

nonlinearity of the relationship between the tax ratio and CPV in the sample. Furthermore, the coefficient of the lagged value of the tax ratio is statistically significant at the 1% level, implying that the dynamic specification of the tax ratio equation is the best one.

The results in Table 3 present the determinants of the tax ratio in the low and high regimes of CPV. The estimated threshold of CPV is 4.13. Thus, our results show that commodity price volatility does not affect the tax ratio in the low regime. However, in the high regime of CPV, i.e., for values of CPV beyond 4.13, CPV hurts tax revenues. A one-standard-deviation increase in CPV reduces SSA countries' tax revenues by 0.845 points as a percentage of gross domestic product. This result confirms the high vulnerability of SSA countries which are in majority net exporters of commodities. While our descriptive statistics revealed that half of the SSA countries have an average tax ratio of less than 11%, these findings highlight the importance of mitigating these adverse effects of CPV in SSA. Our results are in line with previous studies in the region. Indeed, Ehrhart and Guerineau (2013) used the System-GMM estimator in a sample of 80 developing countries over the period 1980–2008 and concluded that CPV hurts both commodities' net importers and exporters' countries. They further revealed that the magnitude of the negative effect of commodity volatility prices on tax revenues in export countries depends on the share of commodity exports in their exports. The negative effect of CPV on tax revenues in the high regime could be transmitted through the channel of income taxes since indirect taxes are less vulnerable to exogenous shocks.

Furthermore, the sign of most of the control variables exhibits our expectations. The lagged tax revenues, the GDP per capita, and the degree of digitalization of the economy have positive effects on tax revenues in the low regime of CPV. The negative effect of the lagged value of the tax ratio in the high regime could be explained by the fact that in the high regime of CPV, the economies face high levels of incertitude so that economic variables are desynchronized from their previous trends.

## *Mitigating Role of Monetary Policy, Corruption Control, and Political Stability*

Let us assume that the negative effects of CPV could be mitigated by monetary policy, corruption control, and political stability. To test that assumption, we created an interactive variable between the CPV index and monetary policy on the one hand and corruption control and political

stability on the other hand. Two indicators are used to measure the monetary policy, namely, the credits to the economy and the lending interest rate.

The results presented in Table 4 show that the coefficients of CPV are negative but non-significant in both the low and high regimes of all the models, except in the corruption control model. Equally, the coefficient of the interactive term between CPV and monetary policy and governance is non-significant except for that of corruption control. Thus, this result implies that when taking into account monetary policy and governance (political stability), CPV does not affect tax revenues. The net effect of CPV in the low-regime of corruption control model remains negative as indicated by the coefficient $-0.023$[1] but lower in absolute value than that obtained in the tax equation ($-0.095$) that ignores corruption control in Table 3.

The net effect of CPV in the high regime when considering the monetary policy and the governance (political stability) is non-significant as both the coefficients of CPV and those of the mitigating variable are non-significant. This confirmed once again our results found in the low regime that political stability and lending rate mitigate the detrimental effect of CPV. On the contrary, our results revealed that the net effect of CPV when consider the corruption control $(-0.084)$[2] is negative and significant. However, though this effect is negative, the latter remains lower in absolute value than that obtained in the model that ignores the role of corruption control ($-0.845$) in the high regime of Table 3.

Overall, the results presented in Table 4 indicate that monetary policy mitigates the negative effect of CPV on SSA countries' tax revenues. Our results confirm the thesis of Comley, Anthony and Ferguson (2002) that is, rationing credits to the private sector hurts capital stock and output, resulting in lower tax revenue collection. Moreover, these results indicate that monetary policy significantly reduces the vulnerability of SSA to CPV shocks by increasing the threshold value of CPV from 4.13 to 4.39 and 4.95, respectively, in the credit-to-economy model and lending rate model.

Our findings also confirm those of Majumder, Raghavan and Vespignani (2022), who found that monetary policy reduces the negative effect of CPV on fiscal balance by lowering the real interest rate by 10% in a sample of net exporters' developing countries over the period 1993–2018.

The results also show that governance significantly mitigates the negative effect of CPV on tax revenues. More importantly, the corruption control mitigated the negative effect of CPV by 75.79%[3] and 90.06%[4], respectively, in the low and high regimes. Besides, better control of corruption increases the

**Table 4.** Mitigating Role of Monetary Policy, Corruption Control, and Political Stability.

| | Coefficient (standard errors) | | | |
|---|---|---|---|---|
| Variable | Credits to economy | Lending rate | Political stability | Corruption control |
| *Low regime of CPV* | | | | |
| Lag(TR) | 0.207*** | 0.603*** | 0.466*** | 0.943* |
| | (0.012) | (0.114) | (0.147) | (0.256) |
| CPV | −1.209 | −1.806 | 0.004 | −0.032* |
| | (1.470) | (1.203) | (0.057) | (0.054) |
| MV | 0.035*** | −0.371 | 0.129* | 0.384** |
| | (0.014) | (0.341) | (0.019) | (0.259) |
| MV[a] × CPV | 0.056 | −0.135 | −0.118 | −0.013*** |
| | (0.016) | (0.012) | (0.070) | (0.010) |
| GDP | 2.993*** | 2.034** | 1.257 | 0.078** |
| | (0.862) | (1.293) | (0.123) | (0.086) |
| AGRI | −0.076 | 0.004 | −0.025 | −0.091 |
| | (0.021) | (0.001) | (0.018) | (0.048) |
| TO | −0.013 | −0.012** | −0.001 | −0.008 |
| | (0.009) | (0.011) | (0.009) | (0.017) |
| ICT | 0.085* | 0.064*** | −0.015 | 0.058 |
| | (0.050) | (0.024) | (0.008) | (0.086) |
| FDA | 0.059 | 0.065* | 0.017 | −1.182 |
| | (0.028) | (0.059) | (0.09) | (0.782) |
| Constant | −0.421 | 0.536 | 0.536 | 1.359 |
| | (0.181) | (0.217) | (0.217) | (0.299) |
| *High regime of CPV* | | | | |
| Lag(TR) | 0.244** | 0.672 | 0.466*** | −0.565 |
| | (0.035) | (0.138) | (0.146) | (0.088) |
| CPV | −0.012 | 0.005 | −0.222 | −0.127** |
| | (0.035) | (0.004) | (0.190) | (0.048) |

*(continued)*

**Table 4.** (continued)

| Variable | Coefficient (standard errors) | | | |
|---|---|---|---|---|
| | Credits to economy | Lending rate | Political stability | Corruption control |
| MV | 0.004*** | 0.003 | 0.229** | 0.801* |
| | (0.001) | (0.007) | (0.191) | (0.094) |
| MV × CPV | 0.062 | −0.189 | 0.033 | −0.062** |
| | (0.027) | (0.004) | (0.007) | (0.314) |
| GDP | −0.467* | −0.576 | −0.780* | −0.352 |
| | (0.057) | (0.331) | (1.616) | (0.058) |
| AGRI | 0.015 | 0.0139 | −0.012 | 0.015 |
| | (0.024) | (0.017) | (0.005) | (0.002) |
| TO | 0.159** | −0.003 | 0.042** | −0.015 |
| | (0.015) | (0.076) | (0.008) | (0.024) |
| ICT | 0.027** | 0.020 | −0.042 | 0.086** |
| | (0.015) | (0.004) | (0.009) | (0.005) |
| FDA | 0.051 | −0.074** | −0.092 | 0.053 |
| | (0.050) | (0.032) | (0.018) | (0.008) |
| CPV | 4.952* | 4.399*** | 4.513** | 4.314* |
| Threshold | (1.974) | (1.012) | (1.101) | (1.865) |

Note: ***; **; * indicate significance at the 1%, 5%, and 10% levels, respectively.
[a]MV is the moderating variable (credits to economy, lending rate, corruption control, and political stability) that mitigate the effect of commodity volatility price on tax revenues.

threshold of CPV from 4.13 (Table 3) in the model without control corruption variable to 4.31 with corruption control (Table 4)

## Conclusion

The crisis of foreign public debt in most of the Sub-Saharan African countries revived the debate on the mobilization of domestic revenues to finance sustainable goals in the continent. While characterised by a large share of agriculture and an embryonic manufacturing sector, the majority of Sub-Saharan African countries are commodity-dependent revenues. Thus,

these countries are subject to the detrimental effects of the volatility of commodity prices, making the fiscal policy difficult. Recent works have widely highlighted the fiscal costs of CPV in developing countries, especially in Sub-Saharan Africa. However, less attention has been devoted to mechanisms through which the detrimental effects of community price volatility may be shackled. This paper contributes to filling this gap in the literature by investigating the mitigating role of monetary policy, corruption control, and political stability. Based on a sample of 37 sub-Saharan African net exporters-countries over the period 2002–2020, we used a panel dynamic threshold regression to shed light on the nonlinear relationship between tax revenues and CPV. To that end, a new indicator of CPV, namely, semivariance, is computed focusing only on the negative deviations of commodity prices. Thus, our results showed that there is a threshold of CPV from which the latter becomes detrimental to tax revenue mobilization in the sample. We further revealed that the harmful effect of CPV can be mitigated by effective monetary policy and better control of corruption. Accommodative monetary policies, nonconventional monetary policies, and improvements in both political and economic governance should be promoted in sub-Saharan African countries to tackle the detrimental effects of CPV.

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## Notes

1. This coefficient is obtained from equation 7 using the results in Table 4 as follows: −0.032 + (−0.013)*(−0.698).
2. This coefficient is obtained from equation 7 using the results in Table 4 as follows: −0.127 + (−0.062)*(−0.698).
3. This value is calculated as follows: [(−0.023+0.095)/−0.095]*100.
4. This value is calculated as follows: [(−0.084+0.845)/−0.845]*100.

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# Appendix

**Table A1.** Exported Commodities.

| N° | Country | Commodities |
|---|---|---|
| 1 | Angola | Oil; Coffee; Cotton |
| 2 | Benin | Cotton; Palm Oil |
| 3 | Botswana | Diamond; Copper; Natural Gas |
| 4 | Burkina Faso | Cotton; Gold |
| 5 | Burundi | Coffee; Tea |
| 6 | Cameroon | Cocoa Beans; Palm Oil; Rubber |
| 7 | Comoros | Coffee; Tea |
| 8 | Cote d'Ivoire | Cocoa Beans; Coffee; Rubber |
| 9 | Congo, Rep, | Oil; Timber; Natural Gas |
| 10 | Ethiopia | Coffee |
| 11 | Gabon | Oil; Timber |
| 12 | Ghana | Cocoa Beans; Gold; Rubber |
| 13 | Guinea-Bissau | Cashew nut; Cotton; Palm Oil |
| 14 | Equator Guinea | Oil ; Natural Gas; Cocoa Beans |
| 15 | Kenya | Tea; Coffee |
| 16 | Madagascar | Coffee; Vanilla |
| 17 | Malawi | Cotton; Gold |
| 18 | Mali | Tobacco; Tea; Cotton |
| 19 | Mauritania | Lamb; Beef; Poultry |
| 20 | Mozambique | Coal; Aluminium; Natural Gas |
| 21 | Namibia | Diamond; Zinc; Uranium |
| 22 | Niger | Uranium; Cotton |
| 23 | Nigeria | Oil; Natural Gas; Cocoa Beans |
| 24 | Uganda | Coffee; Tea; Tobacco |
| 25 | Congo, Dem, Rep, | Cobalt; Copper; Oil |
| 26 | Central African Republic | Diamond; Timber; Oil |
| 27 | Congo, Rep, | Sugar; Cocoa Beans |
| 28 | Rwanda | Tin; Coffee |
| 29 | Senegal | Gold |
| 30 | Sierra Leone | Iron; Diamond; Timber |
| 31 | South Africa | Gold; Platinum; Diamond |
| 32 | Sudan | Gold; Oil |
| 33 | Tanzania | Coffee; Cotton; Tobacco |
| 34 | Chad | Cotton; Oil |
| 35 | Togo | Cotton; Coffee; Cocoa Beans |
| 36 | Zambia | Copper; Cobalt; Tobacco |
| 37 | Zimbabwe | Tobacco; Cotton; Coffee |