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# Shocks and Shields: Macroeconomic Institutions During Commodity Price Swings

Rabah Arezki, Patrick A. Imam, Kangni Kpodar and Dao Le-Van

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Strategy, Policy, and Review Department

**Shocks and Shields: Macroeconomic Institutions During Commodity Price Swings**

**Prepared by Rabah Arezki, Patrick A. Imam, Kangni Kpodar, and Dao Le-Van**

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**ABSTRACT:** Countries facing commodity (net) export price shocks tend to implement fiscal rules and to financially close their economies, demonstrating “macroeconomic prudence”. These effects are (unsurprisingly) asymmetric between import and export price shocks. The impact of commodity (net) export prices on macroeconomic institutions is influenced by the intensity of shocks and income levels of the countries, with higher-income countries driving the main results. These findings remain robust across various checks, including different estimators and additional control and dependent variables. These findings suggest that macroeconomic institutions are reactive to terms of trade shocks stemming from commodity price fluctuations.

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WORKING PAPERS

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Prepared by Rabah Arezki, Patrick A. Imam, Kangni Kpodar, and Dao Le-Van<sup>1</sup>

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# 1. Introduction

Commodity price shocks are significant sources of macroeconomic fluctuations particularly for developing countries. An extensive literature exists on the macroeconomic consequences of commodity export windfalls (Sachs and Warner, 2001; Van der Ploeg, 2011; Frankel, 2012; Venables, 2016; Arezki, Ramey and Sheng, 2017). These windfalls affect economies through a myriad of channels associated with the “resource curse”, including Dutch disease, excessive indebtedness, conflicts and erosion of democracy (Frankel 2012; Ross, 2012). In contrast, there has been limited exploration of how commodity export windfalls influence macroeconomic institutions. The present paper addresses this gap.

Rather than assessing the effectiveness of macroeconomic institutions such as fiscal rules or financial liberalization (Bekaert et al. 2005; Frankel et al. 2013; Caselli et al. 2022), this paper investigates the genesis of these macroeconomic institutions in response to macroeconomic shocks. Specifically, we focus on terms of trade shocks induced by commodity price fluctuations for two reasons. First, commodity price shocks are a salient source of variation, especially for less diversified developing economies. Second, these shocks are plausibly exogenous, as most countries are price takers in commodity markets, making them useful for identifying causal relationships. We exclude leading exporters of major commodities from our sample to account for the potential endogeneity associated with commodity price making.

The paper explores the extent to which terms of trade shocks from commodity prices drive the adoption of fiscal rules and financial liberalization. Examining the extent to which terms of trade shocks induced by commodity prices drive the adoption of fiscal rules and financial liberalization is essential for several reasons. Commodity-dependent economies are particularly susceptible to price shocks, which can cause substantial macroeconomic instability. Understanding how these shocks influence fiscal rule adoption will illuminate how countries can better stabilize their economies and maintain sustainable fiscal management. Additionally, investigating the relationship between commodity price shocks and financial liberalization is crucial for developing policies that optimize the benefits of open financial markets while mitigating associated risks. Such research is particularly valuable for developing countries seeking to strengthen their macroeconomic institutions and enhance resilience against external shocks. Furthermore, this analysis addresses a significant gap in the literature by exploring the origins of macroeconomic policy responses to external economic pressures. Insights gained from this study will provide critical guidance for policymakers aiming to achieve long-term economic stability and growth.

The economics literature has largely overlooked this topic, focusing more on the macroeconomic consequences of commodity price shocks, such as the “resource curse,” rather than on the institutional responses. Data limitations have hindered comprehensive analysis, and there has been a stronger emphasis on assessing the effectiveness of existing macroeconomic institutions rather than exploring their origins. These reasons have collectively led to a gap in understanding the relationship between commodity price shocks and the adoption of fiscal rules and financial liberalization, which this paper addresses.

Our findings indicate that countries facing commodity (net) export price shocks tend to adopt fiscal rules and close their economies financially, reflecting “macroeconomic prudence”. These effects are (unsurprisingly) asymmetric across import and export price shocks. The impact of commodity (net) export prices on macroeconomic institutions varies with the intensity of the shocks and the income levels of the countries, with higher income showing the most significant results. These findings are robust to a battery of checks including different estimators and additional control and dependent variables, suggesting that macroeconomic institutions respond to terms of trade shocks driven by commodity prices.

Our paper is closely related to the literature on economic reforms. A substantial body of work has examined the political economy of reforms (Alesina and Drazen, 1991). Various authors have investigated the timing of reforms both empirically and theoretically. Notably Ranciere and Tornell (2015) develop a rent seeking model that explains why reforms occur during crisis. Alesina et al. (2023) provide empirical evidence that reforms are particularly costly for incumbents during downturns and when the benefits of reforms take time to materialize. In this paper, we use commodity export shocks to identify the causal link between terms of trade shocks and macroeconomic institutions.

Our paper also relates to the literature on the effectiveness of fiscal rules and financial liberalization. Frankel et al. (2013) show that many developing economies have graduated from fiscal procyclicality in recent decades, coinciding with the adoption of fiscal rules. Pieschacón (2012) uses a dynamic stochastic general equilibrium model to demonstrate that fiscal discipline in the face of oil shock is welfare enhancing. Another important strand of literature has documented the consequences of financial liberalization, with Bekaert et al. (2005) finding that equity and capital account liberalization spur economic growth. In this paper, we examine the impact of commodity terms of trade shocks on the adoption of fiscal institutions and financial liberalization, considering potential heterogeneity of effects based on the intensity of the shock and the income levels of countries.<sup>1</sup>

The remainder of the paper is organized as follows. Section 2 presents the data and empirical analysis. Section 3 discusses the main results. Section 4 covers extensions and robustness checks. Section 5 concludes.

## 2. Data

### Fiscal rules

Fiscal rules are mechanisms designed to ensure the sustainable management of public finances by establishing guidelines or constraints on fiscal policies. According to a dataset developed by Davoodi et al. (2022), fiscal rules are categorized into four main types: (i) budget balance rules, which aim to keep the

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<sup>1</sup> Arezki and Brueckner (2012) explore the effect of commodity export price shocks on external debt. The authors find that that democracies (autocracies) experience a decline (an increase) in external debt following commodity price shocks.

government's budget balanced or in surplus; (ii) debt rules, which reduce (or fix) the accumulation of public debt, often as a ratio to GDP; (iii) expenditure rules, which limit the growth rate of government spending; and (iv) revenue rules, which set limits on the growth of government revenues to prevent overreliance on specific sources and ensure revenue stability.

In this paper, we use a dummy variable that assigns a value of 1 if a country implemented at least one of the rules, and 0 otherwise. The measure covers 106 economies from 1985 to 2021.

## Capital account openness

Capital account openness measures how freely capital flows in and out of an economy.<sup>2</sup> We use Chinn-Ito capital openness index (KAOPEN) to assess this, which ranges from 0 (closed) to 1 (open), taking into account factors such as exchange rate volatility and capital controls. Financial integration is a crucial policy lever as it promotes economic growth (Chinn & Ito, 2008; Ito & Chinn, 2022). This index encompasses four primary aspects of an economy's financial openness: the existence of multiple exchange rates, restrictions on current account transactions, restrictions on capital account transactions, and the mandatory surrender of export proceeds. These four components are integrated into a principal component, with higher values indicating greater openness to cross-border capital transactions. The measure covers 182 economies from 1970 to 2021.

## Commodity price shocks

Commodity terms of trade shocks, induced by commodity prices, are obtained from Gruss and Kebhaj (2019). The construction of these shocks is detailed in Equations 1 and 2. The measure and associated weight are as follows:

$$\Delta \text{Log}(\text{Index})_{i,t} = \sum_{j=1}^J \Delta P_{j,t} \Omega_{i,j,t} \quad (1)$$

$$\Omega_{i,j,t} = \frac{1}{3} \sum_{s=1}^3 \frac{x_{i,j,\tau-s} - m_{i,j,\tau}}{GDP_{i,\tau-s}} \quad (2)$$

where  $P_{j,t}$  denotes the natural logarithm of the actual price of commodity  $j$  in year  $t$ .<sup>3</sup> The computation involves first differencing and time-varying country specific weights for commodity trade ( $\Omega_{i,j,t}$ ), derived from the average trade flows over the prior three years. Mathematically,  $\Omega_{i,j,t} = \frac{1}{3} \sum_{s=1}^3 \omega_{i,j,\tau-s}$ , where  $\tau$  corresponds to the

<sup>2</sup> We refer to capital account openness as financial openness thereafter.

<sup>3</sup> Commodities are categorized into four main groups: (i) energy, which include coal, crude oil, and natural gas; (ii) metal commodities, which comprises aluminum, copper, gold, iron ore, lead, nickel, tin, uranium, and zinc; (iii) food and beverages, encompassing items like bananas, barley, beef, cocoa, coffee, corn, fish, fish meal, groundnuts, lamb, olive oil, oranges, palm oil, poultry, rapeseed oil, rice, shrimp, soybean meal, soybean oil, soybeans, sugar, sunflower seed oil, swine meat, tea, and wheat; and (iv) agricultural raw materials, including cotton, hard logs, hard sawn wood, hides, natural rubber, soft logs, soft sawn wood, and wool.

calendar year for period  $t$ . Equation (2) shows how  $\Omega_{i,j,t}$  is constructed.  $x_{i,j,\tau}$ ,  $m_{i,j,\tau}$ , and  $GDP_{i,\tau}$  represent the export value of commodity  $j$ , the import value of commodity  $j$ , and the nominal GDP of country  $i$  in year  $\tau$ , respectively, measured in US dollars.

Commodity terms of trade shocks indicate income variations due to international price shifts. A 1 percent change in this index represents a proportional change in aggregate disposable income relative to GDP. To explore the symmetry of export and import commodity price shocks, we use two additional indexes. The commodity export price shocks track the average change in prices of commodities that a country exports, weighted by  $\frac{x_{i,j,\tau-s}}{GDP_{i,\tau-s}}$ . The commodity import price shocks measure the average change in prices of imported commodities over time, weighted by  $\frac{m_{i,j,\tau}}{GDP_{i,\tau-s}}$ . These measures cover 182 economies from 1962 to 2022.

## Control variables

GDP growth is sourced from the World Development Indicators (WDI) of the World Bank. The annual percentage growth rate of GDP at market prices is calculated using constant local currency.<sup>4</sup> Feenstra (2015) provides evidence that GDP growth promotes international trade by increasing goods production and consumer purchasing power. In this paper, GDP growth serves as a control variable to capture business cycle fluctuations that drive the adoption of macroeconomic institutions alongside commodity price shocks.

Electoral democracy data is collected from The V-Dem Dataset. Milner and Kubota (2005) find that democratic countries generally maintain lower trade barriers and more predictable trade policies, encouraging greater trade flows. Quinn (2000) argues that democratic governments are more responsive to domestic electorate demands and international investor expectations, resulting in increased financial transparency and reduced investor risks. Including democracy in our empirical specification helps control for coordination issues around macroeconomic institutions.

Corruption control is obtained from the WDI.<sup>5</sup> High levels of corruption can escalate transaction costs and introduce uncertainty in international trade, necessitating bribes and illicit payments to navigate bureaucratic obstacles, deterring foreign investors and trading partners and reducing trade volumes (Wei, 2000). Alfaro et al. (2008) demonstrate that countries with lower corruption levels exhibit more open financial systems, attracting greater foreign direct investment and facilitating smoother capital flows. Including corruption control captures

<sup>4</sup> The annual percentage growth rate of GDP at market prices is based on constant local currency. Aggregates are calculated using constant 2015 prices and expressed in U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy, plus any product taxes, and minus any subsidies not included in the value of the products. This calculation does not deduct for depreciation of fabricated assets or for depletion and degradation of natural resources.

<sup>5</sup> Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the “capture” of the state by elites and private interests. The estimate provides the country’s score on the aggregate indicator, in units of a standard normal distribution, ranging from approximately -2.5 to 2.5. Detailed documentation of the World Governance Institute, interactive tools for exploring the data, and full access to the underlying source data available at [www.govindicators.org](http://www.govindicators.org) (Kaufmann et al. 2010).



differences in business and financial environments across countries and over time. Annex I presents descriptive statistics for the variables used in the empirical analysis.

### 3. Main Results

We now describe the empirical strategy to explore the effects of commodity price shocks on macroeconomic institutions. To do so, we estimate the following econometric model:

$$Macro\ Inst_{i,t} = \alpha_i + \lambda_t + \gamma(Price\ Shock)_{i,t-1} + Z'\beta + u_{i,t} \quad (3)$$

where  $Macro\ Inst_{i,t}$  denotes either the existence of a fiscal rule (binary variable) or the level of financial openness for country  $i$  at year  $t$ . *Price shocks* represent country specific variations in terms of trade commodity price shocks.  $Z'$  is a vector of control variables, including GDP growth, democracy, and control of corruption.  $\alpha_i$  are country fixed effects capturing time-invariant country-specific unobservable factors,  $\lambda_t$  denotes year fixed effects capturing common shocks across years and,  $u_{i,t}$  is the error term. In our baseline regression, we use the net export commodity price index, accounting for changes in both export and import sides. We also separately examine the effects of changes in commodity terms of trade on exports and imports.

Table 1 shows the results for the main regressions with fiscal rules and financial openness as dependent variables and commodity price shocks as independent variables. Columns 1-2 of Table 1 report estimates of Equation (3), where the occurrence of commodity terms of trade shocks is captured by net export commodity price shocks.<sup>6</sup> The results indicate a statistically significant direct relationship between commodity price shocks and both fiscal rule adoption and financial liberalization. However, the coefficients' signs are opposite in Columns (1) and (2). Higher commodity price shocks causally lead to the adoption of fiscal rules and reduced financial openness. These results control for country-specific characteristics such as geography and resource endowment, as well as global shocks. The result should be interpreted as an average response of net export shocks on macroeconomic institutions. Using Columns (1) and (2) of Table 1 as benchmarks, these findings are consistent with “macroeconomic prudence” in the face of shocks, reinforcing related institutions. In other words, governments tend to commit fiscal institutions and limit financial openness in response to positive shocks.

**Table 1. Commodity Net Export Price Shocks on Fiscal Rules and Financial Openness**

Dependent variables	FISCAL RULES	FINANCIAL OPENNESS
Columns	(1)	(2)

<sup>6</sup> In Annex II, we explore the asymmetry between export and import sides of commodity shocks on macro-economic institutions. The results confirm the asymmetry found in our analysis, showing that commodity price shocks affect the adoption of fiscal rules and financial liberalization differently for exports and imports.

<i>Commodity net export price shocks</i> $s_{t-1}$	0.004*** (0.001)	-0.003*** (0.000)
Countries Fes	Yes	Yes
Year Fes	Yes	Yes
Observations	4,648	7,117
R-squared	0.560	0.695
Number of countries	106	167
Number of years	51	51

Notes: The “Commodity net export price shocks” measure presents the windfall gains and losses in income associated with fluctuations in global prices, considering both export and import prices. The fiscal rule, denoted by a dummy variable, imposes lasting restrictions on fiscal policy through numerical limits on budgetary aggregates. This variable takes a value of 1 if the central government, general government, or public sector enacts at least one of the following rules: budget balance rules (BBR), debt rules (DR), expenditure rules (ER), and revenue rules (RR). It is assigned a value of 0 if none of these rules are implemented or if data is missing during survey periods (Davoodi et al., 2022). Financial openness reflects the extent of a country’s capital account openness. Our study employs the Chinn-Ito index (KAOPEN), a continuous variable [0, 1], as the primary measure for this concept (Chinn & Ito, 2008). In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for the potential endogeneity associated with commodity price making. Stars indicate significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Quantitatively, a one standard deviation in commodity price shocks is associated with a 0.12 standard deviation increase in the adoption of fiscal rules and a 0.06 standard deviation decrease in financial openness. The effect of commodity price shocks on macroeconomic institutions is statistically significant but relatively small economically. However, this average statistical significance but relatively small economic significance might mask heterogeneity across different income levels and shock intensities.

Table 2 presents the results of the main regressions augmented with interactions between commodity price shocks and dummies for middle-income and low-income groups. Columns 1-2 of Table 2 report estimates of the augmented Equation (3), incorporating interaction terms between net export commodity price shocks and income group dummies. The results indicate that our main findings linking commodity price shocks with both fiscal rule adoption and financial liberalization are primarily driven by high-income countries. The default income group corresponding to the coefficient associated with commodity price shocks is higher income.

Columns (1) and (2) show that the default coefficients are positive for fiscal rules and negative for financial openness. In contrast, the interaction terms with commodity price shocks for middle-income and low-income groups have opposite signs to the default coefficients. Specifically, these coefficients are negative for fiscal rules and positive for financial openness in Columns (1) and (2). Combining the default coefficients and interaction terms, the net effect of commodity price shocks is positive for middle income countries and negative for low-income countries regarding fiscal rule adoption. The net effect is zero for both middle and low-income countries concerning financial openness.

These results presented in Table 2 suggest that “macroeconomic prudence” in the face of shocks is driven by high income countries.<sup>7 8</sup> In other words, governments in high-income countries are more likely to commit to fiscal institutions and limit financial openness in the face of positive shocks compared to middle and low-income countries.

**Table 2. Commodity Net Export Price Shocks on Financial Openness: Income Heterogeneity**

Dependent variables	FISCAL RULES	FINANCIAL OPENNESS
Columns	(1)	(2)
<i>Net export price shocks</i> <sub>t-1</sub>	0.005*** (0.001)	-0.005*** (0.001)
<i>Net export price shocks</i> <sub>t-1</sub> × <i>middle income</i> (p25 – 50)	-0.004* (0.002)	0.005*** (0.002)
<i>Net export price shocks</i> <sub>t-1</sub> × <i>low income</i> (p25)	-0.007** (0.003)	0.005*** (0.001)
Countries Fes	Yes	Yes
Year Fes	Yes	Yes
Observations	4,648	7,117
R-squared	0.561	0.698
Number of countries	106	167
Number of years	51	51

Notes: Countries are considered low-income if their GDP per capita (constant 2015 US\$) averaged over the study period falls below the 25th percentile of the world average. Countries are classified as middle-income if their average GDP per capita (constant 2015 US\$) during the study period falls between the 25th and 50th percentiles of the world average. An analysis with commodity export and import price shocks is presented in Annex III. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars indicate significance levels: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

**Table 3. Commodity Price Shocks on Fiscal Rules and Financial Openness: Intensity Heterogeneity**

Dependent variables	FISCAL RULES				FINANCIAL OPENNESS			
Columns	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
90 <sup>th</sup> percentile threshold <sub>t-1</sub>	0.049*** (0.014)				-0.025*** (0.010)			
80 <sup>th</sup> percentile threshold <sub>t-1</sub>		0.035*** (0.011)				-0.024*** (0.008)		
70 <sup>th</sup> percentile threshold <sub>t-1</sub>			0.025***				-0.019***	

<sup>7</sup> In Annex III, we present the results of our exploration of the asymmetry between exports and import sides of commodity shocks on macro-economic institutions distinguishing different income groups. Results presented in Annex III confirm the asymmetry of our main results along import and export sides and also broadly that countries pertaining to higher income group drive those results.

<sup>8</sup> In Annex IV, we present the results of our exploration of our main results for different regional grouping. Results presented in Annex IV confirm the robustness of our main results for most regional grouping except less so for Asia.

	(0.009)				(0.006)			
$60^{th}$ percentile threshold $_{t-1}$				0.017**				-0.015***
				(0.008)				(0.005)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,768	4,768	4,768	4,768	7,233	7,233	7,233	7,233
R-squared	0.550	0.550	0.550	0.549	0.688	0.688	0.688	0.688
Number of countries	106	106	106	106	167	167	167	167
Number of years	51	51	51	51	51	51	51	51

Notes: The independent variables are dummies; their values take the value of 1 if they exceed pre-set thresholds and 0 if otherwise. These thresholds are set at the 90th, 80th, 70th, and 60th percentiles, with the percentile values determined separately for each country during the given study periods. A more detailed analysis is presented in Annex V. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Some countries are not included in the original sample. Stars indicate significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 3 shows the results for the main regressions using threshold dummy variables to capture the intensity of commodity price shocks. These dummy variables take a value of 1 if the shock is above a given threshold, and 0 otherwise. Columns 1-4 and 5-8 of Table 2 report estimates of Equation (3) using these threshold dummies, with fiscal rule adoption and financial openness as dependent variables, respectively.

The results indicate that our main findings linking commodity price shocks with both fiscal rule adoption and financial liberalization are driven by higher-intensity shocks. The coefficients associated with higher intensity thresholds are larger in absolute value than those for lower intensity thresholds across Columns 1-8 in Table 3.<sup>9</sup> We interpret these results as indicating that governments exercise greater prudence in the face of more intense shocks.

## 4. Extensions and Robustness Checks

In this section, we explore a set of extensions and robustness checks regarding the relationship between commodity price shocks and macroeconomic institutions. Specifically, we examine the inclusion of control variables, different estimators and alternative dependent variables.

Table 4 presents the results for the main regressions, with fiscal rules and financial openness as dependent variables and commodity price shocks as independent variables, including a series of control variables. Columns 1-3 and 4-6 in Panel A and B of Table 4 indicate the statistical significance of the direct relationship between commodity price shocks and both fiscal rule adoption and financial liberalization. Quantitatively, the coefficients associated with commodity price shocks in these regressions are slightly smaller than those in

<sup>9</sup> In Annex V, we present the results of our exploration using a more extensive set of threshold intensity dummies. Annex V confirms that the coefficients associated with lower intensity thresholds are smaller than those for higher intensity thresholds.

Table 1. Overall, our main results are robust to the inclusion of additional controls, suggesting that governments display macroeconomic prudence by reinforcing related institutions.<sup>10</sup>

**Table 4. Net Export Price Shocks on Fiscal Rules and Financial Openness Including with Additional Controls**

**PANEL A: Level-level regression model**

Dependent variables	FISCAL RULES			FINANCIAL OPENNESS		
Columns	(1)	(2)	(3)	(4)	(5)	(6)
<i>Net export price shocks</i> <sub><i>t</i>-1</sub>	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	-0.001** (0.000)	-0.002*** (0.001)	-0.001* (0.000)
GDP growth	-0.002*** (0.001)	-0.002** (0.001)	-0.002 (0.001)	0.002*** (0.000)	0.001*** (0.001)	-0.000 (0.001)
Electoral democracy index		0.138*** (0.039)	-0.166*** (0.063)		-0.141*** (0.024)	-0.080** (0.033)
Control of Corruption			0.101*** (0.025)			0.044*** (0.011)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,306	4,062	2,266	6,331	5,948	3,295
R-squared	0.572	0.561	0.752	0.721	0.726	0.893
Number of countries	106	100	100	165	154	154
Number of years	48	48	23	47	47	22

**PANEL B: Level-log regression model**

Dependent variables	FISCAL RULES			FINANCIAL OPENNESS		
Columns	(1)	(2)	(3)	(4)	(5)	(6)
<i>Ln(Net export price shocks)</i> <sub><i>t</i>-1</sub>	0.356*** (0.070)	0.359*** (0.070)	0.328*** (0.094)	-0.107*** (0.040)	-0.168*** (0.042)	-0.081** (0.040)
GDP growth	-0.002*** (0.001)	-0.002** (0.001)	-0.002 (0.001)	0.002*** (0.000)	0.001*** (0.001)	-0.000 (0.001)
Electoral democracy index		0.139*** (0.039)	-0.165*** (0.063)		-0.141*** (0.024)	-0.080** (0.033)
Control of Corruption			0.102*** (0.025)			0.044*** (0.011)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,306	4,062	2,266	6,331	5,948	3,295
R-squared	0.572	0.561	0.753	0.722	0.726	0.893
Number of countries	106	100	100	165	154	154
Number of years	48	48	23	47	47	22

<sup>10</sup> In Annex VI, we present the results of our exploration of the asymmetry between the export and import sides of commodity shocks on macroeconomic institutions. Annex VI demonstrates that our main results are robust when a series of control variables is included.

Notes: The “net export price shocks” represent the windfall gains and losses in income associated with fluctuations in global prices, considering both export and import prices. GDP growth (% annual)<sup>11</sup> and control of corruption (z-score) are sourced from World Development Indicators. Electoral democracy [0,1], representing democracy, is collected from the V-Dem Indicators dataset. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 5 shows the results for the main regressions using different estimators. We use discrete choice model estimators to account for the binary nature of the dependent variable in the case of fiscal rule adoption. For financial openness, we use Poisson and Tobit estimators to address the truncated nature of the dependent variable. Columns 1-2 and 3-4 of Table 5 indicate the statistical significance of the direct relationship between commodity price shocks and both fiscal rule adoption and financial liberalization. Overall, our main results are robust to the use of different estimators. These results suggest that governments display macroeconomic prudence by reinforcing related institutions.

**Table 5. Net Export Price Shocks on Fiscal Rules and Financial Openness using Different Estimators**

Dependent variables	FISCAL RULES		FINANCIAL OPENNESS	
	(1)	(2)	(3)	(4)
Columns				
Estimators	Probit	Logit	Tobit	Poisson
<i>Commodity net export price shocks<sub>t-1</sub></i>	0.011** (0.005)	0.021** (0.008)	-0.001* (0.000)	-0.006*** (0.002)
Countries Fes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes
Observations	4,648	2,315	7,117	7,117
Number of countries	106	52	167	167
Number of years	51	51	51	51

Notes: The “Commodity export (res. import) price shocks” represent the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. The fiscal rule, denoted by a dummy variable, imposes lasting restrictions on fiscal policy through numerical limits on budgetary aggregates. This variable takes a value of 1 if the central government, general government, or public sector enacts at least one of the following rules: budget balance rules (BBR), debt rules (DR), expenditure rules (ER), and revenue rules (RR). It is assigned a value of 0 if none of these rules are implemented or if data is missing during survey periods (Davoodi et al., 2022). Financial openness reflects the extent of a country’s capital account openness. Our study employs the Chinn-Ito index (KAOPEN), a continuous variable [0, 1], as the primary measure for this concept (Chinn & Ito, 2008). Column [3] runs a regression with Tobit estimation with a lower limit of 0 and an upper limit of 1; accordingly, it has 5,606 uncensored observations, and 1,511 right-censored observations. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price taking. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Tables 6 and 7 show the results for the main regressions using alternative dependent variables: the choice of the exchange rate regime and the adoption of loan to value limits (LTV) —a prominent macro-prudential measure.

<sup>11</sup> The annual percentage growth rate of GDP at market prices is calculated using constant local currency. The aggregates are derived based on constant 2015 prices and are presented in U.S. dollars.

In Table 6, Columns 1-3 and 4-6 display the results for different sets of estimators using 6-category and 3-categories measures of exchange rate regimes, respectively. The result in Table 6 indicate the statistical significance of the direct relationship between commodity price shocks and the choice of exchange rate regime for both categorizations. The negative sign associated with the commodity price shock variable indicates that a positive terms of trade shock is linked with a choice of a more rigid exchange rate regime.<sup>12</sup>

In Table 7, we use monthly frequency measure of loan to value limits (LTV) as the dependent variable. Column 1 in Table 7 shows a positive and statistically significant association between commodity price shock and LTV limits. We interpret these results as indicating a higher propensity to use LTV limits in the context of a positive terms of trade shock induced by commodity price fluctuations. Columns 2 and 3 in Table 7 present the results for the export and import sides of commodity price shocks, confirming the asymmetry found in our main results.<sup>13</sup> Overall, our main results are robust to the inclusion of additional controls, suggesting that governments display macroeconomic prudence by reinforcing related institutions.

**Table 6. Commodity Net Export Price Shock and Exchange Rate Arrangements**

Dependent variables	Exchange Rate Arrangements (6 categories)			Exchange Rate Arrangements (3 categories)		
	OLS	Tobit	Logit	OLS	Tobit	Logit
Estimators						
Columns	(1)	(2)	(5)	(12)	(13)	(16)
<i>Net export price shock</i> <sub><i>t</i>-1</sub>	-0.004*** (0.002)	-0.019*** (0.004)	-0.024*** (0.004)	-0.002** (0.001)	-0.011*** (0.003)	-0.016*** (0.005)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,738	8,738	8,738	8,738	8,738	8,738
R-squared	0.506			0.450		
Number of countries	170	170	170	170	170	170
Number of years	57	57	57	57	57	57

Notes: The dependent variable is the exchange rate arrangements. Countries are classified into distinct groups based on their exchange rate arrangements, as outlined by the recommendations of Ilizetki, Reinhart, and Rogoff (2017).<sup>14</sup> The variable is divided into 6 categories as follows:

- 1 Least flexible: from no separate legal tender to de facto pegs;
- 2 Gradualist adjustment: from crawling peg to narrow crawling bands;
- 3 Broad bands and managed floating;
- 4 Freely floating;

<sup>12</sup> In Annex VII, we present the results of our exploration of the asymmetry between the export and import sides of commodity shocks and the choice of exchange rate regime. Annex VII shows that our main findings regarding the asymmetry between export and import sides are robust when using exchange rate regime choice as dependent variables.

<sup>13</sup> In Annex VIII, we present the results of our exploration linking commodity shocks to LTV limits using data with quarterly frequency. Annex VIII confirms that our main results are robust to the use of higher frequency data.

<sup>14</sup> See URL link to the dataset: <https://www.ilizetki.com/irr-data>

5 Freely falling: from no separate legal tender to de facto pegs;

6 Flexibly unstable: Multiple, dual, or parallel markets with limited or no data.

In columns [4]-[6], we use a traditional approach where the dependent variable is coded as 1 if it falls into Group 1 or 2, 2 if it falls into Group 3 or 4, and 3 otherwise. Since the exchange rate arrangements variable is discrete, with higher values implying more flexibility in the exchange rate regime, columns [2] and [5] use Tobit model estimation with a lower limit of 1 and an upper limit of 6. Additionally, columns [3] and [6] use the logistic regression.

In column [2], there are 4,038 left-censored observations, 4,341 uncensored observations, and 359 right-censored observations. In columns [3] and [6], the likelihood ratio (LR) test compares an ordered logistic regression model (ologit) against a simpler model, likely the null model or a more restricted version. The p-value is 0.0000, indicating that the ordered logistic model fits significantly better than the simpler model. In column [5], there are 6,088 left-censored observations, 2,650 uncensored observations, and 0 right-censored observations. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for the potential endogeneity associated with commodity price making Stars denote significance levels: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

**Table 7. Commodity Export and Import Price Shock and Loan to Value limits (Monthly frequency)**

Dependent variables	Average of the regulatory loan-to-value (LTV) limits	
Columns	(1)	(2)
<i>Commodity export price shock<sub>t</sub></i>		0.033** (0.014)
<i>Commodity import price shock<sub>t</sub></i>		-0.304*** (0.024)
<i>Net export price shock<sub>t</sub></i>	0.090*** (0.012)	
Countries Fes	Yes	Yes
Time Fes	Yes	Yes
Observations	22,000	22,000
R-squared	0.659	0.661
Number of countries	60	60
Number of months	384	384

Notes: In Column [1], the dependent variable represents the simple average of the regulatory loan-to-value (LTV) limits. It specifically focuses on LTV limits for real estate mortgage loans (both residential and commercial), while dummy-type indicators and text information may cover other types of loans (e.g., auto loans). If a country does not have any LTV limits, the value is set at 100. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars denote significance levels: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

## 5. Conclusion

This paper explored the effect of shocks in commodity export prices on macroeconomic institutions. It found that countries facing commodity (net) export price shocks tend to adopt fiscal rules and to financially close their economies, demonstrating “macroeconomic prudent” behavior. These effects are (unsurprisingly) asymmetric across import and export price shocks. The impact of commodity (net) export prices on macroeconomic



institutions varies depending on the intensity of shocks and income levels, with higher-income countries driving the main results.

These findings are robust to various checks, including different estimators and additional control variables. The results suggest macroeconomic institutions are reactive to terms of trade shocks stemming from commodity prices. From a policy perspective, it is important to consider the potential reversal of macroeconomic institutions in the face of shocks and account for these fluctuations as an integral part of macroeconomic policy.

Based on the findings in our paper, it is imperative for countries, particularly those heavily reliant on commodity exports, to adopt robust fiscal rules and strengthen financial regulations to mitigate the volatility induced by commodity price shocks. Consistent enforcement of these fiscal rules is crucial to maintaining stable and predictable fiscal policies, even during significant commodity price fluctuations. Additionally, policymakers should consider limiting financial openness during positive commodity price shocks to prevent economic overheating and the accumulation of excessive financial risks. Enhancing financial regulatory frameworks to manage capital inflows and outflows is essential for ensuring financial stability and reducing vulnerability to external shocks.

Further research could usefully explore the differentiated effects of commodity price shocks from different types of commodities. Isham et al. (2005) shows that countries endowed with “point source” natural resources such as minerals and hydrocarbons experience lesser growth performance than countries endowed with “diffuse” resources such as agriculture products. It is conceivable that point source, as opposed to diffuse natural resources, also have differentiated effects on macroeconomic institutions. Indeed, macroeconomic institutions reflect the ability to socially coordinate on policies, and the nature of underlying resource endowments could be deep factor underpinning such ability.

## Annex I. Descriptive Statistics

			Observations	Mean	Standard deviation	Min	Max
	Units	Source					
Fiscal rules	0 or 1 (dummy)	Davoodi et al. (2022) <sup>15</sup>	4996	0.181	0.385	0.000	1.000
Financial Openness	[0,1]	Chinn and Ito (2008) <sup>16</sup>	7462	0.459	0.362	0.000	1.000
Commodity net export price shock	IMF calculation	IMF <sup>17</sup>	9855	99.801	13.256	35.610	177.005
Commodity export price shock	IMF calculation	IMF	9855	94.895	11.229	35.552	132.391
Commodity import price shock	IMF calculation	IMF	9855	95.453	5.655	47.053	109.748
GDP growth	%	WDI	7697	3.458	5.918	-64.047	88.958
Electoral democracy index	[0,1]	The V-Dem Dataset <sup>18</sup>	9596	0.433	0.287	0.007	0.924
Control of Corruption	z-score	WDI	4084	-0.042	0.996	-1.782	2.459

Source: Authors. Notes: The “Commodity net export price shocks” represents the windfall gains and losses in income associated with fluctuations in global prices, considering both export and import prices. The “Commodity export (res. import) price shocks” presents the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. The fiscal rule takes a value of 1 if the central government, general government, or public sector enacts at least one of the following rules: budget balance rules (BBR), debt rules (DR), expenditure rules (ER), and revenue rules (RR). It is assigned a value of 0 either if none of these rules are implemented or if data is missing during survey periods. Financial openness, a continuous variable, reflects the extent of a country’s capital account openness. Our study employs the Chinn-Ito index (KAOPEN) as the primary measure for this concept.

<sup>15</sup> <https://www.imf.org/external/datamapper/fiscalrules/map/map.htm>

<sup>16</sup> [https://web.pdx.edu/~ito/Chinn-Ito\\_website.htm](https://web.pdx.edu/~ito/Chinn-Ito_website.htm)

<sup>17</sup> <https://data.imf.org/?sk=2CDDCCB8-0B59-43E9-B6A0-59210D5605D2>

<sup>18</sup> <https://v-dem.net/data/the-v-dem-dataset/>

## Annex II. Commodity Export and Import Price Shocks on Fiscal Rules And Financial Openness

### PANEL A: Level-level regression model

Dependent variables	FISCAL RULES		FINANCIAL OPENNESS	
	(1)	(2)	(3)	(4)
<i>Commodity net export price shocks</i> <sub><i>t</i>-1</sub>	0.004*** (0.001)		-0.003*** (0.000)	
<i>Commodity export price shocks</i> <sub><i>t</i>-1</sub>		0.005*** (0.001)		-0.003*** (0.001)
<i>Commodity import price shocks</i> <sub><i>t</i>-1</sub>		-0.005** (0.002)		0.003** (0.001)
Countries Fes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes
Observations	4,648	4,648	7,117	7,117
R-squared	0.560	0.560	0.695	0.696
Number of countries	106	106	167	167
Number of years	51	51	51	51

### PANEL B: Level-log regression model

Dependent variables	FISCAL RULES		FINANCIAL OPENNESS	
	(1)	(2)	(3)	(4)
<i>Ln(Commodity import price shocks)</i> <sub><i>t</i>-1</sub>	0.365*** (0.064)		-0.236*** (0.034)	
<i>Ln(Commodity net export price shocks)</i> <sub><i>t</i>-1</sub>		0.364*** (0.072)		-0.244*** (0.038)
<i>Ln(Commodity export price shocks)</i> <sub><i>t</i>-1</sub>		-0.374** (0.188)		0.197** (0.088)
Countries Fes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes
Observations	4,648	4,648	7,117	7,117
R-squared	0.560	0.560	0.695	0.695
Number of countries	106	106	167	167
Number of years	51	51	51	51

Notes: The “Commodity net export price shocks” presents the windfall gains and losses in income associated with fluctuations in global prices, considering both export and import prices. The “Commodity export (res. import) price shocks” presents the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. The fiscal rule, denoted by a dummy variable, enforces lasting restrictions on fiscal policy through numerical limits on budgetary aggregates. This variable takes a value of 1 if the central government, general government, or public sector enacts at least one of the following rules: budget balance rules (BBR), debt rules (DR), expenditure rules (ER), and revenue rules (RR). It is assigned a value of 0 either if none of these rules are implemented or if data is missing during survey periods (Davoodi et al., 2022). Financial openness reflects the extent of a country’s capital account openness. Our study employs the Chinn-Ito index (KAOPEN), a continuous variable, as the primary measure for this concept (Chinn & Ito, 2008). In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals,

and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars indicate significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Annex III. Commodity Export and Import Price Shocks on Fiscal Rules and Financial Openness: Income Analysis B

### PANEL A: Commodity Export and Import Price Shocks

Dependent variables	FISCAL RULES	FINANCIAL OPENNESS
Columns	(1)	(2)
<i>Export price shocks</i> $s_{t-1}$	0.005*** (0.001)	-0.004*** (0.001)
<i>Export price shocks</i> $s_{t-1} \times \text{low income}(p25)$	0.005 (0.003)	0.002 (0.002)
<i>Export price shocks</i> $s_{t-1} \times \text{middle income}(p25 - 50)$	-0.006*** (0.002)	0.001 (0.001)
Countries Fes	Yes	Yes
Year Fes	Yes	Yes
Observations	4,648	7,117
R-squared	0.561	0.696
Number of countries	106	167
Number of years	51	51

### PANEL B: Commodity Import Price Shocks

Dependent variables	FISCAL RULES	FINANCIAL OPENNESS
Columns	(1)	(2)
<i>Import price shocks</i> $s_{t-1}$	-0.009*** (0.002)	0.006*** (0.001)
<i>Import price shocks</i> $s_{t-1} \times \text{low income}(p25)$	0.011*** (0.003)	0.002 (0.002)
<i>Import price shocks</i> $s_{t-1} \times \text{middle income}(p25 - 50)$	-0.005 (0.003)	-0.013*** (0.002)
Countries Fes	Yes	Yes
Year Fes	Yes	Yes
Observations	4,648	7,117
R-squared	0.560	0.697
Number of countries	106	167
Number of years	51	51

Notes: Countries are considered low-income if their GDP per capita (constant 2015 US\$) averaged over the study period falls below the 25th percentile of the world average. Countries are classified as middle-income if their average GDP per capita (constant 2015 US\$) during the study period falls between the 25th and 50th percentiles of the world average. In this sample, we exclude the top five leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi

Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars indicate significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Annex IV. Commodity Net Export Price Shocks on Fiscal Rules and Financial Openness: Regional Analysis

PANEL A: Level-level regression model

Dependent variables	FISCAL RULES				FINANCIAL OPENNESS			
	AFRICA	AMERICAS	ASIA	EUROPE	AFRICA	AMERICAS	ASIA	EUROPE
Regions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Net export price shocks</i> <sub><i>t</i>-1</sub>	0.002** (0.001)	0.018*** (0.002)	0.001 (0.002)	0.023*** (0.007)	-0.001* (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.001 (0.002)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,138	1,002	1,097	198	2,247	1,502	1,805	1,273
R-squared	0.583	0.640	0.540	0.625	0.588	0.541	0.801	0.786
Number of countries	46	21	27	7	50	32	43	34
Number of years	51	51	51	30	51	51	51	51

PANEL B: Level-log regression model

Dependent variables	FISCAL RULES				FINANCIAL OPENNESS			
	AFRICA	AMERICAS	ASIA	EUROPE	AFRICA	AMERICAS	ASIA	EUROPE
Regions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Ln(Net export price shocks)</i> <sub><i>t</i>-1</sub>	0.223*** (0.077)	1.903*** (0.256)	0.155 (0.149)	2.454*** (0.755)	-0.100** (0.047)	-0.390*** (0.116)	-0.230*** (0.048)	-0.095 (0.166)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,138	1,002	1,097	198	2,247	1,502	1,805	1,273
R-squared	0.584	0.640	0.540	0.625	0.588	0.543	0.800	0.786
Number of countries	46	21	27	7	50	32	43	34
Number of years	51	51	51	30	51	51	51	51

Notes: In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Countries worldwide are categorized into five main geographic regions: Africa, Americas, Asia, Europe, and Oceania.<sup>19</sup> However, there are no countries from the Oceania region included in the study data. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

<sup>19</sup> <https://github.com/luke/ISO-3166-Countries-with-Regional-Codes/blob/master/all/all.csv>

## Annex V. Commodity Price Shocks (Thresholds) on Fiscal Rules and Financial Openness

### PANEL A: FISCAL RULES

Dependent variables	FISCAL RULES								
	Columns	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
90 <sup>th</sup> percentile threshold <sub>t-1</sub>		0.049*** (0.014)							
80 <sup>th</sup> percentile threshold <sub>t-1</sub>			0.035*** (0.011)						
70 <sup>th</sup> percentile threshold <sub>t-1</sub>				0.025*** (0.009)					
60 <sup>th</sup> percentile threshold <sub>t-1</sub>					0.017** (0.008)				
50 <sup>th</sup> percentile threshold <sub>t-1</sub>						0.022*** (0.008)			
40 <sup>th</sup> percentile threshold <sub>t-1</sub>							0.019** (0.008)		
30 <sup>th</sup> percentile threshold <sub>t-1</sub>								0.012 (0.009)	
20 <sup>th</sup> percentile threshold <sub>t-1</sub>									0.009 (0.011)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,768	4,768	4,768	4,768	4,768	4,768	4,768	4,768	4,768
R-squared	0.550	0.550	0.550	0.549	0.550	0.549	0.549	0.549	0.549
Number of countries	106	106	106	106	106	106	106	106	106
Number of years	51	51	51	51	51	51	51	51	51

### PANEL B: FINANCIAL OPENNESS

Dependent variables	FINANCIAL OPENNESS								
	Columns	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
90 <sup>th</sup> percentile threshold <sub>t-1</sub>		-0.025*** (0.010)							
80 <sup>th</sup> percentile threshold <sub>t-1</sub>			-0.024*** (0.008)						
70 <sup>th</sup> percentile threshold <sub>t-1</sub>				-0.019*** (0.006)					
60 <sup>th</sup> percentile threshold <sub>t-1</sub>					-0.015*** (0.005)				
50 <sup>th</sup> percentile threshold <sub>t-1</sub>						-0.017***			

					(0.005)			
$40^{th}$ percentile threshold $_{t-1}$						-0.023***		
						(0.005)		
$30^{th}$ percentile threshold $_{t-1}$							-0.027***	
							(0.006)	
$20^{th}$ percentile threshold $_{t-1}$								-0.042***
								(0.007)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,233	7,233	7,233	7,233	7,233	7,233	7,233	7,233
R-squared	0.688	0.688	0.688	0.688	0.688	0.688	0.688	0.689
Number of countries	167	167	167	167	167	167	167	167
Number of years	51	51	51	51	51	51	51	51

Notes: The independent variables are dummies; their values take the value of 1 if they exceed pre-set thresholds and 0 if otherwise. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making... These thresholds are set at the 90th, 80th, 70th, 60th, 50th, 40th, 30th and 20th percentiles, with the percentile values determined separately for each country during the respective study periods. Stars indicate significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Annex VI. Commodity Export and Import Price Shocks on Fiscal Rules and Financial Openness

PANEL A: Commodity Export and Import Price Shocks On Fiscal Rules, With Controls

Dependent variables	FISCAL RULES					
Columns	(1)	(2)	(3)	(4)	(5)	(6)
<i>Commodity export price shocks</i> $s_{t-1}$	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)			
<i>Commodity import price shocks</i> $s_{t-1}$				-0.011*** (0.003)	-0.010*** (0.003)	-0.004 (0.003)
GDP growth	-0.002*** (0.001)	-0.002** (0.001)	-0.002 (0.001)	-0.002*** (0.001)	-0.002** (0.001)	-0.002 (0.001)
Electoral democracy index		0.139*** (0.039)	-0.163** (0.063)		0.133*** (0.039)	-0.166*** (0.064)
Control of Corruption			0.102*** (0.025)			0.099*** (0.025)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,306	4,062	2,266	4,306	4,062	2,266
R-squared	0.571	0.560	0.752	0.571	0.560	0.751
Number of countries	106	100	100	106	100	100
Number of years	49	48	23	49	48	23

Notes: The "Commodity export (res. import) price shocks" presents the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. GDP growth (% annual) and control of corruption (z-score) are sourced from World Development Indicators. Variable representing democracy is electoral democracy [0,1], is collected from V-Dem dataset. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

PANEL B: Commodity Export and Import Price Shocks on Financial Openness, With Controls

Dependent variables	FINANCIAL OPENNESS					
Columns	(1)	(2)	(3)	(4)	(5)	(6)
<i>Commodity export price shocks</i> $s_{t-1}$	-0.001** (0.001)	-0.002*** (0.001)	-0.001 (0.001)			
<i>Commodity import price shocks</i> $s_{t-1}$				0.001 (0.001)	0.005*** (0.001)	0.002* (0.001)
GDP growth	0.002*** (0.000)	0.001*** (0.001)	-0.000 (0.001)	0.002*** (0.001)	0.001*** (0.001)	-0.000 (0.001)
Electoral democracy index		-0.140*** (0.024)	-0.081** (0.033)		-0.142*** (0.024)	-0.082** (0.033)
Control of Corruption			0.045*** (0.011)			0.045*** (0.011)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes



Observations	6,331	5,948	3,295	6,331	5,948	3,295
R-squared	0.721	0.726	0.893	0.721	0.726	0.893
Number of countries	165	154	154	165	154	154
Number of years	47	47	22	47	47	22

Notes: The "Commodity export (res. import) price shocks" presents the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. GDP growth (% annual) and control of corruption (z-score) are sourced from World Development Indicators. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**PANEL C: Commodity Export and Import Price Shocks on Fiscal Rules, with Controls (level-log regression model)**

Dependent variables	FISCAL RULES					
Columns	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{Commodity export price shocks})_{t-1}$	0.333*** (0.079)	0.341*** (0.078)	0.361*** (0.106)			
$\ln(\text{Commodity import price shocks})_{t-1}$				-0.928*** (0.226)	-0.889*** (0.226)	-0.344 (0.274)
GDP growth	-0.002*** (0.001)	-0.002** (0.001)	-0.002 (0.001)	-0.002*** (0.001)	-0.002** (0.001)	-0.002 (0.001)
Electoral democracy index		0.139*** (0.039)	-0.163** (0.063)		0.133*** (0.039)	-0.166*** (0.064)
Control of Corruption			0.102*** (0.025)			0.100*** (0.025)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,306	4,062	2,266	4,306	4,062	2,266
R-squared	0.571	0.560	0.752	0.571	0.560	0.751
Number of countries	106	100	100	106	100	100
Number of years	49	48	23	49	48	23

Notes: The "Commodity export (res. import) price shocks" presents the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. GDP growth (% annual) and control of corruption (z-score) are sourced from World Development Indicators. Variable representing democracy is electoral democracy [0,1], is collected from the V-Dem Indicators dataset. In this sample, we exclude the top five world leading exporters of hydrocarbons, minerals, and agriculture based on 2022 data (e.g., the United States, Russia, Australia, Saudi Arabia, and Canada) to account for potential endogeneity associated with commodity price making. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**PANEL D: Commodity Export and Import Price Shocks on Financial Openness, with Controls (level-log regression model)**

Dependent variables	FINANCIAL OPENNESS					
Columns	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{Commodity export price shocks})_{t-1}$	-0.119*** (0.045)	-0.133*** (0.045)	-0.065 (0.044)			
$\ln(\text{Commodity import price shocks})_{t-1}$				0.060 (0.094)	0.414*** (0.115)	0.177* (0.104)
GDP growth	0.002*** (0.000)	0.001** (0.001)	-0.000 (0.001)	0.002*** (0.001)	0.001*** (0.001)	-0.000 (0.001)
Electoral democracy index		-0.140***	-0.081**		-0.142***	-0.083**

		(0.024)	(0.033)		(0.024)	(0.033)
Control of Corruption			0.045***			0.045***
			(0.011)			(0.011)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,331	5,948	3,295	6,331	5,948	3,295
R-squared	0.722	0.726	0.893	0.721	0.726	0.893
Number of countries	165	154	154	165	154	154
Number of years	47	47	22	47	47	22

Notes: The "Commodity export (res. import) price shocks" presents the windfall gains and losses in income associated with fluctuations in global prices, considering only export (res. import) prices. GDP growth (% annual) and control of corruption (z-score) are sourced from World Development Indicators. Stars denote significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Annex VII. Commodity Export and Import Price Shock and Exchange Rate Arrangements

PANEL A: Level-level regression model

Dependent variables	Exchange Rate Arrangements (6 categories)			Exchange Rate Arrangements (3 categories)		
	OLS	Tobit	Logit	OLS	Tobit	Logit
Estimators						
Columns	(1)	(2)	(5)	(12)	(13)	(16)
<i>Commodity export price shock</i> <sub><i>t</i>-1</sub>	-0.007*** (0.002)	-0.024*** (0.004)	-0.029*** (0.005)	-0.003*** (0.001)	-0.018*** (0.003)	-0.026*** (0.005)
<i>Commodity import price shock</i> <sub><i>t</i>-1</sub>	-0.002 (0.004)	-0.006 (0.007)	0.004 (0.007)	-0.002 (0.002)	-0.024*** (0.006)	-0.036*** (0.009)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,738	8,738	8,738	8,738	8,738	8,738
R-squared	0.507			0.450		
Number of countries	170	170	170	170	170	170
Number of years	57	57	57	57	57	57

PANEL B: Level-log regression model

Dependent variables	Exchange Rate Arrangements (6 categories)			Exchange Rate Arrangements (3 categories)		
	OLS	Tobit	Ologit	OLS	Tobit	Ologit
Estimators						
Columns	(1)	(2)	(5)	(12)	(13)	(16)
<i>Ln(Net export price shock)</i> <sub><i>t</i>-1</sub>	-0.383*** (0.128)	-1.291*** (0.310)	-1.640*** (0.338)	-0.138** (0.065)	-0.847*** (0.245)	-1.230*** (0.388)
Countries Fes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,738	8,738	8,738	8,738	8,738	8,738
R-squared	0.506			0.450		
Number of countries	170	170	170	170	170	170
Number of years	57	57	57	57	57	57

## Annex VIII. Commodity Export and Import Price Shock and Loan to Value limits (Quarterly data)

Dependent variable	Average of the regulatory loan-to-value (LTV) limits	
	(1)	(2)
<i>Commodity export price shock<sub>t</sub></i>		0.034 (0.024)
<i>Commodity import price shock<sub>t</sub></i>		-0.311*** (0.042)
<i>Net export price shock<sub>t</sub></i>	0.092*** (0.022)	
Countries Fes	Yes	Yes
Time Fes	Yes	Yes
Observations	7,334	7,334
R-squared	0.661	0.663
Number of countries	60	60
Number of quarters	128	128

Notes: the dependent variable represents the simple average of the regulatory loan-to-value (LTV) limits (LTV\_average). In Column [1], the dependent variable represents the simple average of the regulatory loan-to-value (LTV) limits (LTV\_average). It specifically focuses on LTV limits for real estate mortgage loans (both residential and commercial), while dummy-type indicators and text information may cover other types of loans (e.g., auto loans). If a country does not have any LTV limits, the value is set at 100.

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# PUBLICATIONS

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