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Commodity price shocks and fiscal procyclicality in developing economies: New evidence from resource-dependent countries

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***Abstract*---**The cyclicality of fiscal policy has long been debated in the literature, with evidence consistently showing that developing economies tend to adopt procyclical fiscal stances, unlike the countercyclical patterns observed in advanced economies. While much of the existing research has documented this procyclicality bias, limited attention has been given to the role of resource dependence in shaping fiscal behavior. This study extends the debate by investigating fiscal cyclicality in commodity-exporting developing countries, where international commodity price fluctuations critically influence fiscal revenues and expenditure decisions. Employing a panel fixed-effects model covering 2005–2021, we find robust evidence of fiscal procyclicality, driven largely by positive shocks in commodity prices. Our results further demonstrate that fiscal rules and institutional quality mitigate procyclicality, whereas, in contrast to previous studies, Financial openness is positively associated with government spending in resource-dependent economies, as rising commodity revenues and access to external capital amplify expenditures during booms, while downturns and capital reversals prompt sharp cuts, reinforcing procyclicality. Moreover, the sensitivity of government spending to commodity price fluctuations is moderated by fiscal rules and financial openness, particularly during boom periods, though this effect is weaker for revenues. These findings underscore the importance of strengthening fiscal frameworks, improving institutional capacity, and carefully managing financial openness to reduce procyclicality and enhance macroeconomic stability in commodity-dependent developing countries.

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JEL Classification: E1, E3, E62

1 Introduction

According to economic theory, effective fiscal policies should be designed to counteract the natural fluctuations of the business cycle. During periods of economic expansion, governments are encouraged to implement contractionary fiscal policies, such as increasing taxes or reducing public spending, to prevent overheating and inflation. Conversely, in times of recession, expansionary fiscal policies, like increasing government spending or cutting taxes, can stimulate demand and help mitigate economic downturns. This approach, known as countercyclical fiscal policy, aims to stabilize output, control inflation, and reduce unemployment, ensuring long-term economic stability.

However, despite this theoretical framework, there is a notable divergence in practice. While high-income nations generally manage to implement countercyclical policies, recent studies show that many developing countries tend to adopt procyclical fiscal measures. Instead of counteracting economic cycles, these governments increase spending during booms and cut back during recessions. This fiscal choice contrasts with economic theory, as procyclicality can exacerbate volatility, deepening economic downturns and overheating during periods of growth. This discrepancy highlights the need for a deeper understanding of the underlying factors driving variations in fiscal policy behavior across different countries.

Some scholars attribute this variation to differences in the extent of political pressures and levels of corruption control (Talvi and Vegh, 2005; Tornell and Lane, 1999). In contrast, Ilzetzki (2011) argues that differences in political stability across nations are responsible for this phenomenon. Aizenman et al. (2000), Gavin and Perotti (1997), and Riascos and Vegh (2003) assert that the primary reason lies in the limited access of most developing countries to international credit markets during economic downturns. This limited access, compounded by various borrowing constraints and imperfections in credit markets, has been identified as another significant factor contributing to procyclicality in fiscal policies.

This procyclicality challenge is particularly severe for commodity-rich nations, often called commodity republics, due to their heavy reliance on volatile commodity markets (Céspedes and Velasco 2014). These countries experience heightened procyclicality in their fiscal policies, as government revenues and expenditures are closely tied to fluctuations in global commodity prices. Consequently, the economic instability stemming from dependence on commodity prices makes it challenging for commodity republics to manage fiscal policies effectively during economic downturns.

The link between commodity prices and fiscal policy has regained interest, especially due to the sharp price increase from 2020 to 2022. Some analysts

believe that higher commodity prices, such as oil and agricultural products, provide a unique opportunity for governments to strengthen their fiscal reserves, reduce debt, or invest in long-term economic projects. They argue that the surplus from commodity exports can be strategically utilized to enhance economic stability and promote sustainable growth. However, there are concerns that governments may fall into the trap of fiscal procyclicality—spending excessively during boom periods without adequately preparing for potential downturns. This approach can lead to budget imbalances when commodity prices eventually decline. Critics worry that without prudent fiscal management, the temporary windfall could result in increased public spending that is unsustainable in the long run, exacerbating economic volatility and leading to fiscal crises when the market shifts. Therefore, the challenge lies in how governments manage these windfalls to ensure long-term economic health and stability. Balancing short-term gains with long-term stability requires sound fiscal policy. Specially, commodity-exporting countries often face challenges associated with fiscal procyclicality, which can exacerbate economic volatility. This study investigates the tendency of procyclicality in commodity exports by reassessing fiscal dynamics within developing commodity-exporting countries. Specifically, we examine how fiscal policies respond to fluctuations in commodity prices and export revenues and the implications of these responses for macroeconomic stability.

This paper is structured as follows: We provide context on the importance of studying fiscal procyclicality in commodity-exporting countries. We then review relevant literature to contextualize our research within existing scholarship. Following this, we detail our data collection methodology, model development, and analytical approach. Subsequently, we present our findings and conclude with a summary of key insights.

Conceptual Framework

The conceptual framework of this study is grounded in the Keynesian model of the business cycle, which advocates for countercyclical fiscal policy to stabilize output fluctuations. According to Keynesian prescriptions, fiscal authorities should implement contractionary fiscal measures during periods of economic expansion and expansionary measures during downturns.

Moreover, Keynesian theory highlights the presence of sticky prices and wages, indicating that immediate adjustments to demand changes may not occur. Countercyclical fiscal policies facilitate more complete and rapid adjustments to these fluctuations, ensuring smoother economic cycles. In practical terms, this involves increasing government spending and reducing taxes during economic downturns to stimulate demand while decreasing spending and increasing savings during booms to prevent overheating.

In line with the Keynesian Model framework, the study's conceptual framework is based on an Aggregate demand framework with endogenous fiscal policy in response to output fluctuations in the aggregate demand model(AD): $y - \tilde{y} = \frac{-\theta\beta}{1-\delta}(\pi - \tilde{\pi}) + \frac{\mu^D}{1-\delta}$, Where δ represents the cyclicality parameter, indicating the direction and magnitude of fiscal policy responses to output fluctuations($y - \tilde{y}$). A

positive δ value suggests a procyclical fiscal policy, while a negative value indicates a countercyclical fiscal policy. The study mainly examines the procyclicality level of government spending. Hence, in the aggregate demand model (AD) model, the focus is the parameter that captures the cyclicality of government spending. The conceptual framework guided in this research is illustrated in the diagram below.

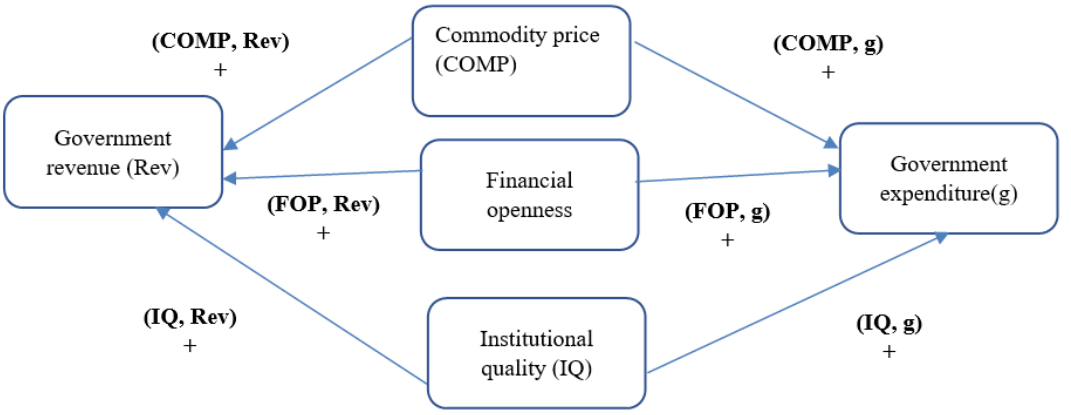

Figure 1: Conceptual Framework

A positive correlation is anticipated between commodity prices and government revenue in export commodity countries, with higher prices leading to increased revenue from taxes, royalties, and fees. Financial openness can allow these countries to borrow from the international markets and remove the credit constraints facing them, allowing them to smooth spending during the downturn. Similarly, Institutional quality also influences the pro-cyclicality level in government spending; this relates to the fact that countries with a higher quality of institutions tend to save more during boom periods by spending less to adjust it in bad times without cutting their spending in bust periods. However, the relationship between government expenditure and commodity prices is complex. While increasing commodity prices is associated with higher government revenue, it can also lead to increased spending during the commodity price boom, where there may be political pressure to invest in infrastructure, social programs, or other development projects. Conversely, when commodity prices decline, governments may encounter budgetary limitations, which could necessitate spending reductions that exacerbate economic downturns.

Literature Review

Numerous empirical studies have delved into fiscal procyclicality in developing countries, shedding light on the intricate relationship between government fiscal policies and economic cycles. In this section, we offer a review of empirical research on fiscal procyclicality, focusing on its manifestations and implications in developing countries. These studies have employed various methodological approaches, including panel data analysis, time-series econometrics, and case studies, to examine how government fiscal policies exacerbate economic fluctuations rather than mitigate them.

Ahmad et al. (2021) conducted a study on fiscal space and the procyclicality of fiscal policy, analyzing data from 133 countries from 1950-2014. The research findings underscored fiscal space's pivotal role in influencing fiscal policies' cyclicality. Countries with greater fiscal space demonstrated a higher capacity to implement countercyclical fiscal measures, particularly following significant economic events such as the global financial crisis. The study also revealed a nonlinear relationship between fiscal space and fiscal procyclicality, indicating that nations with limited fiscal capacity require substantial improvements to engage in countercyclical policy actions effectively. By employing various empirical methods and fiscal space measures, the research highlighted the importance of building fiscal reserves during economic growth to enable proactive responses during economic downturns.

Similarly, Céspedes and Velasco (2014) studied fiscal policy in commodity republics and analyzed data from 32 countries from 1990-2008 to estimate the semi-elasticity of fiscal balances with commodity prices. Comparing results from different boom episodes, the findings indicated a reduction in fiscal procyclicality and a shift towards countercyclical fiscal policies, emphasizing the role of institutional quality in shaping fiscal outcomes. This study deepened the understanding of fiscal dynamics in commodity republics and highlighted the crucial role of institutional improvements in fostering sustainable fiscal policies amid commodity price fluctuations.

Taking a distinctive perspective, Combes et al. (2017) investigated the impact of public debt on the cyclicality of fiscal policy in a panel of 56 developed, emerging, and developing economies from 1990 to 2011. Using advanced econometric techniques such as Generalized method moment estimations and threshold effect analysis, the study revealed a non-linear relationship between public debt levels and the cyclical behavior of fiscal policy. The findings indicated that fiscal policy shifted from counter-cyclical to pro-cyclical when the public debt-to-GDP ratio exceeded 87%, highlighting the importance of fiscal rules in mitigating the procyclical effects of high debt.

Aliyev (2012) studied the procyclicality of fiscal policy in countries rich in natural resources. The study examined the relationship between resource richness and government capital expenditures. The study analyzed two hypotheses, the political economy hypothesis and the borrowing constraints hypothesis, using regression analysis to explore the relationship between fiscal policy cyclicality and measures of resource richness. The findings revealed a U-shaped pattern between procyclicality and resource richness, suggesting that fiscal behavior may vary in resource-rich developing economies due to political economy factors and borrowing constraints. The study emphasizes the complexity of the impact of resource abundance on fiscal policy behaviors and highlights the importance of understanding these dynamics in different political systems.

Building on the insights of Aliyev (2012), Coutinho et al. (2022) explored fiscal procyclicality in resource-dependent countries using data spanning 1960-2011 from 84 nations. Employing an instrumental variable (IV) methodology, they investigated the impact of factors like GDP growth, commodity prices, and governance indicators on fiscal policy. The findings revealed a prevalent pattern of

strong procyclical fiscal policies, with government spending rising during economic booms and falling in downturns. Democratic governance and checks and balances mechanisms were found to mitigate procyclicality, while the presence of sovereign wealth funds (SWFs) acted as a deterrent. Surprisingly, fiscal rules showed limited effectiveness.

Other studies present evidence of procyclicality for resource-dependent countries to a greater extent. A study by Erbil (2011) analyzed fiscal policy trends in 28 developing oil-producing countries (OPCs) from 1991-2009, aiming to deepen understanding of fiscal procyclicality, particularly during high oil prices. Employing a range of econometric methods, including OLS, fixed-effects, Instrumental, and Generalized method moment estimations, the research unveils a pronounced procyclical pattern in total expenditure across most OPCs, with countercyclicality observed only in high-income nations. Emphasizing the importance of effective countercyclical fiscal measures in managing volatile oil revenues, the study underscores the role of robust institutions and transparency in ensuring long-term growth and stability.

Moreover, Frankel et al. (2013) conducted a comprehensive analysis into the phenomenon of graduating from fiscal procyclicality to countercyclical fiscal policy among emerging and developing countries. The study used panel regression analysis and instrumental variable techniques to reveal a significant number of nations making this transition. Their findings highlighted the pivotal role of institutional quality as a key determinant in achieving this graduation from fiscal procyclicality. The research rigorously investigated how institutional robustness influences fiscal policy dynamics, providing compelling evidence that stronger institutions lead to less procyclicality or greater countercyclicality in fiscal policies.

Likewise, Gootjes and de Haan (2022) conducted a study examining the procyclicality of fiscal policy in 27 European Union member states from 2000 to 2015. The research utilized rigorous econometric methods to assess whether fiscal policy exhibited counter or procyclical tendencies and the impact of fiscal rules and government efficiency. The findings indicated a disparity between fiscal plans, which tended to be cyclical, and actual budgetary outcomes, which displayed procyclical patterns. The study identified enhanced government efficiency and strict adherence to fiscal rules as crucial factors in mitigating fiscal procyclicality. Moreover, the study observed an increased procyclical tendency during economic booms and in non-euro area countries. Additionally, the research examined the effectiveness of various fiscal rules, highlighting the potential of expenditure rules to promote cyclical behavior during implementation, while balanced budget and debt rules demonstrated similar efficacy in curbing procyclical fiscal policies.

A similar study conducted by Thornton (2008) examined the dynamics of procyclical fiscal policy in African countries. The study utilizes series regressions and a cross-country analysis using data from 37 low-income African nations between 1960 and 2004. The study reveals that in African countries, government consumption is highly procyclical, with spending rising or falling more sharply than changes in output. The research suggests that government consumption is

more procyclical in countries that heavily rely on external aid and exhibit lower levels of corruption. Conversely, it is less procyclical in nations with unequal income distribution and higher levels of democracy. The analysis also emphasizes the potential impact of corruption and democracy on fiscal procyclicality, with reduced corruption promoting more counter-cyclical fiscal policies. Furthermore, the research indicates that the initial level of per capita GDP generally does not significantly influence fiscal procyclicality in African countries.

Avellan and Vuletin (2015) studied fiscal procyclicality and output forecast errors, analyzing data from output forecasts for 101 countries. Their findings challenged the notion that over-optimism in output forecasts is directly linked to fiscal procyclicality. They also discovered that forecast errors do not consistently lead to systematic effects on fiscal procyclicality.

Bergman and Hutchison (2020) also investigated fiscal procyclicality in developing economies across 101 countries, analyzing the influence of fiscal rules, institutional features, and economic conditions. Their findings revealed that expenditure and balanced budget rules were associated with reduced procyclicality in emerging markets but had limited effects in low-income countries. Conversely, pro-cyclical fiscal policy was positively correlated with government debt levels, terms-of-trade volatility, and participation in IMF programs while negatively associated with government efficiency and inflation-targeting monetary regimes.

Furthermore, Carneiro and Garrido (2015) provided new evidence on the cyclicality of fiscal policy across 180 countries from 1980 to 2012, employing various methodological approaches. Their study scrutinizes the robustness of proxies for fiscal cyclicality, examines country-specific sub-periods to identify structural breaks, and investigates how countries behave in different business cycle phases. The analysis confirms previous literature and reveals a causal link between stronger institutions and less procyclical fiscal policy, even after addressing endogeneity concerns. The findings underscore the importance of institutional quality in shaping fiscal policy dynamics, highlighting the need for effective governance structures to mitigate procyclicality and promote economic stability.

Additionally, using panel regression in a different context, Herrera et al. (2019) examined fiscal policy procyclicality across 116 developing countries from 2000 to 2016. The study uncovered varying degrees of procyclicality, with Sub-Saharan Africa exhibiting the highest level while other regions experienced shifts over time. Economic factors like financial depth, tax base variability, and natural resource dependence were identified as influential determinants. Additionally, political economy variables such as corruption perception and social fragmentation were associated with procyclicality. Fiscal rules were found to mitigate procyclical bias, while expenditure rigidity and fiscal space also played significant roles. Moreover, asymmetric policy stances were observed, with heightened procyclicality during recessions and electoral years.

Methodology and Model

We need fiscal policy measures to assess the effect of commodity prices on fiscal policy. The main instruments fiscal authority uses to influence the economy are government spending and revenue. Since we are focusing on cyclical policy, the change in government spending as a share of the GDP and the change in government revenue as a share of the GDP would be the indicators that captures the cyclical components of government spending and revenue, respectively.

Therefore, two distinct models will be estimated: (i) the impact of commodity price growth ($\Delta lnCOMP$) on change in government spending as a share of GDP ($\Delta G/GDP$), and (ii) the impact of commodity price growth ($\Delta lnCOMP$) on change in government revenue as a share of GDP ($\Delta Rev/GDP$).
As we have seen in the literature review, the degree of financial integration/openness and institutions play a key role in the fiscal policy choice. So, the financial openness indicator (FOP), institutional quality (IQ), and a dummy variable on the existence of fiscal rules (FR) are included in the models to control the effects of institutions, Fiscal rule and financial openness on government spending and revenue.

- Model 1: $\Delta G = F(\Delta lnCOMP, FOP, IQ, FR)$..... (1)
- Model 2: $Rev = F(\Delta lnCOMP, FOP, IQ, FR)$..... (2)

Empirical strategy

To estimate the two models, we use panel regressions with country and time-fixed effects based on a sample of selected developing commodity exporter countries. Change in government expenditure as a percentage of GDP and change in government revenue as a percentage of GDP are dependent variables. The main explanatory variable is commodity price growth. Control variables are financial integration/openness indicator, institutional quality, and Fiscal rules.
The basic specification for analyzing the relationship between the variables is a panel regression with interaction terms, country, and time-fixed effects, as shown here.[1]:

$$\Delta G_{it} = \beta_0 + \beta_1 \Delta lnCOMP_{it} + \beta_2 FOP_{it} + \beta_3 IQ_{it} + \beta_4 FR_{it} + \beta_5 FOP_{it} \times \Delta lnCOMP_{it} + \beta_6 IQ_{it} \times \Delta lnCOMP_{it} + \beta_7 FR_{it} \times \Delta lnCOMP_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (1)$$

$$\Delta Rev_{it} = \alpha_0 + \alpha_1 \Delta lnCOMP_{it} + \alpha_2 FOP_{it} + \alpha_3 IQ_{it} + \alpha_4 FR_{it} + \alpha_5 FOP_{it} x \Delta lnCOMP_{it} + \alpha_6 IQ_{it} x \Delta lnCOMP_{it} + \alpha_7 FR_{it} x \Delta lnCOMP_{it} + \gamma_i + \delta_t + \mu_{it} \quad (2)$$

Where:
ΔG_{it}: Change in government expenditure as a percentage of GDP ($\Delta G/GDP$)
ΔRev_{it}: Change in government revenue as a percentage of GDP (($\Delta Rev/GDP$)
$\Delta lnCOMP_{it}$: Commodity price growth

[1] In addition to the basic specification, two other specifications will be presented for each model (see tables 2 and 3).

FOP, IQ and FR are respectively financial openness, institutional quality and Fiscal rules indicators.
$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \beta_6 \text{ and } \beta_7$ are the coefficients. We expect that $\beta_1 > 0, \beta_2, \beta_3 \text{ and } \beta_4, \beta_5 \beta_6, \beta_7 < 0$.
Similarly, in the second model, the coefficients are $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6 \text{ and } \alpha_7$. We expect that $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6 \text{ and } \alpha_7 > 0$.
γ_i represents country-fixed effects that allow us to control for country-specific characteristics that are constant over time. δ_t represents year-fixed effects that allow us to control for common shocks that might affect all countries at a particular time.

Data and Descriptive Statistics

Due to limitations, the data is annual and covers 2005 to 2021. Our sample consists of 20 developing commodity-exporting countries: Bolivia, Cameroon, Chad, Côte d'Ivoire, Republic of Congo, Ghana, Guinea, Honduras, Mongolia, Mozambique, Myanmar, Mauritania, Nicaragua, Niger, Nigeria, Papua New Guinea, Sudan, Tajikistan, Yemen, and Zambia.

This list was established based on the classification of Aslam et al. (2016). They consider a country a commodity exporter if commodity products have a share of at least 35 percent of its total exports and the share of net exports of commodities is at least 5 percent of its gross trade[2].

Original data on fiscal indicators are countries' general government expenditure and revenue denominated in local currency. These data sources are the IMF World Economic Outlook Database of October 2023. GDP in local currency was collected from the World Development Indicators (WDI) database of the World bank.

Commodity prices are represented by a country-specific commodity export price index collected from a page on the IMF website dedicated to commodity prices.[3]
Financial openness is measured by Chinn-Ito index (Chinn and Ito 2006[4]). The index ranges from 0 to 1. A higher value means a higher degree of financial openness.

Institutional quality is measured using the Country Policy and Institutional Assessment (CPIA) Index quality of economic management rating collected from the World Development Indicators (WDI) database of the World Bank. This CPIA criterion assesses the quality of fiscal policy, debt management and policy, and monetary/exchange rate policies. The rating ranges between 1 (lowest institutional quality) and 6 (highest institutional quality), but we normalized the variable to get values between 0 and 1. There is no explicit requirement to have Fiscal Rules in the CPIA criterion. So, we added the Dummy variable on Fiscal Rules. Data on Fiscal Rules are provided by Davoodi et al. (2022). It is a Dummy variable that takes the value of 1 if the country has either expenditure, revenue, budget balance, or debt rule, 0 otherwise.

[2] Aslam et al (2016) used data available for 1962–2014.
[3] https://www.imf.org/en/Research/commodity-prices
[4] https://web.pdx.edu/~ito/Chinn-Ito_website.htm

Summary Statistics

Table 1 shows that the mean changes in government spending and revenue are 3.1% and 2.7% of GDP, respectively, while the average commodity price growth is 0.5%. This suggests that, over the period 2005-2021, on average, these variables have increased. Moreover, on average, financial openness and institutional quality ratings are 0.357 and 0.477, respectively, which are just below the moderate levels. Lastly, only 27.6% of country-year observations have Fiscal Rules.

Table 1: Summary statistics of key variables

Variable	Obs	Mean	Std. Dev.	Min	Max
$\Delta G/GDP$	338	.031	.041	-.157	.218
$\Delta Rev/GDP$	338	.027	.064	-.278	.356
ΔlnCOMP	340	.005	.043	-.294	.218
FOP	339	.357	.335	0	1
IQ	324	.477	.12	.1	.7
FR	340	.276	.448	0	1

Notes: $\Delta G/GDP$: Change in Government Expenditure as Percentage of GDP, ΔRev: Change in Government Revenue as Percentage of GDP, $\Delta lnCOMP$: growth in Commodity price. FOP: Financial Openness. IQ: Institutional quality, FR: Fiscal Rule.

Figure 2a shows that the average change of government spending as a share of GDP in each continent fluctuates over time. It declines sharply when the commodity price falls (Figure 2b), for example, during the global financial crisis in 2008.

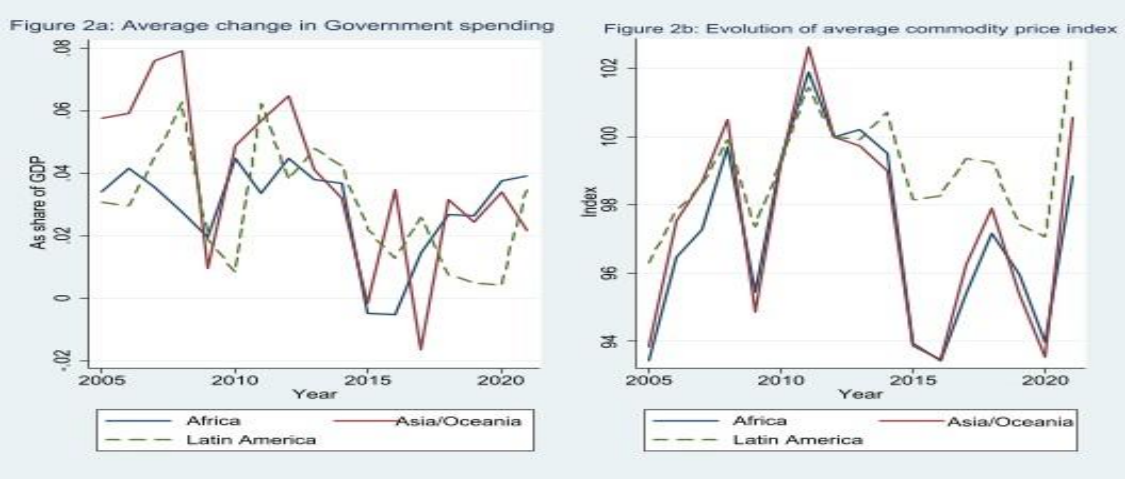

Figure 2: Average change in Government spending as a share of GDP and Average commodity price index by continent, 2005-2021

Correlation analysis

A simple correlation analysis sketches the relationship between changes in government spending and changes in commodity prices. As shown in Figure 1, from 2005 to 2021, most countries in the sample (12 out of 20) had positive correlation coefficients between the two variables. The highest positive correlation is attributed to the Republic of Yemen (0.68). This country tends to be the most procyclical in the group. Cote d'Ivoire tends to be the most countercyclical country, with a coefficient of correlation of -0.4.

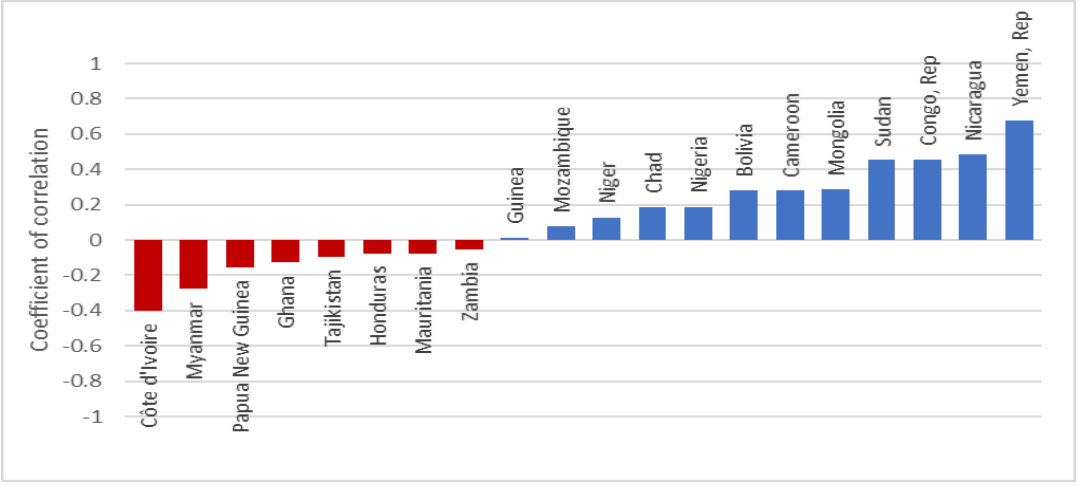

Figure 3: Correlation between change in government spending as percentage of GDP and change in commodity price for each country, 2005-2021

These results suggest that the sample under review is dominated by procyclical countries. Regression analyses will help confirm this finding.

Empirical Analysis

The study uses three fixed-effects specifications: Fixed Effects (FE) with no interaction terms, with two interaction terms (IQxΔlnCOMP and FRxΔlnCOMP), and with three interactions (IQxΔlnCOMP, FRxΔlnCOMP, and FOPxdlnCOMP). According to empirical results from model 1, the growth in commodity price positively affects change in government spending but is statistically insignificant in the third specification (column 3 of Table 2).

Table 2: Regression of government spending (model 1)
Dependent variable: Change in Government spending as a share of GDP

VARIABLES	(1) FE with no interactions	(2) FE with two interactions	(3) FE with all interactions
ΔlnCOMP	0.220*** (0.062)	0.498** (0.236)	0.189 (0.271)

VARIABLES	(1) FE with no interactions	(2) FE with two interactions	(3) FE with all interactions
IQ	-0.039	-0.028	-0.037
	(0.027)	(0.029)	(0.029)
FR	-0.059***	-0.059***	-0.057***
	(0.019)	(0.019)	(0.019)
FOP	0.071***	0.071***	0.073***
	(0.026)	(0.026)	(0.026)
IQxΔlnCOMP		-0.534	-0.389
		(0.436)	(0.438)
FRxΔlnCOMP		-0.032	0.128
		(0.101)	(0.122)
FOPxΔlnCOMP			0.426**
			(0.186)
Constant	0.037	0.032	0.034
	(0.024)	(0.024)	(0.024)
Observations	321	321	321
R-squared	0.370	0.373	0.385
Country Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

*Notes: $\Delta lnCOMP$ = growth in commodity price, IQ = Institutional Quality, FR = Fiscal Rule, FOP = Financial Openness. Figures in parentheses are standard errors. The stars (***, **, and *) indicates significance at the 1% (*** p<0.01), 5% (** p<0.05) levels, and 10% (* p<0.1), respectively.*

This shows the existence of fiscal procyclicality in these countries during the boom and bust period in the commodity's price. Conversely, the institutional quality negatively correlates with lower $\Delta G/GDP$ but is statistically insignificant at all levels, however, the degree in which in which institutional quality effect cyclicality depends the interaction with commodity price volatility. Similarly, fiscal rules negatively impact fiscal procyclicality, and results show that coefficients are statistically significant at a one percent level. However, the study results show a surprisingly positive correlation between financial openness and government spending on these export commodities countries. Unlike previous studies in the context of developing countries, which show a negative relationship between fiscal openness and fiscal procyclicality, the study shows that excess financial openness and removing credit constraints are associated with procyclical behavior. However, the sensitivity of government spending to changes in commodity price is smaller with interaction with Fiscal rules and financial openness relative to government revenue during the boom period of commodity price (see column 3 of table 3). This suggests that, even during a boom in commodity prices leading to higher government revenues, government consumption tends to respond differently when fiscal rules are in place and there are no credit constraints. Fiscal discipline and access to credit accessibility likely play a role in moderating how governments adjust their spending during times of economic growth

Table 3: Regression of government revenue (model 2)
Dependent variable: Change in Government revenue as a share of GDP

VARIABLES	(1) FE with no interactions	(2) FE with two interactions	(3) FE with all interactions
ΔlnCOMP	0.621***	1.155***	0.449
	(0.096)	(0.361)	(0.408)
IQ	-0.032	0.002	-0.018
	(0.042)	(0.044)	(0.043)
FR	-0.034	-0.033	-0.029
	(0.029)	(0.029)	(0.028)
FOP	0.058	0.055	0.060
	(0.040)	(0.040)	(0.039)
IQxΔlnCOMP		-1.463**	-1.132*
		(0.666)	(0.661)
FRxΔlnCOMP		0.225	0.590***
		(0.155)	(0.185)
FOPxΔlnCOMP			0.972***
			(0.281)
Constant	0.020	0.003	0.008
	(0.037)	(0.037)	(0.036)
Observations	321	321	321
R-squared	0.405	0.421	0.445
Country Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

*Notes: ΔlnCOMP = growth in commodity price, IQ = Institutional Quality, FR = Fiscal Rule, FOP = Financial Openness. Figures in parentheses are standard errors. The stars (***, **, and *) indicate significance at the 1% (*** p<0.01), 5% (** p<0.05) levels, and 10% (* p<0.1), respectively.*

We also examined the relationship between the commodity price, government revenue, and other explanatory variables in the second model (table 3). The model estimation result shows a positive relationship between commodity price and government revenue but is insignificant in the third specification (column 3 of Table 3). Similarly, financial openness has positively impacted government revenue, although financial openness is statistically insignificant. Conversely, the findings showed a unique result as institutional quality and fiscal rule have negatively correlated with the government revenue but are insignificant at all levels. In countries with high financial openness and fiscal rule, the government revenue's response to commodity price changes is larger than government spending, showing a reduction in the government deficit.

Concluding remarks and Policy Recommendation

This paper examined fiscal procyclicality in commodity-exporting countries. We investigate several key explanatory variables, including commodity prices, institutional quality, financial openness, and fiscal rules, which impact the fiscal procyclical behavior of these countries. The empirical findings of our study reveal that commodity prices have a positive effect on the fiscal procyclicality of these countries. Specifically, higher commodity prices are associated with increased revenue, leading to higher spending during economic booms and reduced spending during bust periods. Additionally, financial openness is linked to procyclical behavior in these countries, which is fascinating since removing credit constraints should be associated with less cyclical behavior. Moreover, fiscal rules demonstrate a negative effect on the level of procyclicality. A sound fiscal rule is associated with higher savings during good times and a smaller budget deficit during bad times. Conversely, institutional quality has negatively impacted fiscal procyclicality. Countries with stronger institutions tend to exhibit less pronounced fluctuations in fiscal policy. This suggests that robust institutional frameworks can help mitigate the tendency for governments to overspend during booms and underspend during downturns, contributing to more stable fiscal outcomes.

We also examined the impact of commodity prices on government revenue for commodity-dependent countries, specifically looking at the fiscal procyclical behavior resulting from changes in revenue. Our empirical analysis revealed a significant positive relationship between commodity prices and government revenue. This finding suggests that fluctuations in commodity prices contribute to the observed fiscal procyclicality in these countries. Lastly, when we compare the two models, we find that the reaction of government revenue to a change in commodity price is bigger than that of government spending in countries with high financial openness and fiscal rule, suggesting a decline in a budget deficit.

In light of these findings, policymakers in commodity-exporting developing countries should adopt a comprehensive approach to reduce fiscal procyclicality and enhance macroeconomic stability. Firstly, strengthening fiscal frameworks through well-designed fiscal rules, countercyclical policies, and stabilization funds is essential to shield government spending from commodity price fluctuations. Moreover, improving institutional quality, transparency, and governance can limit discretionary fiscal decisions and reduce excessive spending during booms. Furthermore, effective management of financial openness, coupled with regulatory measures to oversee capital flows and borrowing, is necessary to minimize external vulnerabilities. Additionally, economic diversification into value-added industries will reduce dependence on volatile commodity exports, fostering more stable fiscal outcomes.

Directions for Future Research

This study explores fiscal procyclicality in commodity-exporting developing countries, emphasizing the role of commodity price volatility, institutional quality, financial openness, and fiscal rules. However, further research could offer deeper insights into the role of commodity dependence. Comparing resource-rich and

non-resource-rich developing nations could provide a clearer understanding of how commodity dependence influences fiscal policy. Additionally, disaggregating government expenditure into current and capital expenditure, as well as revenue into commodity-related and non-commodity-related components, would help identify which fiscal areas are more sensitive to commodity price shocks. Future research could also explore the impact of fiscal institutions, such as sovereign wealth funds, on mitigating procyclicality. Investigating the influence of global factors, such as financial crises and international trade agreements, would further enhance understanding of external forces on fiscal cyclicality. Expanding these areas of research could refine policy recommendations, thereby strengthening fiscal resilience in commodity-dependent economies.

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Authors' declaration contribution

Ambinintsoa Rajaona: Designed and implemented the econometric modeling framework, conducted data collection from multiple international statistical sources, performed data cleaning and preprocessing, and prepared all tables and figures for empirical analysis.

Mustaf Abshir Ali: Conceived and conceptualized the research idea, conducted a comprehensive literature review, drafted the initial manuscript, interpreted and analyzed the econometric results, revised and edited the paper for intellectual content, and coordinated the overall research process.