Macroeconomic Stability in World-Commodity Countries

Fabrizio Ardiles Decker
The University of Nottingham

September 8, 2026

Abstract

South American economies are deeply exposed to world commodity prices; shocks pass quickly to producer costs and the exchange rate, while most central banks target CPI under heterogeneous FX regimes. This raises a design question: which monetary framework best stabilizes inflation and activity in commodity exporters?. This paper investigates the question by (i) estimating a SVAR to gauge the roles of global commodity and external financial shocks in regional inflation and policy rates, and (ii) building and estimating (on Chile) a New Keynesian small open-economy model with a commodity-exporting sector. I compare CPI targeting, PPI targeting, and a PPI+exchange-rate-smoothing rule. Empirically, commodity shocks dominate price dynamics; PPI responds far more than CPI, and policy rates react weakly. In the model, strict PPI stabilizes inflation better than CPI but raises output and rate volatility; the hybrid rule breaks this trade-off, anchoring prices while damping imported volatility. Moreover, welfare favors the hybrid regime: gains up to 1.6% of steady-state consumption versus CPI targeting (about 0.8% versus strict PPI).

Keywords: South America, Commodities, Price Targeting

1 Introduction

South American economies are structurally exposed to world commodity markets. Metals, hydrocarbons, and agricultural products account for a large fraction of export revenues and, in several countries, for a nontrivial share of domestic income (International Monetary Fund (2017)). External price movements thus transmit rapidly to domestic costs, producer prices, and the exchange rate, shaping inflation dynamics and complicating monetary stabilization (Auer et al. (2017)). Yet the prevailing institutional arrangement in the region remains a consumer price index (CPI) inflation–targeting regime, implemented under heterogeneous exchange-rate arrangements. This juxtaposition of supply-side exposure and demand-centric policy anchors motivates the central question of this paper: if exogenous movements in global commodity prices are a key driver of domestic inflation in South America, which monetary policy framework best stabilizes prices and activity in these economies?

To make the problem concrete, Table 1 summarizes four stylized features that frame policy design for the region. First, all South American countries are top global exporters of at least one major commodity—copper for Chile and Peru, soybeans for Brazil and Paraguay, lithium for Argentina and Bolivia, among others—so terms-of-trade fluctuations are a systematic, not idiosyncratic, source of macro shocks. Second, the ratio of leading commodity exports to total expots is sizable—often well above ten percent (excluding Argentina and Colombia), indicating that commodity price movements are macrocritical rather than sectoral (see Fernández et al. (2017) and Gruss and Kebhaj (2019)). Third, despite the production-side nature of these shocks, monetary institutions overwhelmingly target CPI rather than producer prices (PPI): Brazil, Bolivia, Colombia, Peru, Chile, Argentina, and Paraguay operate CPI-focused frameworks, while Ecuador is dollarized. Fourth, exchange-rate arrangements vary widely: some countries float (e.g., Brazil, Paraguay), others fix (Bolivia, Ecuador), and several adopt managed floats with episodic interventions (Colombia, Peru, Chile, Argentina). These four columns together pose a clear design problem: the dominant shocks originate in costs and external prices, but policy frameworks center on consumer prices and operate under heterogeneous currency regimes.

The paper asks whether commodity shocks are the primary force behind inflation fluctuations in South America; whether the prevailing CPI-based policy rule is well aligned with those shocks; and, conditional on the answers, which rule minimizes macroeconomic volatility and improves welfare in commodity-dependent small open economies. The empirical starting point is a structural vector autoregression (SVAR) estimated on a broad sample of South American countries to quantify the relative importance of global commodity price shocks and foreign financial shocks for domestic inflation and policy rates. The SVAR evidence points to two robust facts. First, commodity shocks are a dominant

Country	Commodity	X^o to World	Share of total X (%)	MP	ER Regime
Chile	Copper	(+2)	56.8	CPI	Managed
Bolivia	Zinc	(+6)	13.2	CPI	Fixed
Peru	Copper	(+1)	25.2	CPI	Managed
Paraguay	Soybean	(+4)	24.9	CPI	Free
Brazil	Soybean	(+4)	14.7	CPI	Free
Ecuador	Banana	(+1)	12.7	Dollarized	Fixed
Argentina†	Lithium	(+2)	1.07	CPI	Managed
Colombia‡	Emeralds	(+1)	1.00	CPI	Managed

Table 1: South America as commodity exporter; export exposure; stated policy target (CPI vs. PPI); and exchange-rate arrangement.

Notes: Column (1) ranks each country among world exporters of its leading commodity; Column (2) reports the ratio of that commodity's exports to total exports; Column (3) lists the announced inflation target; Column (4) classifies the exchange-rate regime. † Argentina's figure refers to lithium carbonate exports within total goods; it is a processed chemical and not always included in "primary commodity" bundles. ‡ Colombia's figure refers to HS-7103 (emeralds and other precious stones).

driver of price dynamics in the region, and their imprint is far stronger on producer prices than on consumer prices. Second, the historical response of policy rates to commodity-driven inflation is limited and appears more sensitive to external financial conditions than to the cost-push pressures arising from global commodity markets. Together, these facts suggest a misalignment between the main inflation impulse and the policy indicator that central banks currently emphasize.

Guided by these findings, the paper uses and estimates a New Keynesian small open economy model tailored to commodity exporters which builds on Ferrero and Seneca (2019a). The framework augments the canonical open-economy model by introducing an offshore export sector that transforms domestic intermediate goods into commodities sold at exogenous world prices. This production structure generates a direct, cost-based channel from global commodity prices to domestic marginal costs and PPI inflation. Monetary policy follows a Taylor-type rule that can be configured to respond to CPI inflation, to PPI inflation, and—reflecting regional practice—to movements in the exchange rate. The model is estimated on Chile, an archetypal commodity exporter in South America with high export-to-GDP exposure and an inflation-targeting framework that coexists with periodic foreign-exchange interventions. The Chilean estimation disciplines key parameters, pins down the persistence and volatility of commodity shocks, and provides a laboratory for policy counterfactuals.

Three sets of results emerge. First, in the data, commodity shocks consistently raise both CPI and domestic producer prices, but the effect on PPI is markedly larger and more persistent. This wedge implies that a CPI-only policy anchor downweights precisely the component of inflation that commodity cycles move the most. The variance and historical decompositions corroborate that commodity shocks account for a large share of

inflation episodes across the region, whereas their contribution to interest-rate movements is comparatively small.

Second, in the model, strict PPI targeting stabilizes inflation more effectively than CPI targeting but at the cost of higher output volatility. Under a CPI rule, interest-rate responses are too weak relative to cost-push inflation, so inflation persistence is higher and stabilization is slower. Under a PPI rule, policy reacts aggressively, expectations re-anchor more quickly, and inflation disinflates faster, but the short-run output contraction is sharper because the required interest-rate path is steeper. These dynamics replicate the core trade-off monetary authorities face when supply shocks dominate, and they arise from the model's explicit cost channel linking world prices to domestic marginal costs.

Third, a hybrid regime that combines a strong response to PPI with exchange-rate smoothing substantially relaxes the inflation–output trade-off. Because exchange-rate movements are a key conduit of imported volatility, explicitly smoothing the exchange rate in the policy rule attenuates excessive pass-through without relinquishing the cost-based inflation anchor. Quantitatively, the hybrid regime stabilizes CPI and PPI nearly as effectively as strict PPI targeting, while delivering a much smaller decline in output and lower interest-rate volatility. A welfare analysis based on a quadratic loss function shows that this hybrid rule yields gains of up to 1.6 percent of steady-state consumption relative to CPI targeting and about 0.8 percent relative to strict PPI targeting, with especially large marginal benefits from increasing the response to exchange-rate fluctuations. The welfare surface over the policy space confirms that stabilizing the exchange rate is a critical complement to a cost-based inflation anchor in commodity-dependent economies.

These results speak directly to the four descriptive columns in Table 1. Being top global exporters means that exogenous world prices—not domestic demand—drive key relative prices facing producers; large commodity share of total exports ratios make those external impulses macrocritical; CPI-centered regimes underweight the prices most affected by commodity shocks; and heterogeneous exchange-rate practices indicate that in reality policy already relies, to varying degrees, on the foreign-exchange instrument. The model formalizes this institutional reality and shows that a framework combining a PPI anchor with measured exchange-rate management expands the feasible policy frontier, delivering lower inflation variability without incurring excessive real-side volatility.

The paper contributes to the literature along complementary margins. Empirically, it provides region-wide evidence that commodity shocks dominate inflation dynamics in South America, that producer prices bear the brunt of these shocks, and that interest-rate settings have historically responded weakly to them. Theoretically, it implements a small open economy model with an explicit commodity-exporting sector that uses domestic intermediates, thereby delivering a production-side pass-through from world prices to domestic inflation absent from many canonical frameworks. For policy design, it offers a transparent comparison of CPI targeting, PPI targeting, and a PPI-plus-exchange-

rate-smoothing rule that comports with the institutional realities of managed floats and limited interventions in the region. Normatively, it provides a welfare ranking that favors the hybrid regime and quantifies the gains relative to status quo practice, clarifying when and why exchange-rate management is welfare improving rather than a mere operational detail.

Finally, the analysis offers practical guidance for central banks in commodity-exporting economies. In environments where external price shocks are persistent and pass-through to marginal costs is strong, a cost-based inflation anchor is better aligned with the structure of inflation than a consumer-price anchor, and explicit exchange-rate smoothing is an essential complement rather than an ad hoc add-on. These conclusions do not require abandoning inflation targeting; rather, they call for re-centering the target on domestic inflation pressures and recognizing the stabilizing role of the exchange-rate instrument in a transparent, rules-based framework.

2 Related Literature

This paper contributes to two strands of the literature. First, on the empirical side, it relates to work documenting the macroeconomic salience of commodity shocks in emerging markets. Early contributions show that terms-of-trade movements are first-order drivers of fluctuations in inflation and activity across the region, with effects mediated by exchange-rate regimes and the choice of policy target (CPI versus domestic prices) (e.g., Frankel and Rose (2008); Céspedes and Soto (2012)). A complementary line of research emphasizes the role of global demand and financial conditions—U.S. rates, risk premia, and the global dollar cycle—in shaping business cycles and policy in emerging economies (Ahmed et al. (2017), Fernandez et al. (2015), Rey (2015)). At the same time, work on international price transmission documents that external cost shocks propagate swiftly to domestic producer prices via input–output linkages, helping explain the synchronization of PPI inflation across countries (Auer et al. (2017)). Studies on commodity markets and world price formation further rationalize why these shocks are largely exogenous from the vantage point of small open commodity exporters (Kilian (2009), Jacks et al. (2011), Chen et al. (2010), Aastveit et al. (2016)).

Within this empirical tradition, the paper makes three contributions. First, using a SVAR for south american countries, it quantifies the *relative* importance of commodity price shocks vis-à-vis external financial shocks in driving domestic prices and policy rates, thereby unifying two literatures that are often studied separately—commodity cycles and the global financial cycle. The identification and measurement strategy build on established VAR approaches in open economies and monetary policy (Bernanke et al. (2005), Canova and Pina (2005), Bjørnland and Halvorsen (2013), Kilian and Vega (2011)). Second, the estimates show that producer prices respond much more strongly than consumer

prices to commodity disturbances, while ex-post policy rates react weakly—evidence that aligns with theories of cost-push transmission and with the view that CPI targets underweight the margin most exposed to external price swings (Bernanke et al. (1997)). Third, the historical decompositions and FEVDs provide a region-wide perspective focused on commodity exporters, complementing country studies and offering a systematic benchmark for South America where exposure to a few world commodities is large in GDP terms. In this sense, the paper fills an empirical gap by placing commodity shocks and foreign financial shocks on the same footing within a single identification scheme tailored to the institutional realities of the region.

Second, on the theoretical side, the paper speaks to the open-economy New Keynesian literature on optimal monetary policy under external disturbances. Canonical small-open-economy models with nominal rigidities provide the benchmark for welfare analysis and policy design (Galí and Monacelli (2005); Galí (2011); Justiniano and Preston (2010)). In the context of commodity producers, a central insight is that world-price shocks act through marginal costs and the terms of trade, generating inflation–output trade-offs for policy (Bodenstein et al. (2011)). A related normative literature shows that when supply shocks dominate, targeting domestic inflation—proxied by producer prices—can improve welfare relative to CPI targeting in small open economies (De Paoli (2009); Monacelli (2005)). Recent contributions further argue that in externally vulnerable economies, optimal or implementable rules should acknowledge the exchange rate explicitly to balance internal and external stability (Corsetti et al. (2012), Adler and Magud (2019)).

The paper advances this theoretical agenda in three ways. First, it embeds a commodity-exporting sector that *uses domestic intermediates* into the New Keynesian small-open-economy framework, following the commodity–production structure emphasized by Ferrero and Seneca (2019b) and Ferrero and Seneca (2019a). This feature delivers a direct, production-side pass-through from world commodity prices to domestic marginal costs and PPI inflation that is absent from many baseline models. Second, it estimates the augmented model on Chile—an archetypal South American commodity exporter—thereby disciplining the quantitative transmission mechanism and policy trade-offs with country data rather than calibrations detached from the region. Third, it compares standard CPI targeting with two alternatives: strict PPI targeting and a hybrid rule that targets PPI while smoothing exchange-rate fluctuations. In contrast to earlier theoretical work that stops at qualitative comparisons or excludes FX smoothing, the paper delivers a welfare ranking and shows that the hybrid rule materially expands the policy frontier, achieving near-PPI stabilization with less output and interest-rate volatility (Bodenstein et al. (2011); Corsetti et al. (2012)).

Taken together, the empirical and theoretical strands are mutually reinforcing. The SVAR evidence that commodity shocks dominate inflation dynamics while policy rates respond weakly rationalizes why CPI-only rules underperform in commodity exporters, and mo-

tivates a cost-based anchor. The structural model, estimated on South American data, explains the mechanism—world prices raise domestic marginal costs through the export sector's demand for home intermediates—and clarifies why adding exchange-rate smoothing is welfare improving when terms-of-trade shocks are persistent. In doing so, the paper bridges empirical documentation of price transmission (Auer et al. (2017)) with normative prescriptions on targets and instruments (De Paoli (2009); Corsetti et al. (2012)), and offers a region-specific benchmark for the design of resilient monetary frameworks in commodity-dependent small open economies.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 analyzes the impact of commodity price shocks across South American economies using country-level evidence. Section 4 presents the baseline model, describes the data and the estimation, and discusses the main results of the model as well as of a welfare analysis. Section 5 presents policy discussions. Section 6 concludes. Complementary analysis is provided in Appendix.

3 How important are commodities for SA?

This section establishes the empirical relevance of commodities for South American (SA) macroeconomic dynamics. I quantify the contribution of commodity-price shocks—relative to external financial disturbances—to inflation and monetary policy in SA by estimating a SVAR on quarterly data for each south american country. The section proceeds as follows: it links the descriptive facts in Table 1 to an econometric framework tailored to each country's leading export commodity; it then details the SVAR specification and identification, and reports three complementary pieces of evidence—forecast error variance decompositions, impulse responses to commodity shocks, and historical shock decompositions. Together, these results document that commodity shocks are a first-order driver of price dynamics across SA, whereas policy rates respond primarily to global financial conditions. The section thereby motivates the model-based analysis that follows, where alternative monetary policy rules are evaluated in an environment that embeds the commodity channel measured here.

Emerging and developing economies are especially vulnerable to global macro-financial conditions, and South America is no exception. A large body of empirical literature has shown that foreign shocks—including fluctuations in global demand, changes in U.S. interest rates, and shifts in international risk premia—play a significant role in shaping macroeconomic dynamics in the region. Studies such as Rey (2015), Fernandez et al. (2015), and Ahmed et al. (2017) demonstrate that domestic variables like output, inflation, and interest rates are often tightly linked to movements in global financial and economic conditions. However, while the importance of foreign financial shocks is well documented, there has been relatively less emphasis on systematically comparing their

impact with that of global commodity price shocks—despite the fact that South American economies are structurally reliant on natural resource exports. This section aims to fill this gap by estimating a Structural Vector Autoregression (SVAR) model to assess and compare the relative importance of foreign financial shocks and commodity price shocks in driving inflation and monetary policy dynamics in South America. The SVAR framework allows us to identify the interactions among key economic variables while imposing theoretically grounded restrictions to achieve identification.

3.1 The SVAR Representation

Let x_t collect the external and domestic variables for a given South American country,

$$x_t = \begin{bmatrix} z_t \\ d_t \end{bmatrix} \qquad \text{with} \qquad z_t = \left(y_t^*,\, i_t^*,\, s_t^*,\, p_t^c\right)', \quad d_t = \left(y_t,\, \pi_t,\, i_t,\, e_t\right)'.$$

The reduced-form VAR(p) is

$$x_t = c + \sum_{\ell=1}^{p} A_\ell\, x_{t-\ell} + u_t, \qquad u_t \sim (0, \Sigma_u), \tag{1}$$

where c contains deterministic terms (intercept and, where appropriate, seasonal dummies), A_ℓ are coefficient matrices, and u_t are reduced-form innovations with covariance matrix Σ_u.

Consistent with the small-open-economy assumption, the system is estimated under *block exogeneity* of the external block: lags of domestic variables do not enter the equations for z_t. Formally, for each lag ℓ,

$$A_\ell = \begin{bmatrix} A_\ell^{zz} & 0 \\ A_\ell^{dz} & A_\ell^{dd} \end{bmatrix}, \tag{2}$$

so global conditions evolve independently of domestic shocks within the VAR, while domestic variables may depend on past external variables.

Structural shocks ε_t are linked to reduced-form innovations by

$$u_t = B_0 \varepsilon_t, \qquad \mathbb{E}[\varepsilon_t \varepsilon_t'] = I, \tag{3}$$

implying $B_0 B_0' = \Sigma_u$. Let $\Sigma_u = PP'$ denote the Cholesky factorization of Σ_u and parameterize $B_0 = PQ$, where Q is orthonormal ($QQ' = I$)[1]

[1]For each draw of reduced-form parameters from the posterior, rotations Q are drawn from the Haar measure and retained only if the associated impulse responses satisfy the sign and short-horizon inequality restrictions, together with the impact restrictions implied by block exogeneity, described in Section 3.3.

3.2 Selection of Variables

The external block comprises (i) foreign output y_t^*, proxied by a composite measure of global activity; (ii) the U.S. short-term policy rate i_t^*; (iii) a global risk-premium/spread s_t^* capturing time-varying external financial conditions; and (iv) the world price of the country's leading export commodity p_t^c. The domestic block includes (i) real output y_t; (ii) price inflation π_t; (iii) the monetary-policy rate i_t; and (iv) the bilateral nominal exchange rate e_t, defined so that an increase denotes a depreciation.

3.3 Structural Identification

To move beyond a purely recursive timing scheme and deliver a *structural* VAR, I identify economically interpretable shocks using a combination of block exogeneity and *sign restrictions* imposed on impact and over short horizons. The approach follows Uhlig (2005), Rubio-Ramírez et al. (2010) and Arias et al. (2018). For each South American country I estimate a country–specific VAR in the vector

$$x_t = \left(y_t^*,\, i_t^*,\, s_t^*,\, p_t^c \;\middle|\; y_t,\, \pi_t,\; i_t,\, e_t\right)',$$

The VAR uses p lags chosen by BIC within $\{2, \ldots, 6\}$ and includes standard deterministic terms (intercept and, where appropriate, seasonal dummies). I treat the "external" block $(y_t^*, i_t^*, s_t^*, p_t^c)$ as block-exogenous with respect to domestic shocks, a small-open-economy assumption that is weaker than recursive timing and is maintained throughout inference. Five structural shocks are identified: a global demand shock (GD), a U.S. monetary policy shock (USMP), a global risk–premium shock (RP), a commodity–supply shock (CS), and a domestic monetary policy shock (MP). Identification is achieved by searching over orthonormal rotations of the reduced-form innovations and retaining only those rotations whose implied impulse responses satisfy the following *sign* pattern on impact and, unless stated otherwise, for the first four quarters ($h = 0, \ldots, 4$). "+" and "−" denote nonzero restrictions; blanks are left unrestricted.

	y^*	i^*	s^*	p^c	y	π	i	e
Global demand (GD)	+			+	+	+	+	−
U.S. monetary (USMP)	−	+		−	−	−	+	+
Risk premium (RP)	−		+	−	−		−	+
Commodity supply (CS)	−/0			+		+	+	−
Domestic MP (MP)					−	−	+	−

Table 2: Structural Identification

Three remarks are in order. First, block exogeneity implies that domestic shocks cannot move $(y_t^*, i_t^*, s_t^*, p_t^c)$ on impact; all restrictions shown for the external variables are there-

fore satisfied by construction for MP. Second, the USMP shock follows the conventional external tightening pattern (foreign rate up, global demand and commodity prices down, domestic depreciation and disinflation). Third, the commodity–supply shock is defined as an *exogenous* increase in the world price of the country's leading commodity that raises domestic producer costs, appreciates the currency (a lower e_t) via an improved terms of trade, and induces a policy tightening; it is allowed to have zero or negative effects on foreign output on impact. To address potential label-switching between GD and CS, I also impose that GD delivers a strictly larger median response of foreign output than CS at $h = 4$; this weak inequality resolves the labeling without forcing long-run neutrality.
The identification is consistent with established SVAR practice rather than an ad hoc ordering. Block exogeneity of the foreign block is standard in small–open-economy VARs and follows Cushman and Zha (1997), Kim and Roubini (2000), Dungey and Pagan (2000), and Bjørnland (2009), among others. The use of sign and (short-horizon) inequality restrictions to recover economically interpretable shocks builds on Uhlig (2005), with formal conditions for identification and inference as in Rubio-Ramírez et al. (2010) and Arias et al. (2018). The external U.S. monetary policy shock—higher foreign interest rates, weaker global demand and commodity prices, domestic depreciation and disinflation—matches the sign patterns widely used in open-economy VARs of monetary transmission [e.g. Kim and Roubini (2000), Scholl and Uhlig (2008), Bjørnland and Halvorsen (2014)]. The commodity-supply shock is identified as an exogenous rise in the world price of the country's leading commodity that raises domestic producer costs, appreciates the currency via the terms of trade, and induces a policy tightening; analogous commodity (oil) supply restrictions are standard in Kilian (2009), Kilian and Murphy (2014), Aastveit et al. (2015), and Peersman and Van Robays (2012). The risk-premium shock—higher global spreads, depreciation, and domestic contraction with a policy easing—follows the small-open-economy SVAR tradition of isolating financial shocks Dungey and Pagan (2000), Miranda-Agrippino and Rey (2020). Finally, to avoid label switching between external demand and commodity-supply disturbances, I require that the median response of foreign output to the global-demand shock at $h = 4$ exceed that to the commodity-supply shock, an inequality restriction akin in spirit to the demand–supply separation in commodity-market SVARs Kilian (2009)[2].

[2]Two features of the identification are worth highlighting. Because the external block is treated as exogenous and the signs are imposed on both external and domestic variables, the CS shock no longer inherits its dynamic profile from the ordering of variables; its effects are filtered out from those of global demand by the joint behavior of p_t^c and y_t^*. Likewise, domestic monetary policy shocks are separated from risk-premium tightening by the opposite restrictions on the exchange rate and the policy rate. These refinements ensure that the SVAR results reported below are not artifacts of recursive timing, and they provide a transparent mapping between the empirical shocks and the mechanisms featured in the model of Section 4.

3.3.0.1 Estimation and inference. I estimate a Bayesian VAR with a Minnesota prior (tightness $\lambda_1 = 0.2$ on own lags, $\lambda_2 = 0.5$ on cross lags, and decay parameter $\lambda_3 = 1$); results are robust to standard alternatives. For each country I draw 10,000 posterior samples of the reduced-form parameters and the residual covariance matrix, and for each draw I generate random orthonormal matrices Q until one satisfies the restrictions above (impact and $h \leq 4$). I report median impulse responses and 68 percent posterior credible sets across accepted draws; FEVDs and historical decompositions are computed shock by shock for the accepted rotations. Acceptance rates exceed 80 percent in every country, indicating that the restrictions are not overly tight.

All series are quarterly; output is in (log) levels, inflation rates are quarter-over-quarter annualized, interest rates and spreads are in percentage points, and the exchange rate is in logs. Country-specific sample windows reflect data availability; the lag order $p \in \{2, \ldots, 6\}$ is selected by BIC. Deterministic components include an intercept and, where needed, country-specific seasonal dummies. The partition in (2)—rather than a recursive ordering—delivers the small-open-economy structure in estimation; identification of economically interpretable shocks is obtained through the sign and inequality restrictions described in Section 3.3.

3.4 Data and Measurement

This subsection documents the construction of all series used in the SVAR and in the model estimation, and provides precise sources. The sample covers Peru, Bolivia, Ecuador, Argentina, Paraguay, Brazil, Chile, and Colombia; the external block is the United States and global aggregates. The frequency is quarterly from 1996Q1 to 2024Q2, constrained by the shortest country–series span. Unless noted otherwise, series enter in logs; inflation rates are quarter-over-quarter annualized log differences; interest rates and spreads are in percentage points; and exchange rates are defined so that an increase denotes a depreciation of the domestic currency against the U.S. dollar. When official series are not seasonally adjusted, I apply X-13ARIMA-SEATS to the monthly data prior to temporal aggregation. All country series are demeaned before estimation.

3.4.0.1 External block. Global real activity y_t^* is proxied by the *world industrial production* index from the CPB World Trade Monitor, aggregated to quarters by averaging (robustness replaces this with OECD+Major Six IP or U.S. real GDP).[3] The foreign short rate i_t^* is the U.S. 3-month Treasury bill (secondary market) from the Board of Governors / FRED, quarterly averaged. The global risk premium s_t^* is the (log) CBOE VIX quarterly average; robustness uses the ICE BofA U.S. High-Yield OAS and J.P.

[3] CPB World Trade Monitor, world industrial production index.

Morgan EMBI Global spread.[4] The commodity price p_t^c is the country-specific benchmark (in USD) from the IMF Primary Commodity Prices Database or the World Bank *Pink Sheet*, deflated by the U.S. CPI to obtain a real price and averaged to quarters.[5]

3.4.0.2 Domestic block. Real output y_t is seasonally adjusted real GDP from national statistical offices or IMF/IFS; when only nominal GDP is available at the quarterly frequency for early years, I deflate with the CPI and splice at the overlap. Domestic price inflation π_t is taken from the IMF/IFS or national statistical offices[6]; The policy rate i_t is the target short policy rate published by each central bank (Selic for Brazil, MPR for Chile, reference policy rate for Peru and Colombia, monetary policy rate for Paraguay and Bolivia). For Ecuador (dollarized), I use the interbank reference rate as the monetary policy indicator. The bilateral nominal exchange rate e_t is the end-of-month or quarterly average domestic currency per U.S. dollar from IMF/IFS; robustness employs the BIS broad nominal effective exchange rate.[7]

3.4.0.3 Country–commodity mapping. For each SA country I take the leading exported commodity and assign the corresponding global price: copper (Chile, Peru), zinc (Bolivia), soybean (Brazil, Paraguay), lithium carbonate (Argentina), bananas (Ecuador), and precious stones for emeralds (Colombia). Copper, zinc, soybean, silver and bananas are from IMF/World Bank benchmark series. Lithium carbonate is available from 2017Q1; I back-cast to 1996 using the World Bank battery-metals composite and the metal price index via a chained growth-rate splice, and treat the splice as a robustness dimension. For emeralds there is no liquid global spot; I construct a quarterly export unit-value index for HS-7103 using DANE customs microdata and UN Comtrade, deflated by the U.S. CPI; robustness replaces this proxy with the World Bank precious-stones price index[8] (see Table 2)[9]

[4] CBOE VIX; ICE BofA U.S. High-Yield Option-Adjusted Spread; J.P. Morgan EMBI Global.

[5] IMF Primary Commodity Prices (various series) and World Bank *Pink Sheet*.

[6] This variables is calculated as the weighted average between the consumer and the producer index

[7] IMF International Financial Statistics (IFS); national statistical offices and central banks; Bank for International Settlements (BIS) effective exchange rates.

[8] UN Comtrade HS-7103; DANE (Colombia) customs unit values; World Bank precious-stones index.

[9] Monthly series are aggregated to quarters by arithmetic means (rates/spreads) or end-of-period for stocks; inflation rates are computed as $400\,\Delta\log(\text{index})$ (annualized). Interest rates measured in annual percent are divided by four when the VAR is estimated in quarterly percent units. Commodity prices in U.S. dollars are expressed in logs and deflated by U.S. CPI to avoid confounding pass-through from dollar inflation. Outliers due to known price freeze episodes or denomination changes are winsorized at the 0.5/99.5 percentiles prior to differencing.

Variable	Symbol	Source	Construction / Notes
World industrial production	y_t^*	CPB WTM	Monthly IP $\rightarrow$ quarterly average; log level; demeaned.
U.S. short rate	i_t^*	Board of Governors / FRED (TB3MS)	3-month T-bill, quarterly average, percent.
Global risk premium	s_t^*	CBOE VIX (baseline); ICE BofA HY OAS; EMBI	log(VIX); robustness to HY OAS and EMBI Global.
Commodity price (country-specific)	p_t^c	IMF PCP; WB Pink Sheet	USD benchmark price; deflated by U.S. CPI; log; quarterly average; lithium spliced; emeralds proxy via unit values.
Real GDP (SA)	y_t	NSOs; IMF/IFS	Seasonally adjusted real GDP; when needed, nominal GDP deflated by CPI and spliced.
Price index	π_t	NSOs; IMF/IFS	$400\,\Delta \log(\text{CPI})$.
Policy rate	i_t	Central banks	Target policy rate (Selic, MPR, etc.); Ecuador: interbank reference.
Bilateral USD exchange rate	e_t	IMF/IFS	Domestic currency per USD; log; increase = depreciation; robustness: BIS NEER.

Table 2: Variables, sources, and construction

3.5 Data description

South America plays a significant role in global commodity exports, as illustrated in Table 1. Each country in the region is ranked among the top exporters of at least one key commodity, highlighting the region's strategic economic importance. Bolivia for instance, is among the top six global exporters of zinc and Argentina ranks fourth in lithium exports globally. The table further demonstrates South America's dominance in both the agricultural and mineral commodity markets: Paraguay and Brazil are key soybean exporters (both ranking fourth), while Peru and Chile lead in copper exports, holding the first and second positions, respectively. Ecuador is a leading banana exporter, and Colombia is the global leader in that category.

Importantly, the column in Table 1, labeled as *X°/GDP (%)*, shows the ratio of each country's top commodity exports to its GDP. This metric captures the domestic macroeconomic relevance of each commodity, beyond its global rank. For example, while Ar-

gentina is only the fourth-largest lithium exporter, lithium exports still account for 12% of its GDP—underscoring their structural importance for the national economy. Likewise, in Bolivia, zinc exports account for 22% of GDP, highlighting the vulnerability of domestic output to commodity price fluctuations. The X°/GDP ratio thus signals the exposure of each country's economy to commodity cycles, which is central to understanding the transmission of external shocks and the need for tailored macroeconomic policy responses.

Columns 3 and 4 in Table 1 —global export ranking and export to GDP ratio— jointly illustrate both the international significance and the domestic dependence on specific commodities in South American economies. A country may be a top global player in a given commodity (e.g., Chile in copper or Colombia in emeralds), but the macroeconomic implications are best understood by also considering the size of those exports relative to GDP. For instance, both Chile and Bolivia not only rank among the top exporters of copper and zinc, respectively, but also show high X°/GDP ratios (25% and 22%), reflecting strong internal dependence on those revenues. This dual lens is crucial: while global export rank signals external market exposure and geopolitical leverage, the X°/GDP ratio highlights internal macroeconomic fragility and policy sensitivity to commodity shocks. Together, these metrics motivate the inclusion of commodity price shocks in the SVAR model and support the need for monetary policy frameworks tailored to commodity dependence[10]. Next, I present the results of the SVAR estimation.

3.6 Results

Figure 1 presents the results of the Forecast Error Variance Decomposition (FEVD) analysis for all South American countries, focusing on the contributions of commodity and external shocks to inflation[11] and interest rates. These two macroeconomic variables are the only ones that exhibit a consistent pattern across all countries, making them the central focus of this analysis.

The findings reveal that inflation is primarily driven by commodity shocks, suggesting that fluctuations in commodity prices play a key role in shaping inflationary dynamics in South American economies. This is evident in the FEVD of Prices, where the contribution

[10]The data presented in Table 1 underscores the outsized role of SA economies in global commodity markets. Every listed country exhibits a commodity export-to-GDP ratio above 10%, with Chile reaching as high as 25%. This high exposure is particularly noteworthy when compared to other commodity-exporting nations such as Canada or Australia, where the same ratio typically hovers between 6% and 12%, depending on global price fluctuations and production cycles. In advanced economies with more diversified export bases, such as the United States or Germany, the ratio falls below 5%. The figures suggest that South American economies are uniquely vulnerable to global commodity price shocks, as external demand fluctuations directly impact a large share of domestic output. This structural characteristic highlights the need for monetary policy frameworks in the region to account for commodity-driven external volatility more explicitly than in other parts of the world.

[11]Recall that inflation is defined as the weighted average between CPI and PPI inflation

of commodity-specific shocks (marked as A in the graphs) is significantly larger compared to other external factors. For instance, in countries such as Brazil and Paraguay, soybean price shocks are a dominant factor in inflationary trends, while inflation in Chile and Peru show a strong dependence on copper prices. Similarly, lithium price fluctuations in Argentina and Bolivia have a relevant impact on domestic inflation, reflecting the growing importance of this resource. These results underscore the structural dependence of South American economies on commodity markets, making them particularly vulnerable to external price shocks.

In contrast, the FEVD of Interest Rates suggests that monetary policy is only weakly influenced by commodity shocks (highlighted as B in the graphs). Instead, interest rate dynamics are primarily driven by external financial factors, such as global demand conditions and financial spreads. This indicates that central banks in South America may not be systematically incorporating commodity price fluctuations into their interest rate policy rules. However, given that commodity shocks are shown to be a key driver of inflation, this lack of response suggests a potential gap in monetary policy frameworks. If central banks do not account for commodity price shocks when setting interest rates, they may be underestimating an important source of inflationary pressure, potentially affecting macroeconomic stability in the region.

These results highlight the complex relationship between commodity markets, inflation, and monetary policy in South America. While commodity prices are a major determinant of inflation, the prevailing monetary policy stance appears to be relatively insulated from these fluctuations. This misalignment raises important questions about the effectiveness of current monetary policy frameworks in economies that are structurally dependent on commodity exports. A more integrated approach that explicitly considers commodity price shocks in monetary decision-making could enhance policy effectiveness in stabilizing inflation.

A comprehensive FEVD analysis covering all macroeconomic fundamentals is presented in the appendices, providing a broader view of the role of commodity shocks in shaping South American economies.

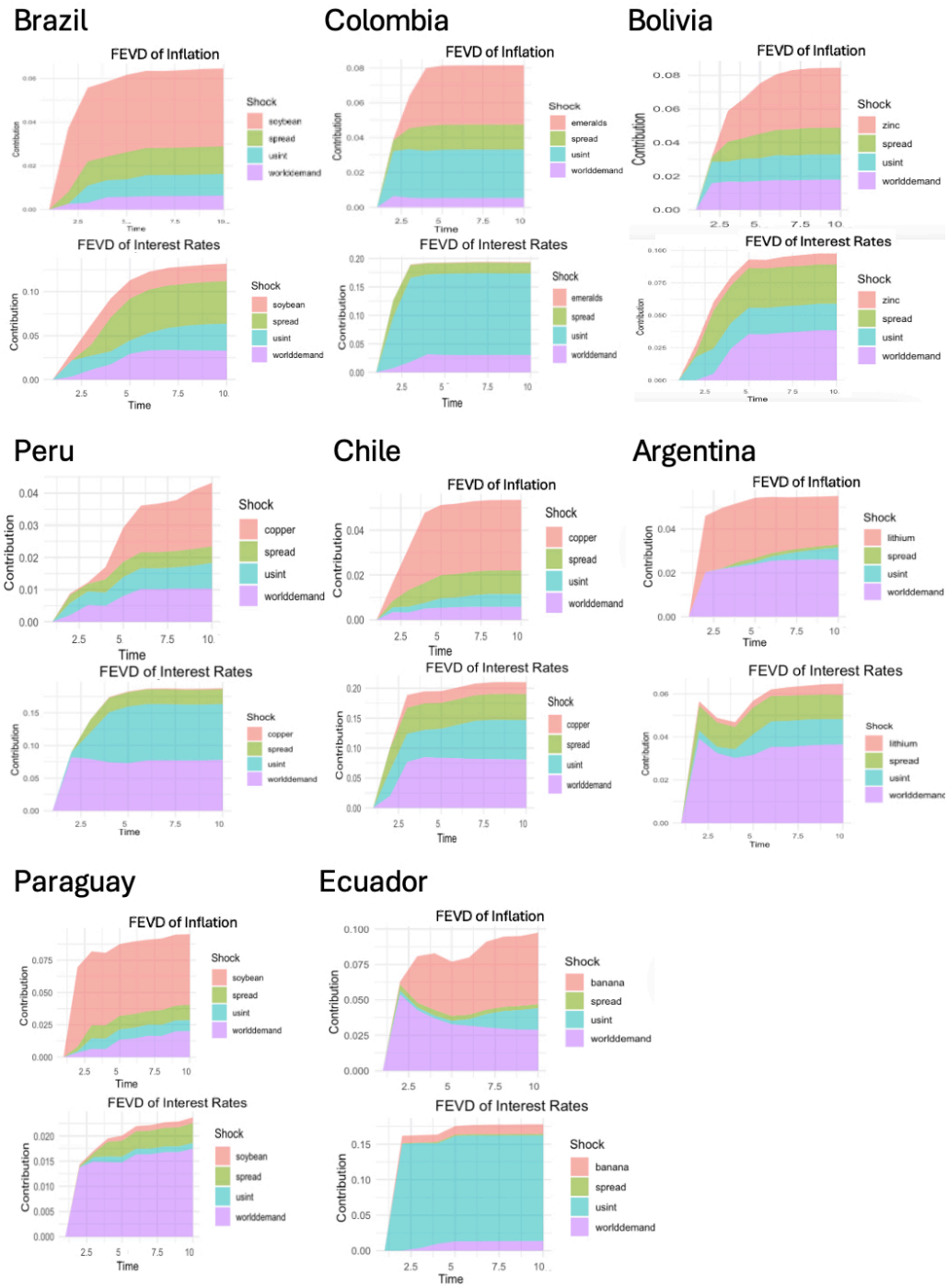


Figure 1: FEVD - Contribution of Foreign/Commodity shocks on each SA variable

Figure 2 builds upon the findings of the previous FEVD analysis, where it was shown that commodity price shocks play a key role in shaping inflation dynamics across South American economies. However, while the previous analysis highlighted the magnitude of commodity-driven inflation, it did not explicitly address whether these shocks tend to generate inflationary (positive) or deflationary (negative) effects. The impulse response functions (IRFs) presented in this figure help clarify this issue by illustrating the response

of CPI and PPI inflation[12] to commodity price shocks in each country.

The results indicate that commodity price shocks consistently generate inflation, as evidenced by the positive response of both CPI and PPI inflation across all South American economies. However, the magnitude of the effect differs significantly between the two price measures. In all cases, the inflationary impact is substantially larger for PPI inflation (red line) compared to CPI inflation (blue line)[13]. This suggests that commodity price fluctuations primarily affect price levels within the production sector of the economy, while the transmission to overall consumer prices is weaker. The effect is particularly pronounced in commodity-dependent economies such as Chile and Peru (copper), Argentina and Bolivia (lithium and zinc), and Brazil and Paraguay (soybean), where domestic prices exhibit a strong and persistent response to commodity price shocks.

[12]CPI is the national *headline* consumer price index compiled by each statistical office; it measures the cost of a fixed basket of goods and services purchased by households and is valued at purchaser prices (i.e., it includes distribution margins and indirect taxes and is affected by administered prices). PPI is the *domestic producer price* index, valued at basic prices (excluding retail margins and VAT) and covering mainly mining and manufacturing; it tracks prices at the first commercial transaction of goods produced domestically and typically excludes export-price quotations. All price indices are quarterly; when not seasonally adjusted I apply X-13 and then aggregate to quarters by arithmetic means.

[13]Why does PPI react more strongly than CPI in South America?. The impulse-response patterns in Figure 2 —a large and persistent rise in producer prices (PPI) and a much milder increase in consumer prices (CPI) after a positive commodity–price shock—are consistent with the measurement of the two indices and with open-economy transmission in commodity exporters. PPI is priced at *basic prices* and closely tracks firms' marginal costs in the mainland sector. In the model, a higher world commodity price raises offshore firms' demand for home intermediates, lifts the relative price of domestic goods $P_{H,t}$, and increases marginal costs; with Calvo frictions this feeds directly into $\pi_{H,t}$ and hence PPI. By contrast, CPI is valued at *purchaser prices* and is a composite of domestic and imported consumption prices, $\pi_t = (1-\alpha)\pi_{H,t} + \alpha\,\pi_{F,t}$. Two forces damp the pass–through to CPI. First, a sizable share of CPI in South America is non-tradable services (housing, education, health, local transport) whose prices are tied to slowly moving wages and regulated tariffs; these components adjust gradually and attenuate the shock even when producer costs jump. Second, commodity booms typically improve the terms of trade and appreciate the currency, lowering the domestic-currency price of imports ($\pi_{F,t} \downarrow$) and offsetting part of the rise in $\pi_{H,t}$. Distribution margins and indirect taxes—present in CPI but not in PPI—further dilute immediate cost pass-through. As a result, PPI—an approximation to $\pi_{H,t}$—moves one-for-one with marginal costs, while CPI, which weights non-tradables and (partly offsetting) imported prices, responds less. This composition effect explains why the IRFs systematically display PPI $>$ CPI across South American economies despite common commodity shocks.

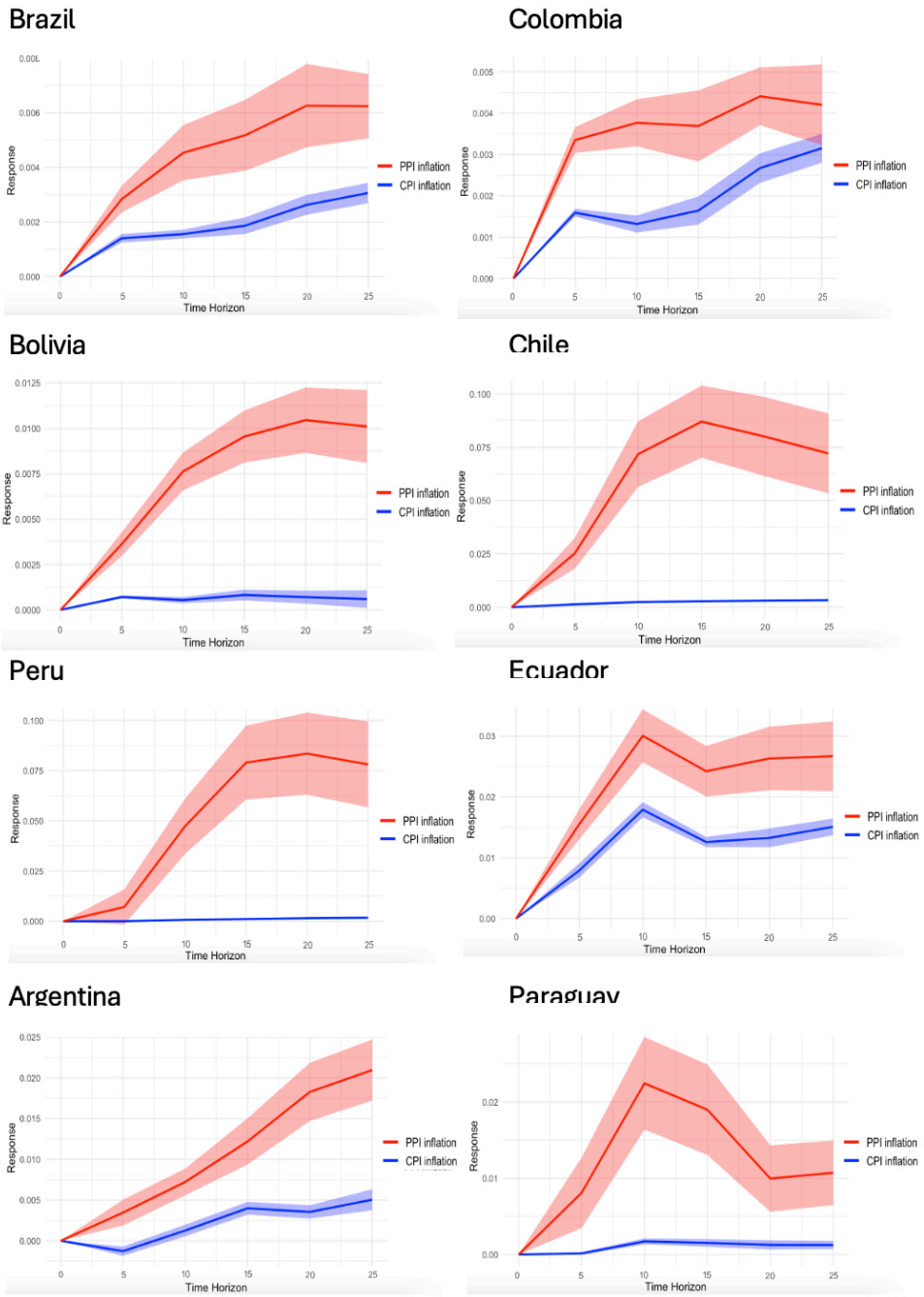


Figure 2: IRF of Prices to Commodity price shocks

What are the implications for Monetary Policy?. A key takeaway from these results is that monetary policy in South America may be underestimating the inflationary pressures originating from the supply side of the economy. Central banks typically set interest rates based on CPI inflation, which, as shown in the figure, exhibits a much weaker response to commodity price shocks compared to Domestic Prices. This suggests that inflation generated by fluctuations in commodity prices (a key component of the supply side) may not be fully accounted for in monetary policy decisions.

If central banks focus primarily on demand-driven inflation (captured by CPI) and overlook inflationary pressures stemming from commodity price fluctuations, they risk un-

derestimating the true inflationary impact on the economy. This could lead to policy misalignment, where interest rate adjustments fail to adequately respond to inflationary episodes driven by supply-side shocks. Given the structural dependence of South American economies on commodity exports, this raises important concerns about the effectiveness of current monetary policy frameworks in addressing inflation dynamics in the region.

In summary, these findings reinforce the idea that commodity prices are a critical determinant of inflation in South America, and their role in shaping price dynamics should be more explicitly considered in monetary policy formulation. Policymakers may benefit from incorporating broader inflation measures that capture both demand-side and supply-side price pressures to ensure a more comprehensive response to inflationary shocks.

The historical shock decomposition (HSD) analysis[14] presented in Figure 3 provides a complementary perspective to the previous findings by examining the extent to which commodity price shocks have influenced the historical fluctuations of prices and interest rates in South America. While the earlier results highlighted the role of commodity shocks in determining inflation and the relatively weak response of interest rates to these shocks, this analysis investigates whether these factors were significant drivers of economic volatility over time. The results further corroborate that commodity price shocks have played a fundamental role in shaping price dynamics, whereas their influence on interest rate fluctuations remains limited.

The findings confirm that commodity price shocks have been a crucial factor in driving historical price fluctuations across South American economies. Throughout the analyzed period, commodity-driven inflationary episodes are clearly observable, reinforcing the argument that supply-side shocks are a dominant force in shaping price behavior. This trend is particularly evident in economies with a strong dependence on commodity exports, such as Chile, Peru, and Argentina, where metals like copper and lithium represent a substantial share of economic activity. The results suggest that inflation in these countries has been closely tied to movements in global commodity markets, further highlighting the vulnerability of these economies to external price shocks.

In contrast, the variance decomposition of interest rates indicates that fluctuations in monetary policy have been weakly influenced by commodity price shocks. Instead, changes in interest rates appear to be primarily driven by financial conditions and global monetary dynamics rather than by direct responses to commodity market movements.

[14]The HSD takes the estimated SVAR and, for each date in the sample, attributes the observed movement of a variable to the sequence of identified shocks—global demand, U.S. monetary policy, risk premium, commodity supply, and domestic monetary policy. In other words, it reconstructs how much of the actual path of, say, inflation or the policy rate is due to each shock through time. I use the HSD to complement impulse responses and variance decompositions: impulse responses show *how* variables react to a shock on average, variance decompositions show *how much* each shock contributes on average, and the HSD shows *when* particular shocks mattered in the historical record (e.g., during specific commodity booms or tightening episodes).

This finding is consistent with the previous results, reinforcing the idea that monetary policy in South America has been largely detached from supply-side inflationary pressures. Consequently, the evidence suggests that central banks in the region may not be adequately considering the impact of commodity-driven inflation when setting interest rates, potentially leading to an underestimation of inflationary risks stemming from external shocks.

The historical decomposition further allows for an examination of the role of commodity price shocks in major economic crises that have affected South America. The early 2000s crisis, which was characterized by severe financial instability and sovereign debt crises in countries such as Argentina, saw a significant contribution of commodity shocks to price fluctuations. This period was marked by volatility in global demand for key exports, which likely exacerbated inflationary pressures in commodity-dependent economies. However, interest rate fluctuations during this period appear to have been more influenced by financial instability and domestic economic conditions rather than commodity price changes.

A similar pattern emerges during the 2007-2008 global financial crisis. The sharp contraction in global demand during this period led to a collapse in commodity prices, which is reflected in the historical variance decomposition as a decline in the contribution of commodity shocks to inflation. This suggests that price stability in South American economies was temporarily influenced by falling commodity prices rather than domestic monetary policy. Once again, interest rate fluctuations during this period were largely driven by financial contagion and global liquidity conditions rather than by commodity market dynamics, further highlighting the disconnect between inflationary pressures from supply-side shocks and the central bank response.

The COVID-19 pandemic represents another significant period of economic disruption, with substantial impacts on both commodity markets and macroeconomic policy. The results indicate that commodity shocks played a major role in inflationary pressures during this period, as global supply chain disruptions and demand imbalances led to increased price volatility. However, the response of interest rates during the COVID-19 crisis was shaped primarily by monetary policy interventions rather than direct reactions to commodity-driven inflation. Central banks in South America implemented emergency rate cuts to counteract the economic downturn, followed by subsequent tightening measures as inflation surged in the post-pandemic recovery phase. This suggests that while monetary authorities responded aggressively to the crisis, their policy decisions were more reactive to demand-side factors rather than proactive in addressing inflationary risks originating from supply-side shocks.

Overall, the historical variance decomposition analysis reinforces the conclusion that commodity price shocks have been a major driver of (positive) inflationary episodes in South America, whereas monetary policy decisions have remained relatively disconnected from

these supply-side pressures. Given the high degree of exposure that South American economies have to global commodity cycles, these findings underscore the need for a more comprehensive monetary policy framework that accounts for both demand-side and supply-side inflationary forces. By better incorporating the impact of commodity price fluctuations into policy decisions, central banks in the region could enhance their inflation-targeting strategies and improve macroeconomic stability in the face of external shocks. I cover this aspect in the next section.

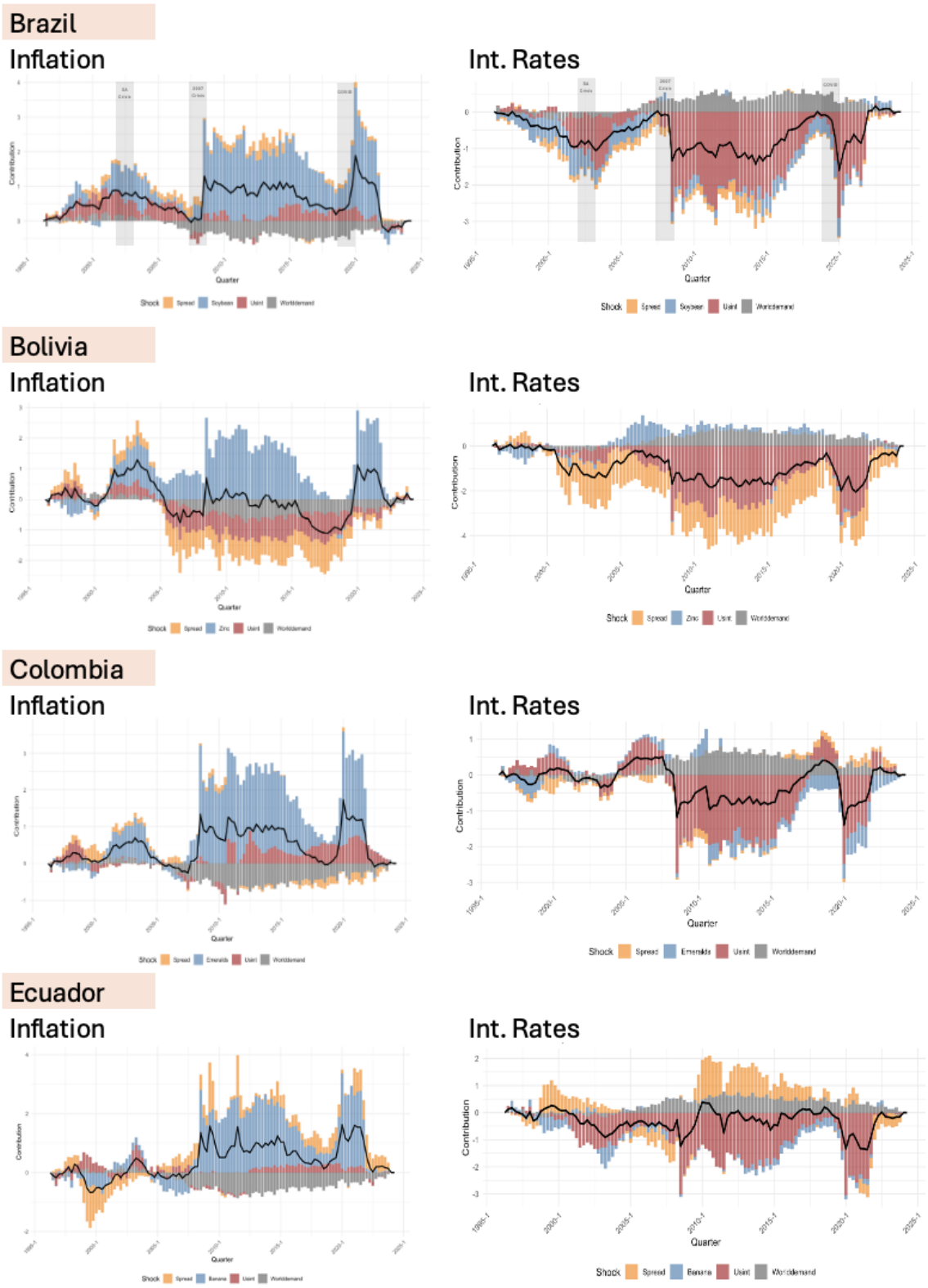


Figure 3: Historical Shock Decomposition of Prices/Interest Rates to Commodity/External shocks

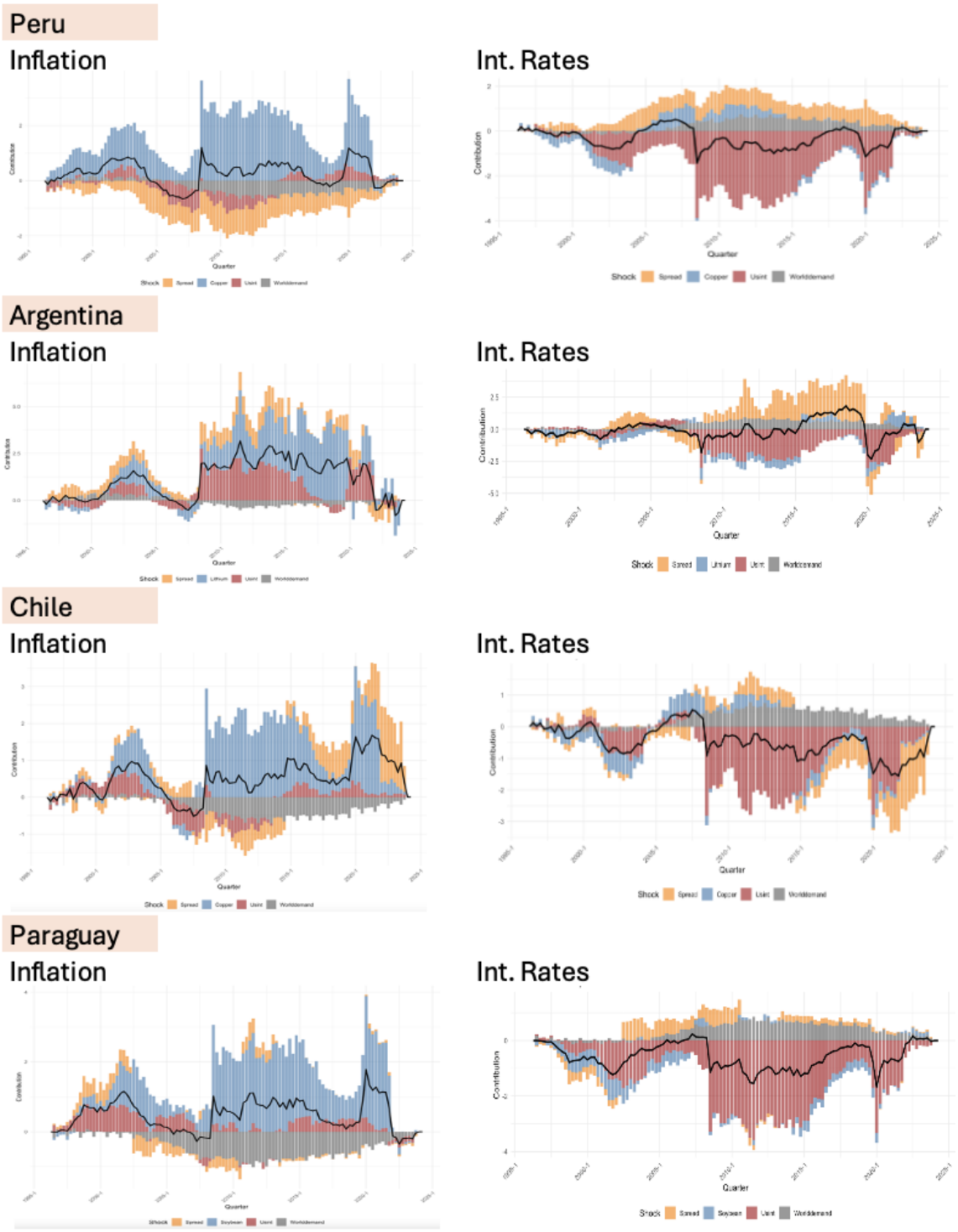


Figure 3a: Historical Shock Decomposition of Prices/Interest Rates to Commodity/External shocks

4 How should monetary policy be conducted for SA countries?

The evidence from the previous section suggests that commodity price fluctuations play a critical role in shaping inflation dynamics in South American economies, yet traditional monetary policy frameworks, which rely primarily on a standard Taylor rule, may not fully account for these supply-side inflationary pressures. To address this limitation, the proposed model extends the canonical framework of Gali and Monacelli (2005), by incorporating the role of commodities, following the approach of Ferrero and Seneca (2019b). While the standard New Keynesian open economy models typically focus on the demand side of inflation and assume a passive role for export sectors, the empirical results presented earlier demonstrate that fluctuations in commodity prices exert significant and persistent effects on domestic price levels—particularly on domestic producer prices (PPI) rather than consumer prices (CPI). Moreover, the SVAR estimations reveal that commodity price shocks explain a substantial proportion of inflation variability in South American countries, while interest rate responses to such shocks remain limited or misaligned. These findings point to a disconnect between the dominant inflationary forces and the instruments used in monetary policy formulation. The model developed in this section explicitly introduces a commodity-exporting sector into a small open economy framework with nominal rigidities, in order to evaluate the implications of alternative monetary policy rules that place greater emphasis on producer price stability. In doing so, it provides a structural foundation to understand the welfare and stability implications of targeting PPI inflation in commodity-dependent economies, as opposed to the conventional CPI-based targeting rule.

4.1 The Model

The model describes a small open economy where households, mainland firms, offshore firms, and the central bank interact. Households supply labor, consume domestic and imported goods, and smooth consumption over time under complete international risk sharing. Mainland firms produce differentiated final goods with price-setting frictions, making monetary policy effective in the short run[15]. The final good can be either consumed by households as an output or used as commodity production inputs for offshore firms[16].

[15]Note that in this framework mainland firms exclusively serve the domestic market and do not engage in exports. Likewise, both offshore and mainland firms rely solely on domestically sourced materials and do not import inputs from abroad.

[16]In this paper, "offshore firms" are *domestic producers that sell their output directly in world markets at the prevailing international (foreign-currency) price.* They take the output price and foreign demand as exogenous (law of one price), purchase labor and intermediate inputs at domestic prices, and are subject to domestic taxes and ownership (profits accrue to domestic households in the baseline). The term "offshore" here refers to the location of *buyers and pricing*—not the location of production. It should

These firms export commodities whose prices are determined in international markets, exposing the domestic economy to external shocks. The central bank sets the nominal interest rate following a Taylor-type rule, influencing consumption, output, and inflation. The interaction between these agents—households, firms, and the central bank—drives the transmission of both domestic and global shocks.

For the technical description of the model, I adopt the standard notation convention, with uppercase letters representing variables in levels, lowercase letters represent log transformations, while Greek letters are reserved for parameters and coefficients. In the following, I present the details of the model.

4.1.1 Households

The representative household maximizes expected lifetime utility over consumption and labor, given by:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\log C_t - \frac{N_t^{1+\varphi}}{1+\varphi} \right], \tag{4}$$

where C_t denotes total consumption and N_t denotes hours worked. The parameter $\beta \in (0,1)$ is the household's subjective discount factor, and $\varphi > 0$ determines the disutility from labor.

The household chooses sequences of consumption, labor, and bond holdings subject to a budget constraint of the form:

$$P_t C_t + \mathbb{E}_t[Q_{t,t+1} D_{t+1}] \leq W_t N_t + D_t + \Psi_t, \tag{5}$$

where P_t is the aggregate price index, W_t the nominal wage, D_t denotes bond holdings[17], $Q_{t,t+1}$ is the stochastic discount factor, and Ψ_t are profits from firm ownership.

Consumption is composed of home and foreign goods aggregated via a CES index:

$$C_t = \left[(1-\alpha) C_{Ht}^{\frac{\eta-1}{\eta}} + \alpha C_{Ft}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{6}$$

not be confused with offshoring (relocating production abroad) or with "offshore" financial centers. Think of copper mines in Chile, soybean exporters in Brazil, or lithium producers in Argentina whose sales are priced on global exchanges.

[17] The term $E_t[Q_{t,t+1}D_{t+1}]$ is the *time-t cost* of purchasing a portfolio that delivers a nominal payoff D_{t+1} next period. Here $Q_{t,t+1}$ is the one–period *stochastic discount factor* (state–price deflator) that converts one unit of nominal currency delivered at $t{+}1$ into its value at t; the expectation $E_t[\cdot]$ is conditional on information at t and simply sums the state prices times the state–contingent payoff across all possible realizations at $t{+}1$. Symmetrically, D_t on the right–hand side is the *realized payoff at t* from the portfolio chosen at $t{-}1$ (i.e., maturing bond holdings), which augments current income together with labor income $W_t N_t$ and profits Ψ_t. When the household buys a one–period *risk-free* nominal bond that pays one unit of currency at $t{+}1$, the price per unit is $E_t[Q_{t,t+1}] = 1/(1+i_t)$, so the expenditure reduces to $D_{t+1}/(1+i_t)$. More generally, with state-contingent claims D_{t+1} may vary by state, and the $E_t[Q_{t,t+1}D_{t+1}]$ notation compactly captures the present value of that entire payoff vector.

where C_{Ht} and C_{Ft} represent consumption of domestic and foreign goods, respectively. The elasticity of substitution between home and foreign goods is given by $\eta > 1$, and $\alpha \in (0, 1)$ measures the openness of the economy.

Expenditure minimization leads to optimal demand for each good and defines the corresponding price index:

$$P_t = \left[(1-\alpha)P_{Ht}^{1-\eta} + \alpha P_{Ft}^{1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{7}$$

where P_{Ht} and P_{Ft} denote the prices of home and foreign goods. The *first order condition (foc)* for labor supply is determined from the intratemporal optimality condition, yielding:

$$\frac{W_t}{P_t} = N_t^{\varphi} C_t. \tag{8}$$

Intertemporal optimization results in the standard Euler equation, which characterizes intertemporal consumption choices. Specifically, households choose current consumption C_t by equating the marginal utility today to the expected discounted marginal utility tomorrow, adjusted for inflation. The *foc* that connects state-contingent securities and consumption yields to the Euler equation:

$$Q_{t,t+1} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-1} \frac{1}{\Pi_{t+1}}, \tag{9}$$

where $Q_{t,t+1}$ is the stochastic discount factor, β is the subjective discount factor, and $\Pi_{t+1} = P_{t+1}/P_t$ is the gross inflation rate between periods t and $t+1$. In equilibrium, the discount factor is related to the real interest rate, which is a function of the nominal interest rate i_t and expected inflation $E_t\pi_{t+1}$. Log-linearizing the Euler equation around the steady state yields:

$$c_t = E_t c_{t+1} - \frac{1}{\sigma}(i_t - E_t\pi_{t+1}), \tag{10}$$

where c_t is the log deviation of consumption from its steady state, σ is the intertemporal elasticity of substitution, and $(i_t - E_t\pi_{t+1})$ represents the expected real interest rate. This formulation illustrates that an increase in the nominal interest rate, holding expected inflation constant, raises the real interest rate and thus reduces current consumption. The mechanism reflects the standard intertemporal substitution effect: higher real returns to saving discourage current consumption in favor of future consumption. As a result, the nominal interest rate becomes a key tool through which monetary policy influences aggregate demand.

Note that the home country's terms of trade are defined as the ratio of the price of foreign goods to that of domestic goods, expressed as

$$\mathcal{T}_t = \frac{P_{Ft}}{P_{Ht}} \tag{11}$$

These terms are linked to relative prices, where the price of home-produced goods relative to the aggregate price level is given by $\frac{P_{Ht}}{P_t} = \mathcal{T}_t^{-\alpha}$, and the relative price of imported goods is $\frac{P_{Ft}}{P_t} = \mathcal{T}_t^{1-\alpha}$. We assume that the home economy does not export its manufacturing goods, meaning $\alpha^* = 0 \Rightarrow P_t^* = P_{Ft}^*$, and that the law of one price holds for foreign goods, so $P_{Ft} = \mathcal{E}_t P_{Ft}^*$, where $\mathcal{E}_t$ represents the nominal exchange rate (units of domestic currency per unit of foreign currency).

These conditions jointly imply a relationship between the real exchange rate and the terms of trade, given by:

$$S_t \equiv \frac{\mathcal{E}_t P_t^*}{P_t} = \mathcal{T}_t^{1-\alpha}. \tag{12}$$

Minimizing total expenditure leads to standard downward-sloping demand functions for both domestic and foreign goods. Based on the relative prices and the terms of trade, the demand functions are expressed as:

$$C_{Ht} = (1-\alpha)\mathcal{T}_t^{\alpha} C_t, \tag{13}$$

$$C_{Ft} = \alpha \mathcal{T}_t^{\alpha-1} C_t. \tag{14}$$

where α represents the share of foreign goods in the domestic consumption basket.

Lastly, under the assumption of perfect risk-sharing, the consumption ratio between countries is linked proportionally to the real exchange rate such that:

$$C_t = \vartheta C_t^* S_t = Y_t^* \mathcal{T}_t^{1-\alpha}, \tag{15}$$

where ϑ is a constant reflecting the initial relative net asset position[18]. In the absence of arbitrage opportunities, the gross return on a domestic risk-free bond i_t satisfies the condition

$$(1+i_t)^{-1} = \mathbb{E}_t Q_{t,t+1}. \tag{16}$$

[18]Note that the second equality in Equation (14) arises by considering the symmetric initial condition $\vartheta = 1$ and the standard small open economy assumption $C_t^* = Y_t^*$ (the asterisk denotes the foreign block). This means that we treat the foreign economy as so large relative to the home country that, to a first-order approximation, its aggregate absorption equals its output—i.e., its trade balance vis-à-vis the home country is negligible. Equivalently, the home economy is too small to affect foreign income, interest rates, or commodity prices, so any tiny deviations of $C_t^* - Y_t^*$ are absorbed into the exogenous foreign-demand process. This simplification is standard when the model is linearized around a balanced-trade steady state, in which net exports and net foreign-asset accumulation are second-order at business-cycle frequencies. Empirically, Y_t^* is proxied by world industrial production (or U.S. GDP), and it serves as the driver of foreign demand in the SVAR.

4.1.2 Mainland Firms

Domestic firms produce differentiated intermediate goods using labor (N_t) as the only input. Production is linear in labor, with output $Y_{H,t}(i) = A_{H,t}N_t(i)$ for firm i, where A_t is aggregate productivity[19]. Each firm faces monopolistic competition and sets prices subject to Calvo-type nominal rigidities. In each period, a fraction $(1-\theta)$ of firms can reoptimize their prices, while the rest keep prices unchanged.

Firms that reoptimize choose a price $\widetilde{P}_{H,t}$ to maximize the expected present value of profits:

$$\max_{\widetilde{P}_{H,t}} \sum_{s=0}^{\infty} \theta^s \mathbb{E}_t \left[Q_{t,t+s} \left(\widetilde{P}_{H,t} Y_{H,t+s|t} - W_{t+s} N_{t+s|t} \right) \right], \tag{17}$$

subject to the demand curve:

$$Y_{H,t}(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\varepsilon} Y_{H,t}, \tag{18}$$

where $\varepsilon > 1$ is the elasticity of substitution across goods, and $P_{H,t}$ is the domestic price index such that

$$P_{H,t} = \left[\int_0^1 P_{H,t}(i)^{1-\varepsilon} \, di \right]^{\frac{1}{1-\varepsilon}}. \tag{19}$$

Log-linearizing the first-order condition of this problem yields the standard forward-looking New Keynesian Phillips Curve:

$$\pi_{H,t} = \beta \mathbb{E}_t[\pi_{H,t+1}] + \kappa mc_t, \quad \text{with} \quad \kappa = \frac{(1-\theta)(1-\beta\theta)}{\theta}. \tag{20}$$

where $\pi_{H,t} = \frac{P_{H,t}}{P_{H,t-1}}$ denotes the rate of domestic inflation at time t, β is the subjective discount factor, capturing the degree to which agents value future outcomes relative to the present. mc_t refers to the real marginal cost in the domestic economy (in log-terms), which acts as a key determinant of inflationary pressures, κ measures the responsiveness of inflation to movements in marginal cost where θ represents the Calvo parameter—the probability that a firm cannot reoptimize its price in a given period. A higher value of θ implies greater price rigidity and leads to more persistent inflation over time.

The real marginal cost (mc_t), in turn, can be written as[20]:

$$mc_t = \varphi y_t - (1+\varphi) a_t + y_t^* + \tau_t, \tag{21}$$

where φ represents the inverse Frisch elasticity of labor supply, y_t is domestic output, a_t is a technology shock, y_t^* is foreign output, and $\tau_t \equiv \ln T_t$ is the log terms of trade.

[19] Recall that A_t follows an AR(1) process such that: $A_{H,t} = \rho_H A_{H,t-1} + \varepsilon_{H,t}$

[20] I present the derivation problem of $\pi_{H,t}$ and mc_t in Appendix A.1 and A.2

This expression reveals that marginal cost depends not only on standard demand and technology forces, but also on the international environment—specifically the gap between domestic and foreign prices embedded in τ_t. This is the core of the inefficient terms-of-trade mechanism in Ferrero and Seneca (2019b).

Lastly, the consumer price index inflation (π_t) is related to domestic and foreign inflation via:

$$\pi_t = (1-\alpha)\pi_{H,t} + \alpha(\pi_{F,t}), \tag{22}$$

where $\pi_{F,t} = \frac{P_{F,t}}{P_{F,t-1}}$ represents the rate of foreign inflation.

4.1.3 Offshore Firms

In addition to the mainland sector, the model features an offshore sector producing commodities exclusively for export[21]. Offshore firms are competitive and produce output $Y_{O,t}$ using mainland goods M_t as an input via the CES technology:

$$Y_{O,t} = A_{O,t} M_t^{\eta}, \quad 0 < \eta < 1. \tag{23}$$

where $A_{O,t}$ represents total factor productivity (TFP) in the commodity production sector[22] and η represents the output elasticity of commodity production with respect to the input M_t (mainland final goods). These firms take prices as given[23] and solve the optimization problem:

$$\max_{M_t} P_{O,t} Y_{O,t} - P_{H,t} M_t, \tag{24}$$

where $P_{O,t}$ is the price of the exported commodity in foreign currency. The first-order

[21] South American export baskets are heavily tilted toward commodities, so treating the offshore sector as a pure commodity exporter is an empirically disciplined abstraction rather than a modeling convenience. Table 1 documents both external prominence and domestic weight of the leading commodity in each country: Chile's copper, Bolivia's zinc, Peru's copper, Paraguay's soybeans, Brazil's soybeans, Ecuador's bananas, Argentina's lithium, and Colombia's emeralds. The last column shows that revenues from that single commodity alone exceed 10% of GDP in every case (25% in Chile, 22% in Bolivia, 19% in Peru, 18% in Paraguay, 15% in Brazil, 13% in Ecuador, 12% in Argentina, and 11% in Colombia), underscoring a high degree of concentration and structural exposure to world commodity markets. These facts are precisely why the model assigns the export margin to the offshore (commodity) sector: it captures that the tradable side of these economies is dominated by primary commodities, while most non-commodity production is absorbed domestically. In addition, the SVAR evidence shows that shocks to these world–commodity prices are the primary drivers of price dynamics across the region—another indication that exports, and hence external transmission, operate chiefly through the commodity channel—thereby validating the modeling choice to let the offshore block export only the leading commodity.

[22] Recall that $A_{O,t}$ follows an AR(1) process such that: $A_{O,t} = \rho_O A_{O,t-1} + \varepsilon_{O,t}$

[23] The commodity-producing firm operates under the assumption that input prices are exogenously given and not subject to its influence. It can sell any desired quantity of output on the global market at the prevailing price, which is expressed in domestic currency as $P_{Ot} = \mathcal{E}_t P^*_{Ot}$. Since domestic commodity producers are too small to influence international markets, they treat the world commodity price P^*_{Ot} as exogenously determined by global supply and demand.

condition yields:

$$M_t = \left(\frac{\eta A_{O,t} P_{O,t}}{P_{H,t}} \right)^{\frac{1}{1-\eta}}. \tag{25}$$

Thus, an increase in foreign commodity prices raises input demand for domestic intermediate goods, introducing a positive terms-of-trade effect[24][25]

4.1.4 Equilibrium Conditions and the Foreign Economy

The market-clearing condition for domestic intermediate goods equates production to their use in consumption and exports:

$$Y_{H,t} = C_{H,t} + M_t. \tag{26}$$

where households allocate domestically produced goods either for consumption or as inputs into commodity production.

Given the small open economy framework, foreign output is entirely consumed abroad, implying $Y_t^* = C_t^*$. Additionally, all commodity extracted domestically is exported, and the global market is assumed to absorb the entire quantity at the prevailing international price[26]. The foreign economy is modelled by exogenous AR(1) processes such that

$$z_{i,t} = \rho_t^* z_{i,t-1} + \varepsilon_{i,t}^* \tag{27}$$

for $\{i = 1, 2, 3\}$ which corresponds to $\{Y_t^*, i_t^*, \Pi_{F,t}^*\}$, where the above-mentioned terms

[24] Recall that the model does not provide an explicit framework of how international markets absorb the commodity produced domestically. What matters for the characterization of the equilibrium, however, is that commodity exports serve as a source of external revenue, which can be used to finance the country's expenditure on imported goods.

[25] Why does a higher world commodity price raise demand for home intermediates and generate a "positive terms-of-trade effect"? Exporters in the model are price takers in world markets: when the foreign-currency price of the country's export commodity rises, each unit sold abroad yields more revenue. Given their technology, the profitable way to scale up exports is to purchase more of the domestically produced intermediate (the mainland good). Their willingness to pay for that input therefore increases, shifting demand toward home output. This additional demand bids up the domestic producer price and domestic marginal costs—delivering a tight, production-side link from world commodity prices to PPI inflation. At the same time, higher export revenues improve national purchasing power vis-à-vis the rest of the world—the classic terms-of-trade channel whereby a unit of exports buys more imports. In our notation, the terms of trade are $T_t \equiv P_{F,t}/P_{H,t}$; an improvement shows up as a "positive" terms-of-trade effect. Modeling the commodity boom in this way is useful for three reasons. First, it microfounds the empirical pattern that PPI reacts much more than CPI to commodity shocks: the cost push operates directly through input competition for home goods, while CPI is partially insulated by exchange-rate and import-price movements. Second, it keeps the small-open-economy logic clean—world prices are exogenous and exporters are too small to influence them—while still allowing external prices to matter domestically through quantities and marginal costs. Third, it delivers the observed co-movement of commodity prices, the exchange rate, and domestic prices (via improved purchasing power and currency appreciation), which is central for comparing CPI- versus PPI-based monetary rules in commodity exporters.

[26] Note that among all relative prices, only the terms of trade $\mathcal{T}_t$ are endogenously determined within the model

represent foreign output, interest rates, and inflation, respectively.
The characterization of equilibrium depends on monetary policy (which sets the nominal interest rate i_t), initial values of endogenous variables and exogenous processes such as foreign output (Y_t^*), foreign interest rates (i_t^*), and foreign inflation ($\Pi_{F,t}^* = \Pi_t^*$). It also depends on productivity levels in the domestic goods sector ($A_{H,t}$) and commodity sector ($A_{O,t}$), as well as the real price of commodities in international markets $\left(\frac{P_{O,t}^*}{P_t^*}\right)$. The resulting equilibrium consists of sequences of quantities

$$\{C_t, C_{Ht}, C_{Ft}, N_t, Y_{Ot}, M_t, Y_{Ht}\}_{t=0}^{\infty}$$

and prices[27]

$$\{Q_{t,t+1}, \Pi_t, \mathcal{E}_t, MC_t, \Pi_{Ht}, \mathcal{T}_t\}_{t=0}^{\infty},$$

such that households and firms optimize and all markets clear in every period.

4.1.5 Monetary Policy

To close the model, we assume monetary policy follows a Taylor-type interest rate rule that allows for varying responses depending on the policy regime. In the baseline case, the central bank sets the nominal interest rate in response to CPI inflation and the output gap:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left(\psi_\pi \pi_t + \psi_y \tilde{y}_t\right). \tag{28}$$

Under an alternative regime, monetary policy instead targets producer price inflation (PPI) and the output gap:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left(\psi_\pi \pi_{H,t} + \psi_y \tilde{y}_t\right). \tag{29}$$

Finally, in the managed exchange rate regime, the central bank also reacts to real exchange rate movements, in addition to PPI and output[28]:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left(\psi_\pi \pi_{H,t} + \psi_y \tilde{y}_t + \psi_e \tilde{e}_t\right), \tag{30}$$

where $\tilde{e}_t$ denotes the deviation of the real exchange rate from its steady-state value.

4.1.6 How monetary policy affects the economy?

Note that in the model, monetary policy affects wages, employment, and pricing decisions through its influence on aggregate demand. A rise in the policy interest rate increases the

[27] Recall that while capital letters represent levels of variables, I use lower case letters to represent the natural logs of levels

[28] In Appendix B.3, I explain the justification for this augmented monetary policy

real interest rate, which reduces household consumption via the Euler equation, leading to a contraction in aggregate demand and output. Lower output reduces firms' demand for labor, thereby decreasing employment. Given the household's labor supply condition, both lower consumption and employment reduce the real wage. On the supply side, reduced output lowers firms' real marginal costs, which, through the New Keynesian Phillips Curve, translates into lower inflationary pressure. Thus, monetary tightening propagates through the real economy by dampening demand, weakening labor markets, and moderating price-setting behavior.

Under a CPI-based monetary policy regime, interest rate adjustments respond to changes in consumer price inflation, which incorporates both domestic inflation and external relative price shifts (i.e., terms of trade). An increase in the policy rate raises the real interest rate, leading to a decline in consumption and output. Lower output reduces labor demand, which weakens employment and wages. These effects reduce marginal costs and slow the rise in domestic prices. However, since CPI inflation also includes import prices, movements in the exchange rate (via interest rate differentials) can offset domestic disinflation. As a result, CPI-based targeting may be less effective in controlling underlying cost-driven inflation, especially in commodity-exporting economies subject to external shocks.

4.2 Discussion

The introduction of a commodity-exporting sector using domestic inputs creates an inefficiency absent in standard small open economy models. In particular, the external demand for domestic goods varies with commodity prices, directly impacting domestic production costs and inflation. Targeting CPI inflation, which includes imported goods whose prices may not reflect domestic marginal costs, may result in monetary policy that is unresponsive to critical supply-side pressures. This motivates the evaluation of alternative policies, including targeting PPI inflation or implementing an augmented Taylor rule that responds explicitly to commodity prices, which is the main focus of my analysis.

4.3 Estimation and Calibration of Model Parameters

The parameter values used in this model are obtained through Bayesian estimation techniques, employing quarterly data from Chile[29]. The choice of Chile is motivated by its high ratio of commodity exports to GDP, making it the most representative case among South American economies for the model's core assumptions. The estimation procedure combines prior information drawn from the literature with likelihood-based inference using macroeconomic data, ensuring both theoretical coherence and empirical consistency.

[29] In Appendix, I present results and a discussion of the bayesian estimation.

The posterior modes of the parameters provide the baseline calibration for the subsequent simulation and policy analysis.

The subjective discount factor, β, is set to 0.9963, a value commonly used in the literature to reflect a quarterly discount rate consistent with annual interest rates of approximately 1.5%. The Calvo parameter for price rigidity, $\theta_H = 0.69$, implies that prices are typically re-optimized every three to four quarters, consistent with micro-based evidence for emerging markets (see Galí and Monacelli (2005); Smets and Wouters, 2007). The elasticity of substitution across varieties, $\epsilon = 6$, determines the degree of monopoly power of firms and is a standard value in New Keynesian models, as used in Christiano et al. (2005) and Medina and Soto (2007).

The openness parameter, $\alpha = 0.35$, captures the share of imported goods in the consumption basket and is calibrated to match Chile's trade-to-GDP ratio. The inverse Frisch elasticity of labor supply, $\varphi = 4.1$, governs the household's labor-leisure tradeoff. This value reflects estimates from labor supply studies in open economies and aligns with previous work by Galí (2011) and **?**.

The elasticity of commodity output with respect to material inputs, $\eta = 0.40$, reflects the technological relationship in the offshore sector where domestic intermediates are transformed into exportable commodities. The value is supported by the structural parameters estimated for commodity-producing countries in Bodenstein et al. (2011).

Two key structural shares in the model include $s_m = 0.15$, the share of domestic goods used as material input in the offshore sector, and $s_c = 0.85$, the share of home consumption in total domestic output. These parameters influence the transmission of commodity shocks to the domestic economy and are based on national accounts data for Chile.

The persistence of commodity price shocks, $\rho_O = 0.96$, and their standard deviation, $\sigma_O = 0.15$, are estimated from historical commodity price series using autoregressive processes, as in Fernandez et al. (2015). These values capture the highly persistent and volatile nature of global commodity markets.

Finally, the ratio of commodity production to GDP, $Y_O/Y = 0.20$, reflects Chile's structural dependence on commodity exports—particularly copper—and plays a crucial role in determining the quantitative effects of commodity shocks in the model. This calibration contrasts with a standard baseline scenario where commodity dependence is lower (e.g., $Y_O/Y = 0.10$), allowing for comparative simulations across economies with varying degrees of export exposure.

The resulting parameter configuration offers a data-consistent and theoretically grounded foundation for the model's dynamic simulations, and ensures that the mechanisms through which commodity prices affect inflation and output are properly calibrated to the characteristics of South American economies[30].

[30]Refer to the Appendix for preliminary findings that provide context for the model's results. These include: (i) a diagram outlining the structure of the model, (ii) the criteria used for selecting the repre-

Param.	Definition	Chile	Standard
β	Subjective discount factor	0.9963	0.9963
θ_H	Calvo price-setting	0.69	0.75
ϵ	Elast. of subs. between varieties	6	6
α	Openness (imports/GDP)	0.35	0.30
φ	Inverse Frisch elast. of labor supply	4.1	3.0
η	Elast. of commod. output w.r.t. materials	0.40	0.38
s_m	Share of GDP used as material (M/Y_h)	0.15	0.10
s_c	Share for consumption (C_h/Y_h)	0.85	0.90
ρ_O	Persistence of world commod. price shocks	0.96	0.96
σ_O	Std. dev. of commodity price shocks	0.15	0.15
Y_O/Y	Commodity-production to total GDP	0.20	0.10

Table 1: Calibration/Estimated Parameters

Table 2 reports the calibration of autoregressive (AR(1)) shock processes used in the model, based on empirical data spanning from 1996Q1 to 2024Q2. The values for the persistence parameters (ρ) and standard deviations (σ) were extracted from observed macroeconomic time series. Specifically, foreign output, foreign inflation dynamics and interest rate shocks are calibrated using U.S. GDP, U.S. inflation and the 3-month Federal Reserve rate, respectively. Domestic productivity parameters are estimated from Chilean macroeconomic data, and commodity productivity shocks—which are particularly relevant for a resource-exporting economy such as Chile—are calibrated using the historical volatility of copper prices, serving as a proxy for commodity sector fluctuations.

The estimated persistence values indicate that all exogenous processes exhibit strong autocorrelation, with ρ values ranging from 0.70 to 0.90. This implies that shocks to both domestic and foreign variables tend to have lasting effects over time. In particular, the high persistence of foreign output and interest rates ($\rho = 0.90$) suggests that external conditions evolve slowly and exert sustained influence on the domestic economy. Similarly, the persistence of domestic productivity ($\rho_{A_H} = 0.74$) and commodity productivity ($\rho_{A_O} = 0.70$) reflects the gradual nature of structural changes in these sectors. The standard deviations of the innovations, while modest in magnitude, capture the inherent volatility in each process and enable the model to replicate realistic fluctuations in economic activity. Overall, these parameter values provide a solid empirical foundation for the simulation and estimation of the model.

sentative country in the theoretical framework, (iii) a comparison of South American commodity price volatility relative to oil prices, and (iv) the impact of a commodity price shock on PPI and CPI inflation.

	Description	Value	Target/Source
ρ_{y^*}	Persistence of foreign output	0.90	US GDP - 1996Q1:2024Q2
$\sigma_{\varepsilon_{y^*}}$	Std. deviation of foreign output	0.0057	US GDP - 1996Q1:2024Q2
ρ_{i^*}	Persistence of foreign interest rate	0.90	3-month FED - 1996Q1:2024Q2
$\sigma_{\varepsilon_{i^*}}$	Std. deviation of foreign int. rate	0.0010	3-month FED - 1996Q1:2024Q2
ρ_{π^*}	Persistence of foreign inflation	0.85	US inflation - 1996Q1:2024Q2
$\sigma_{\varepsilon_{\pi^*}}$	Std. deviation of foreign inflation	0.0020	US inflation - 1996Q1:2024Q2
ρ_{A_H}	Persistence of domestic productivity	0.74	Chile average - 1996Q1:2024Q2
$\sigma_{\varepsilon_{A_H}}$	Std. deviation of domestic productivity	0.0064	Chile average - 1996Q1:2024Q2
ρ_{A_O}	Persistence of commodity productivity	0.70	Copper price volatility for Chile
$\sigma_{\varepsilon_{A_O}}$	Std. deviation of commodity productivity	0.0100	Copper price volatility for Chile

Table 2: Estimated AR(1) Shock Processes

4.4 Results

This section presents and discusses the dynamic responses of key macroeconomic variables to a positive commodity price shock under different monetary policy regimes. In particular, the focus is on comparing the performance of a Taylor rule that targets consumer price inflation (CPI) with an alternative regime that targets producer price inflation (PPI), as well as a third configuration that augments the PPI-based rule with an exchange rate intervention component. Each regime is evaluated in terms of its implications for inflation stabilization, output volatility, and interest rate dynamics.

Under the baseline regime where the central bank follows a Taylor rule that responds to deviations of CPI inflation from its target, the commodity price shock leads to a modest but persistent rise in both CPI and PPI inflation. The central bank raises interest rates gradually (see point A in the lower-right panel), resulting in only partial containment of inflation. Because CPI inflation reflects the prices of both domestic and imported goods, its pass-through from commodity shocks is somewhat muted compared to PPI inflation, which directly incorporates the rising costs of inputs used by mainland firms. Consequently, as shown in panels B and B', PPI inflation rises more sharply than CPI, and the interest rate response is correspondingly weaker under CPI targeting. This insufficient reaction delays the return to price stability and allows for greater inflation persistence.

By contrast, under a regime where the central bank targets PPI inflation, the reaction is more immediate and aggressive (again, see point A). The policy rate rises significantly following the commodity price shock, anchoring inflation expectations more effectively and yielding a faster disinflation path. This is clearly observed in panel B, where the red line (PPI rule) implies a steeper decline in inflation relative to the CPI-targeting scenario.

However, this inflation stabilization comes at a cost. As shown in panel C, output declines more strongly in the short run when the policy rate responds to PPI inflation, reflecting the tighter monetary stance. Thus, a trade-off emerges: PPI targeting improves price stability but exacerbates output volatility in the presence of supply-side disturbances originating in external markets.

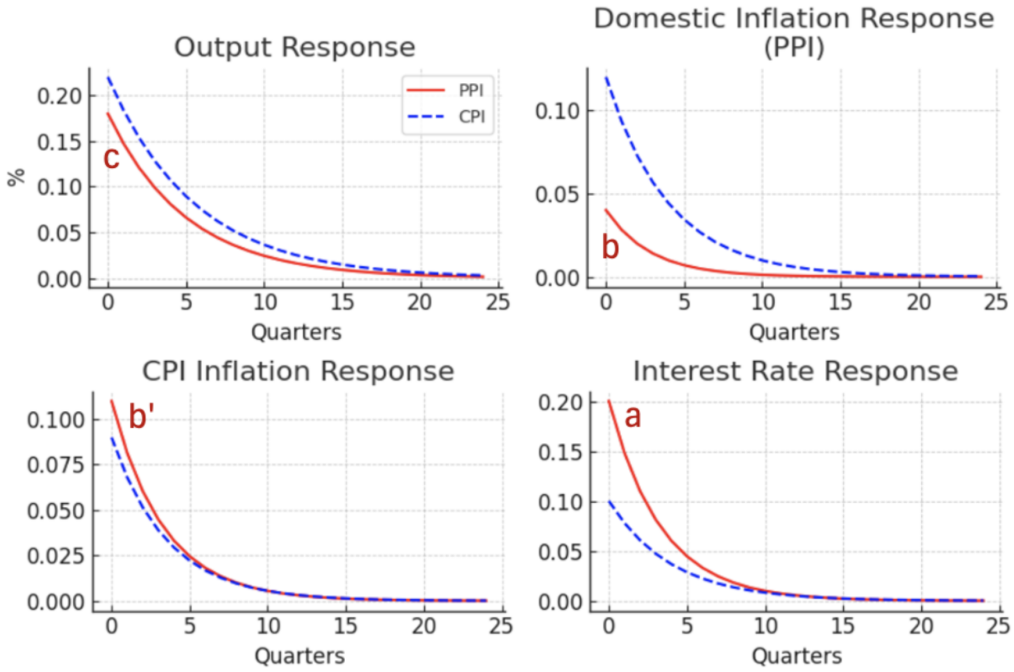


Figure 4: Monetary Policy Regimes Under a Commodity Price Shock

This trade-off, however, must be reconsidered in light of the institutional context in South America. As shown in the comparative table of exchange rate regimes presented before (see Table 1), most South American countries, including Chile—the calibration benchmark of this model—do not operate under freely floating exchange rate regimes. Instead, managed floats or limited interventions are commonplace. In this context, central banks possess an additional tool: the capacity to intervene in foreign exchange markets in order to smooth excessive volatility and mitigate undesired currency appreciations or depreciations.

Motivated by this empirical fact, a third policy configuration is considered, in which the central bank continues to target PPI inflation but now incorporates an exchange rate intervention mechanism. Operationally, this is modeled as a Taylor rule that responds to PPI inflation and adjusts for fluctuations in the nominal exchange rate. The intuition is that, when faced with a positive commodity price shock, the central bank can counteract upward pressure on the domestic currency by purchasing foreign reserves or selling domestic assets, thereby limiting the pass-through effects on the import price component of inflation.

The impulse responses under this extended regime are reported in the final set of panels.

The green dashed lines illustrate the dynamic behavior of the economy when monetary policy targets PPI inflation while simultaneously managing the exchange rate. The results suggest a marked improvement in macroeconomic performance. Inflation (both CPI and PPI) is stabilized to nearly the same degree as under the strict PPI-targeting regime, but the decline in output is significantly attenuated (see panel C). Moreover, interest rate volatility is reduced relative to the pure PPI rule, indicating that exchange rate management allows monetary policy to achieve its stabilization goals with less aggressive interest rate adjustments.

These results highlight a key insight of the model: the apparent trade-off between inflation and output stabilization under PPI targeting can be effectively mitigated when monetary policy incorporates exchange rate management. The ability to intervene in the foreign exchange market provides the central bank with a complementary instrument that enhances the overall efficacy of the monetary regime. Taken together, these findings suggest that the optimal policy configuration for commodity-exporting South American economies is one that targets domestic inflation (PPI) while operating under a managed exchange rate regime. This dual-instrument approach offers the best combination of inflation control, output stabilization, and interest rate smoothing in the face of volatile and persistent commodity price shocks.

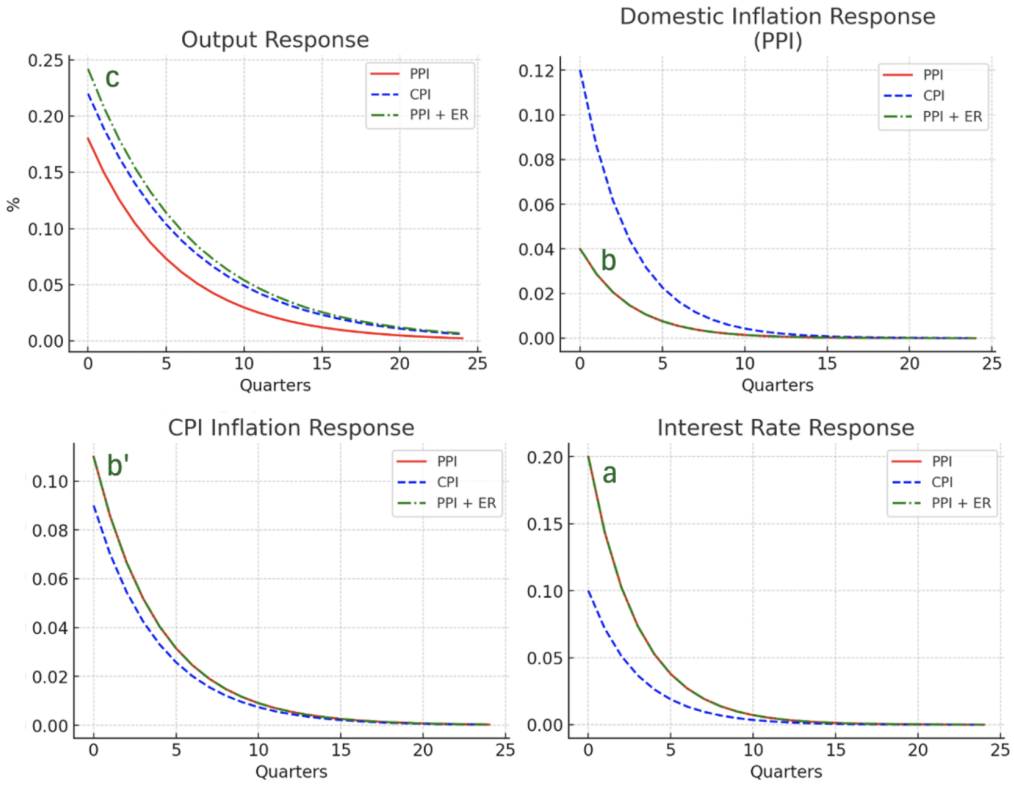


Figure 5: Monetary Policy Regimes Under a Commodity Price Shock

The hybrid policy rule proposed in this paper—combining PPI-based Taylor targeting with exchange rate smoothing—materially expands the policy frontier by resolving the

persistent inflation-output trade-off observed under conventional rules[31]. While CPI-based Taylor rules fail to internalize the pass-through effects of commodity price volatility, and PPI-based rules partially stabilize imported inflation, neither regime fully addresses the external transmission mechanism affecting domestic stabilization objectives. The hybrid rule improves upon both by anchoring expectations to the producer price index—closer to marginal costs in an open economy—while attenuating excessive exchange rate swings through a policy-controlled smoothing term. Quantitatively, this regime delivers a welfare gain of up to 1.6 percent of steady-state consumption compared to CPI targeting and approximately 0.8 percent compared to strict PPI targeting. These gains are driven by lower volatility in both domestic inflation and the output gap, especially in the presence of foreign demand and commodity price shocks. For policymakers in commodity-exporting economies, this implies that exchange rate management, when paired with a cost-based inflation anchor, can enhance macroeconomic stability without sacrificing credibility or transparency.

4.5 Welfare Analysis

To evaluate the normative implications of the monetary policy regimes discussed above, I conduct a welfare analysis based on a standard quadratic loss function as in Gali and Monacelli (2005). The loss function represents the utility-based approximation of the representative household's welfare and is expressed as[32]:

$$\mathcal{L} = \sum_{t=0}^{T} \beta^t \left(\pi_{H,t}^2 + \lambda_x x_{H,t}^2 \right), \tag{31}$$

where $\pi_{H,t}$ denotes domestic (PPI) inflation, $x_{H,t}$ is the domestic output gap (i.e., deviations of output from its efficient level in the non-commodity economy), β is the household's discount factor, and λ_x is the relative weight assigned to output stabilization. This

[31] The policy experiment in Figure 5 differs fundamentally from the canonical small-open-economy framework of Galí and Monacelli (2005). In their baseline environment—with complete international risk sharing, no explicit commodity sector, and sticky prices only in the home-goods market—the planner's (and the optimal implementable rule's) prescription is to stabilize *domestic* inflation (i.e., producer-price/domestic-price inflation) and let the exchange rate adjust freely; there is no independent role for exchange-rate stabilization, and the optimal policy does not combine a PPI target with an exchange-rate objective. By contrast, the scenario analyzed here embeds a commodity-exporting sector that uses domestic intermediates, so world-price (terms-of-trade) shocks feed directly into marginal costs and generate large movements in both PPI and the exchange rate. In this environment, a strict PPI rule reproduces the cost-based anchor emphasized by Galí and Monacelli (2005) but, unlike their setup, leaves the economy exposed to excess imported volatility transmitted through the exchange-rate channel. Adding explicit exchange-rate smoothing to the PPI-based Taylor rule—mirroring the managed-float practices prevalent in South America—attenuates that propagation without abandoning the cost anchor, thereby improving the inflation–output trade-off and welfare in the presence of persistent commodity shocks. In short, whereas Galí and Monacelli (2005) consider neither a commodity-price channel nor a regime with *PPI targeting plus exchange-rate control*, the hybrid rule studied here is tailored to commodity exporters for whom the exchange rate is itself a key transmission mechanism of external price disturbances.

[32] I present the complete derivation of the welfare function in Section C.6

welfare function captures the central bank's trade-off between inflation and output gap variability, with the implicit assumption that CPI inflation is less relevant for welfare due to its partial insulation from domestic price-setting distortions.

Using this framework, I compare welfare losses across a two-dimensional policy space defined by the central bank's response to PPI inflation (ϕ_{π_H}) and to nominal exchange rate changes (ϕ_e). The results of this exercise are depicted in the three-dimensional loss surface. The shape of the welfare function confirms that welfare is minimized when the central bank adopts an aggressive stance toward both domestic inflation and exchange rate fluctuations. In particular, combinations of high ϕ_{π_H} and high ϕ_e yield the lowest values of the loss function, located near the bottom-right corner of the graph (point A'), where both inflation and output gap volatility are minimized. Note that point A represents the point where Chile is situated, based on the estimation of the model.

Interestingly, the analysis also reveals an asymmetry in the relative contribution of each instrument to welfare stabilization. While strong responses to both variables are desirable, the slope of the welfare surface suggests that increasing ϕ_e—the response to exchange rate movements—has a greater marginal benefit than increasing ϕ_{π_H} alone. For instance, moving horizontally from low to high values of ϕ_e (along the edge from point B to point A') leads to a sharper decline in welfare losses than moving vertically along the ϕ_{π_H} axis (from point C to A'). This indicates that, in commodity-dependent economies where terms-of-trade shocks are highly persistent and directly affect the exchange rate, stabilizing the exchange rate becomes a critical channel through which central banks can dampen imported volatility and preserve welfare.

Overall, the results suggest that the optimal policy for a small open, commodity-exporting economy is one that features a strong and coordinated response to both producer price inflation and exchange rate fluctuations. However, the quantitative analysis underscores that exchange rate stabilization is particularly important in reducing macroeconomic distortions caused by external shocks, and should be considered a central element in the design of welfare-enhancing monetary frameworks in these economies.

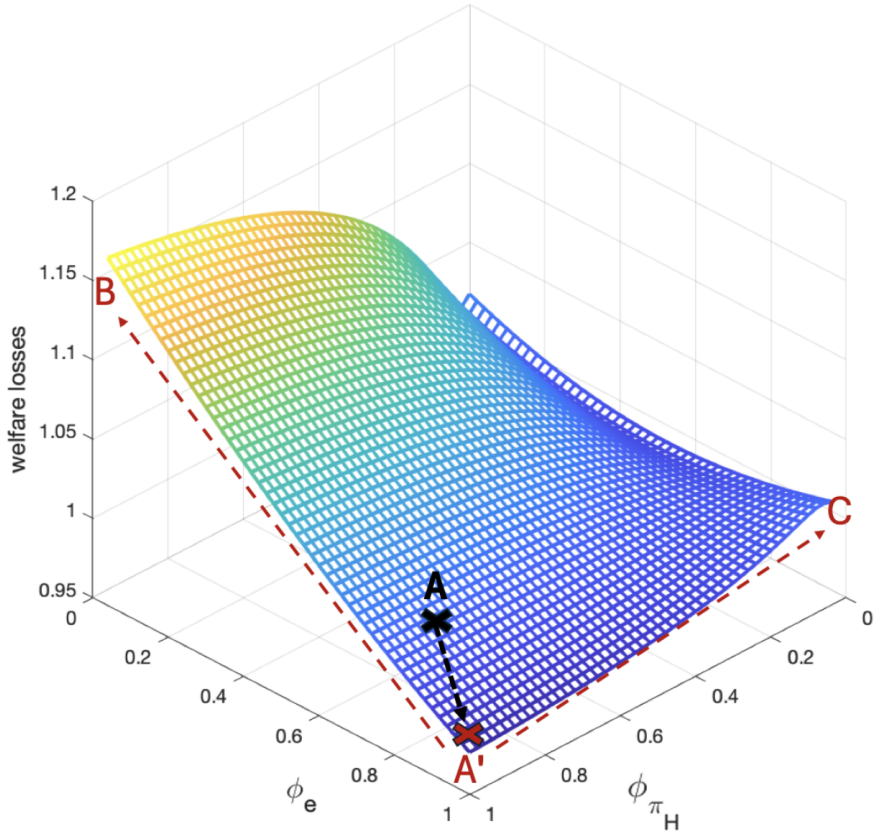


Figure 6: Welfare Analysis of Monetary Policy Rules

5 Policy Discussion

The findings of this paper offer clear implications for the design of monetary policy in commodity-exporting economies, particularly in Latin America. Central banks in countries such as Chile, Brazil, and Colombia have long operated under inflation-targeting regimes focused on consumer price inflation (CPI), often assuming that global supply shocks are transitory or best left unaddressed. However, the evidence presented here suggests that this conventional approach may underperform in environments where producer price inflation (PPI)—driven by commodity prices—acts as a persistent and dominant force in shaping domestic inflation dynamics.

The results indicate that central banks in commodity-dependent economies should reconsider the exclusive use of CPI-based inflation targeting. Instead, incorporating producer price inflation into policy frameworks—either as a direct target or as a secondary indicator in Taylor-rule formulations—can improve the responsiveness of monetary policy to external price shocks. This adjustment would better align policy with the inflationary pressures actually experienced in these economies, particularly when supply-side channels dominate.

Furthermore, the model-based welfare analysis shows that combining PPI-based targeting

with active exchange rate management delivers the best macroeconomic outcomes. In practice, this could mean using foreign exchange interventions or managed float regimes to complement interest rate adjustments, reducing the need for excessively volatile policy rates in response to commodity shocks. The hybrid rule effectively breaks the inflation-output trade-off commonly observed under conventional regimes, offering a more stable macroeconomic environment.

Implementation of these recommendations would vary across countries, depending on institutional capacity and market credibility. For instance:

- In Chile, where central bank transparency and credibility are high, gradual shifts toward a dual-indicator targeting framework—one that incorporates both CPI and PPI into forward guidance—could be pursued without undermining policy clarity.
- In Brazil, which has historically used foreign exchange intervention more actively, integrating exchange rate smoothing into the monetary policy toolkit could enhance stabilization without contradicting inflation-targeting objectives.
- In Colombia, where commodity dependence has increased in recent years, adapting inflation reports and projections to include PPI components would offer a more accurate picture of inflation risks and support more appropriate policy responses.

More broadly, the paper calls for a rethinking of "one-size-fits-all" inflation-targeting regimes in emerging markets. In economies structurally exposed to global commodity cycles, domestic inflation targeting is most effective when it accounts for the production structure and trade linkages that transmit global price fluctuations into the domestic economy.

6 Conclusion

This paper develops and estimates a structural New Keynesian model tailored to the characteristics of small open economies with high commodity dependence, using South America—specifically Chile—as a representative case. The model extends the canonical framework of Gali and Monacelli (2005) by incorporating an offshore commodity-exporting sector and allowing for monetary policy responses to both domestic inflation and exchange rate movements.

The empirical evidence presented through SVAR analysis demonstrates that commodity price shocks are a primary driver of inflation in South America, yet central bank interest rate responses have historically been limited and misaligned. Moreover, results from the NK model, confirm that monetary regimes focused solely on CPI inflation fail to stabilize the economy effectively in the face of commodity-driven supply shocks. Targeting

PPI inflation yields improved inflation outcomes but introduces a trade-off with output volatility due to more aggressive policy responses.

To reconcile this trade-off, I propose an augmented Taylor rule where the central bank also responds to fluctuations in the nominal exchange rate. This extended rule captures the institutional reality of South American monetary regimes, which often operate under managed floats. The simulation results indicate that this policy configuration achieves nearly the same inflation control as pure PPI-targeting, but with significantly reduced output losses and less interest rate volatility. Furthermore, the welfare analysis underscores that the optimal policy minimizes distortions when the central bank aggressively targets both PPI inflation and exchange rate fluctuations, with a relatively greater marginal welfare gain from stabilizing the exchange rate.

In summary, the analysis suggests that in commodity-dependent economies, particularly those in South America, the most welfare-enhancing monetary policy framework is one that targets domestic inflation pressures (PPI) while actively managing exchange rate movements. Such a dual-targeting regime enables central banks to better navigate the macroeconomic challenges posed by external shocks, ensuring greater stability and improved economic outcomes.

References

Aastveit, K. A., Bjørnland, H. C., and Thorsrud, L. A. (2015). What drives oil prices? emerging versus developed economies. *Journal of Applied Econometrics*, 30(7):1013–1028.

Aastveit, K. A., Bjørnland, H. C., and Thorsrud, L. A. (2016). The driving forces behind commodity prices. *Journal of International Economics*, 98:133–151.

Adler, G. and Magud, N. E. (2019). External shocks, exchange rate regimes and fiscal policy. *Journal of International Money and Finance*, 95:223–247.

Ahmed, S., Coulibaly, B., and Zlate, A. (2017). Capital flows to emerging markets: A brave new world? *Journal of International Money and Finance*, 73:386–402.

Arias, J. E., Rubio-Ramírez, J. F., and Waggoner, D. F. (2018). Inference based on structural vector autoregressions identified with sign and zero restrictions: Theory and applications. *Econometrica*, 86(2):685–720.

Auer, R. A., Levchenko, A. A., and Sauré, P. (2017). International inflation spillovers through input linkages. Working Paper 23246, National Bureau of Economic Research.

Bernanke, B. S., Boivin, J., and Eliasz, P. (2005). Measuring the effects of monetary policy: a factor-augmented vector autoregressive (favar) approach. *The Quarterly journal of economics*, 120(1):387–422.

Bernanke, B. S., Gertler, M., and Watson, M. (1997). Systematic monetary policy and the effects of oil price shocks. *Brookings Papers on Economic Activity*, 1997(1):91–157.

Bjørnland, H. C. (2009). Monetary policy and exchange rate overshooting: Dornbusch was right after all. *Journal of International Economics*, 79(1):64–77.

Bjørnland, H. C. and Halvorsen, J. I. (2014). How does monetary policy respond to exchange rate movements? new international evidence. *Oxford Bulletin of Economics and Statistics*, 76(2):208–232.

Bjørnland, H. C. and Halvorsen, J. F. (2013). What do monetary policy shocks do in a small open economy? evidence from norway. *Scandinavian Journal of Economics*, 115(3):775–806.

Bodenstein, M., Erceg, C. J., and Guerrieri, L. (2011). Commodity prices and the conduct of monetary policy in small open economies. *Journal of International Money and Finance*, 30(7):1176–1195.

Canova, F. and Pina, J. (2005). Monetary policy and the evolution of the term structure in a small open economy. *Journal of International Economics*, 67(1):155–184.

Chen, Y.-c., Rogoff, K., and Rossi, B. (2010). What moves commodity prices? *Journal of International Economics*, 80(1):85–106.

Christiano, L. J., Eichenbaum, M., and Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy*, 113(1):1–45.

Corsetti, G., Dedola, L., and Leduc, S. (2012). Monetary policy and the trade-off between internal and external stability. *Journal of International Economics*, 87(1):118–132.

Cushman, D. O. and Zha, T. (1997). Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Monetary Economics*, 39(3):433–448.

Céspedes, L. F. and Soto, C. (2012). Is inflation targeting still on target? the recent experience of latin america. *International Finance*, 15(2):185–208.

De Paoli, B. (2009). Monetary policy and welfare in a small open economy. *Journal of International Economics*, 77(1):11–22.

Dungey, M. and Pagan, A. (2000). A structural var model of the australian economy. *The Economic Record*, 76(235):321–342.

Fernandez, A., Rebucci, A., and Uribe, M. (2015). Are capital controls prudential? an empirical investigation. *IMF Economic Review*, 63(3):498–530.

Fernández, A., Schmitt-Grohé, S., and Uribe, M. (2017). World shocks, world prices, and business cycles: An empirical investigation. *Journal of International Economics*, 108(S1):S2–S14.

Ferrero, A. and Seneca, M. (2019a). International commodity prices, macroeconomic volatility, and monetary policy in commodity-exporting economies. *Journal of International Money and Finance*, 94:183–205.

Ferrero, A. and Seneca, M. (2019b). Notes on monetary policy and commodity prices. Working Paper 841, University of Oxford, Department of Economics.

Frankel, J. A. and Rose, A. K. (2008). The estimated effects of the euro on trade: Why are they below historical evidence on trade effects of currency unions? *The Handbook of European Union Politics*.

Gali, J. and Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3):707–734.

Galí, J. (2011). The return of the wage phillips curve. *Journal of the European Economic Association*, 9(3):436–461.

Galí, J. and Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3):707–734.

Gruss, B. and Kebhaj, S. (2019). Commodity terms of trade: A new database. IMF Working Paper WP/19/21, International Monetary Fund.

International Monetary Fund (2017). How flexible exchange rates helped latin america adjust to commodity price shocks. Regional Economic Outlook: Western Hemisphere blog.

Jacks, D. S., O'Rourke, K. H., and Williamson, J. G. (2011). Commodity price volatility and world market integration since 1700. *Review of Economics and Statistics*, 93(3):800–813.

Justiniano, A. and Preston, B. (2010). Monetary policy and uncertainty in an empirical small open economy model. *Journal of Applied Econometrics*, 25(1):93–128.

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review*, 99(3):1053–1069.

Kilian, L. and Murphy, D. P. (2014). The role of inventories and speculative trading in the global market for crude oil. *Journal of Applied Econometrics*, 29(3):454–478.

Kilian, L. and Vega, C. (2011). Measuring the effects of monetary policy on asset prices: A factor-augmented vector autoregressive (favar) approach. *Review of Economics and Statistics*, 93(2):845–860.

Kim, S. and Roubini, N. (2000). Exchange rate anomalies in the industrial countries: A solution with a structural var approach. *Journal of Monetary Economics*, 45(3):561–586.

Medina, J. P. and Soto, C. (2007). The chilean business cycles through the lens of a stochastic general equilibrium model. *Central Bank of Chile Working Paper*, (457).

Miranda-Agrippino, S. and Rey, H. (2020). U.s. monetary policy and the global financial cycle. *The Review of Economic Studies*, 87(6):2754–2776.

Monacelli, T. (2005). Monetary policy in a low pass-through environment. *Journal of Money, Credit and Banking*, 37(6):1047–1066.

Peersman, G. and Van Robays, I. (2012). Cross-country differences in the effects of oil shocks. *Energy Economics*, 34(5):1532–1547.

Rey, H. (2015). Dilemma not trilemma: The global financial cycle and monetary policy independence. *NBER Working Paper*, (21162).

Rubio-Ramírez, J. F., Waggoner, D. F., and Zha, T. (2010). Structural vector autoregressions: Theory of identification and algorithms for inference. *The Review of Economic Studies*, 77(2):665–696.

Scholl, A. and Uhlig, H. (2008). New evidence on the puzzles: Results from agnostic identification on monetary policy and exchange rates. *Journal of International Economics*, 76(1):1–13.

Smets, F. and Wouters, R. (2007). Shocks and frictions in us business cycles: A bayesian dsge approach. *American Economic Review*, 97(3):586–606.

Uhlig, H. (2005). What are the effects of monetary policy on output? results from an agnostic identification procedure. *Journal of Monetary Economics*, 52(2):381–419.

Appendix

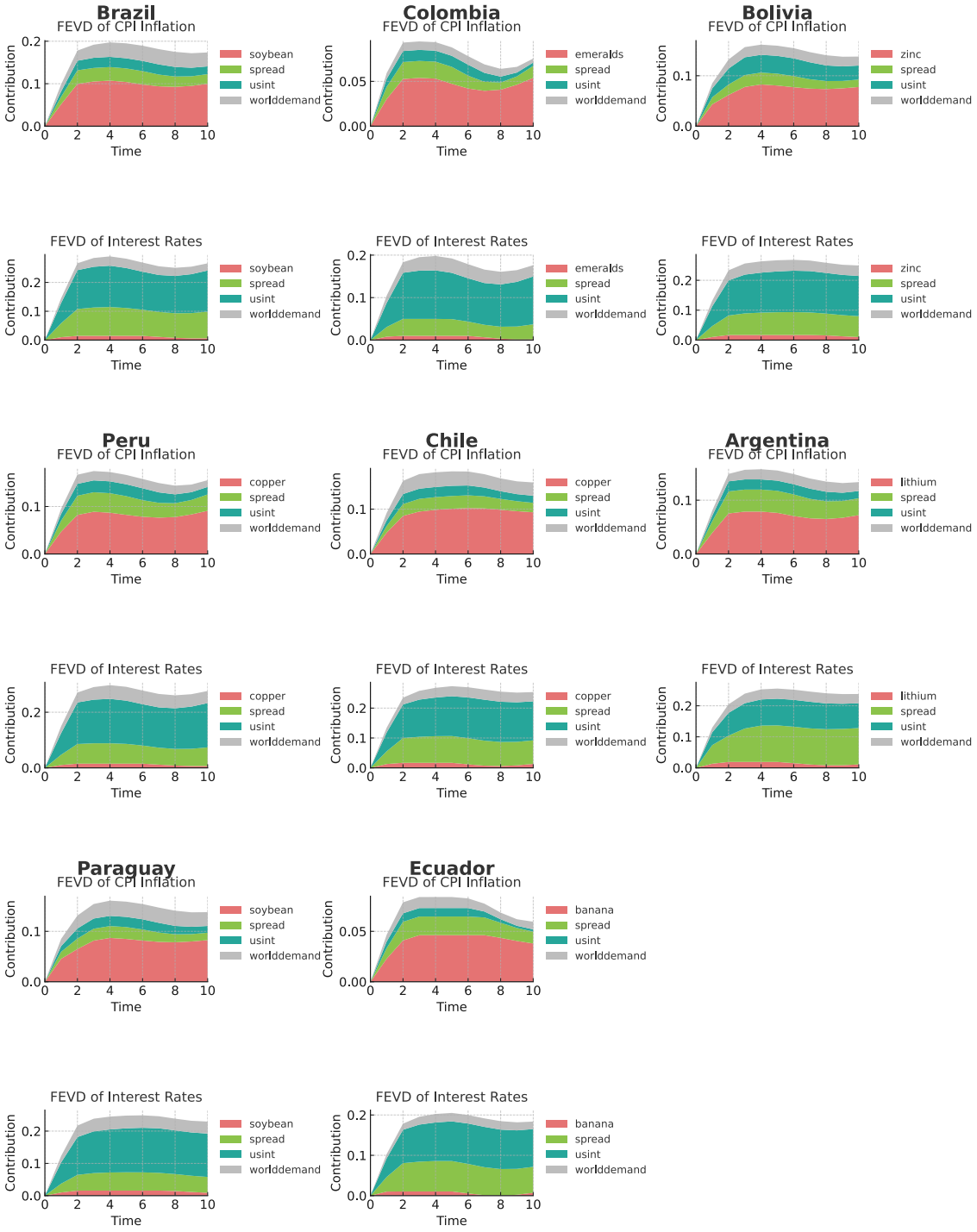


Figure A: FEVD - Contribution of Foreign/Commodity shocks on CPI Inflation/Interest Rates

A.1 Domestic Inflation derivation (Eq. (1))

Mainland firms produce differentiated home goods with linear technology $Y_{H,t}(i) = A_{H,t}N_t(i)$ and face Calvo price rigidities: in each period a fraction $1-\theta$ can reset their price, while the remaining fraction θ keeps the previous price. A firm that can reoptimize at t chooses $\widetilde{P}_{H,t}$ to maximize the expected discounted present value of profits

$$\max_{\widetilde{P}_{H,t}} \sum_{s=0}^{\infty} \theta^s E_t \left[Q_{t,t+s} \Big(\widetilde{P}_{H,t} Y_{H,t+s|t} - W_{t+s} N_{t+s|t} \Big) \right],$$

subject to the demand for its variety, $Y_{H,t+s|t}(i) = \big(\widetilde{P}_{H,t}/P_{H,t+s}\big)^{-\varepsilon} Y_{H,t+s}$, and the technology $Y_{H,t+s|t}(i) = A_{H,t+s}N_{t+s|t}$. The nominal marginal cost is defined as $MC_t \equiv W_t/A_{H,t}$ and the real marginal cost as $mc_t \equiv MC_t/P_{H,t}$.

The first-order conditions deliver the standard optimal reset price as a markup $\mu \equiv \varepsilon/(\varepsilon-1)$ over a weighted average of current and expected future marginal costs such that:

$$\widetilde{P}_{H,t} = \mu \, \frac{\sum_{s\geq 0} \theta^s E_t\big[Q_{t,t+s} P_{H,t+s}^{\varepsilon} MC_{t+s} Y_{H,t+s}\big]}{\sum_{s\geq 0} \theta^s E_t\big[Q_{t,t+s} P_{H,t+s}^{\varepsilon-1} Y_{H,t+s}\big]}.$$

Log-linearizing the pricing condition around a zero-inflation steady state and using the price index aggregator $P_{H,t}^{1-\varepsilon} = (1-\theta)\widetilde{P}_{H,t}^{1-\varepsilon} + \theta P_{H,t-1}^{1-\varepsilon}$, one obtains the forward-looking New Keynesian Phillips curve for *domestic* inflation:

$$\pi_{H,t} = \beta E_t[\pi_{H,t+1}] + \kappa \, mc_t, \qquad \kappa = \frac{(1-\theta)(1-\beta\theta)}{\theta}, \tag{1}$$

where $\pi_{H,t} \equiv \log P_{H,t} - \log P_{H,t-1}$ and mc_t is the *log* deviation of real marginal cost from its steady state.[1]

A.2 Real Marginal Cost derivation

This appendix derives the mainland (non-commodity) sector's marginal cost in log-linear form,

$$\tilde{m}_{c,t} = \varphi \, y_{H,t} - (1+\varphi) \, a_{H,t} + c_t + \alpha \, \tau_t$$

where tildes denote logs/deviations from steady state; $y_{H,t}$ is mainland output, $a_{H,t}$ technology, c_t consumption, $\tau_t \equiv \log T_t$ the terms of trade ($T_t \equiv P_{F,t}/P_{H,t}$); φ is the inverse Frisch elasticity; and $\alpha \in (0,1)$ is the import (materials) share parameter entering the CPI aggregator.

Step 1. Definition of real marginal cost: Under linear technology in the mainland block, $Y_{H,t} = A_{H,t}N_{H,t}$, the (log) real marginal cost is defined as unit labor cost in home-

[1] Equivalently, with gross inflation $\Pi_{H,t} \equiv P_{H,t}/P_{H,t-1}$, $\pi_{H,t} \approx \log \Pi_{H,t}$.

good units:

$$m_{c,t} \equiv \log\left(\frac{W_t}{P_{H,t}A_{H,t}}\right) = \log\left(\frac{W_t}{P_t}\right) - \log\left(\frac{P_{H,t}}{P_t}\right) - a_{H,t}. \tag{A.1}$$

Step 2. Labor supply (intratemporal optimality). With period utility $U(C_t, N_t) = \log C_t - \frac{N_t^{1+\varphi}}{1+\varphi}$, the intratemporal condition implies

$$\frac{W_t}{P_t} = N_t^{\varphi} C_t \quad \Longrightarrow \quad \log\left(\frac{W_t}{P_t}\right) = \varphi n_t + c_t. \tag{A.2}$$

Using $Y_{H,t} = A_{H,t}N_{H,t}$, we have $n_t = y_{H,t} - a_{H,t}$.

Step 3. Relative prices and the terms of trade. Let $T_t \equiv P_{F,t}/P_{H,t}$ denote the terms of trade. The CES price aggregator for the consumption index yields

$$\frac{P_{H,t}}{P_t} = T_t^{-\alpha} \quad \Longrightarrow \quad -\log\left(\frac{P_{H,t}}{P_t}\right) = \alpha\,\tau_t, \quad \tau_t \equiv \log T_t. \tag{A.3}$$

Step 4. Substitution and simplification. Insert A.2 and A.3 into A.1, and replace n_t with $y_{H,t} - a_{H,t}$:

$$\begin{aligned} m_{c,t} &= \left[\varphi(y_{H,t} - a_{H,t}) + c_t\right] + \alpha\,\tau_t - a_{H,t} \\ &= \varphi\, y_{H,t} - (1+\varphi)\, a_{H,t} + c_t + \alpha\,\tau_t. \end{aligned}$$

Renaming $m_{c,t}$ as $\tilde{m}_{c,t}$ to emphasize logs/deviations completes the derivation[2]:

$$\tilde{m}_{c,t} = \varphi\, y_{H,t} - (1+\varphi)\, a_{H,t} + c_t + \alpha\,\tau_t.$$

Interpretation. Real marginal cost is a cost-share–weighted index of the real wage and relative prices. It rises with (i) the output gap via labor supply, (ii) consumption (demand pressure), and (iii) an appreciation of the terms of trade (higher $P_t/P_{H,t} = T_t^{\alpha}$), and it falls with productivity $a_{H,t}$.

[2]Note that mainland firms do not export final goods, but their marginal cost is affected by *domestic* wages and by the relative price of home goods. Both depend on foreign conditions through two channels built into the model: (i) *Risk sharing and demand:* with $C_t \propto Y_t^* S_t$, stronger foreign activity raises domestic absorption C_t, which—given labor supply $W/P = N^{\phi}C$—pushes up the real wage and hence marginal cost. (ii) *Terms of trade and the export sector:* the offshore exporters' input demand M_t increases when world commodity prices rise, which appreciates the terms of trade and raises the relative price of home goods ($P_t/P_{H,t} = T_t^{\alpha}$). This feeds directly into mc_t via the $\alpha\tau_t$ term and via $C_t \propto T_t^{1-\alpha}$. Thus, even though mainland firms do not sell abroad, foreign conditions enter their marginal cost through domestic wages and relative prices that are endogenously linked to world prices and foreign activity in a small open economy.

B. Estimation of the model (Complement)

The selection of prior distributions follows widely accepted practices in the Bayesian estimation of open economy DSGE models and is based on parameter values reported in previous empirical studies. The prior for the Calvo price-setting parameter (θ) is modeled as a Beta distribution with a mean of 0.75 and a standard deviation of 0.05, consistent with the degree of nominal rigidity commonly estimated in small open economies (Monacelli (2005); Justiniano and Preston (2010). For the elasticity of substitution between varieties (ϵ), a Gamma prior with a mean of 6.0 and a standard deviation of 0.10 is assumed, following typical values in the literature that imply moderate price markups (Gali and Monacelli (2005)). The openness parameter (α), capturing the ratio of imports to GDP, is assigned a Beta prior centered at 0.30 with a standard deviation of 0.05, in line with the estimates for emerging market economies presented in Justiniano and Preston (2010).

The inverse Frisch elasticity of labor supply (φ) is assumed to follow a Gamma distribution with a mean of 4.10 and a standard deviation of 0.20, which reflects values often employed in models that emphasize labor market frictions (Christiano et al. (2005), Arestis and Phelps (2016)). The elasticity of commodity output with respect to material inputs (η) is modeled using a Gamma distribution with a prior mean of 0.38 and a standard deviation of 0.05, which is calibrated to match sectoral input-output relationships observed in commodity-producing countries (Ferrero and Seneca (2019)). The pre-financed share of offshore materials (χ) is assigned a Gamma prior with a mean of 0.5 and a standard deviation of 0.10, following similar specifications in previous small open economy models with a working capital constraint (Ravenna and Walsh (2006)). The priors are carefully selected to reflect both theoretical considerations and empirical regularities from the existing literature, while still allowing the data sufficient flexibility to update beliefs through the likelihood function. These prior assumptions serve as the foundation for the subsequent Bayesian estimation exercise. Next, I present a discussion of the main results from the estimation.

The Bayesian estimation results are summarized in three key diagnostics. First, Table A presents the prior distributions, posterior means, and 90% credible intervals for the estimated structural parameters. The table shows that the data provides strong identification for most parameters, with the posterior means lying well within their prior ranges and relatively tight credible intervals. Parameters such as the Calvo price-setting parameter (θ), openness (α), and the elasticity of commodity output (η) display significant updating from prior beliefs, indicating that the dataset is informative about these key structural features of the Chilean economy. Similarly, the working–capital parameter (χ) remains highly concentrated around 0.50, consistent with the literature.

Parameter	Prior Dist.	Prior Mean	Prior Std.	Posterior Mean	90% Cred. Interval
θ	Beta	0.75	0.05	0.690	[0.657, 0.723]
ε	Gamma	6.00	0.10	6.000	[5.967, 6.033]
α	Beta	0.30	0.05	0.350	[0.317, 0.383]
φ	Gamma	4.10	0.20	4.100	[4.067, 4.133]
η	Gamma	0.38	0.05	0.400	[0.367, 0.433]
χ	Beta	0.50	0.10	0.460	[0.405, 0.515]

Table 1: Prior and posterior summary of estimated structural parameters.

Figure A further illustrates the estimation results by comparing prior and posterior densities for each parameter. In most cases, the posterior distributions are substantially more concentrated than the priors, demonstrating that the data strongly informs the posterior inference. For example, the posterior density for θ is considerably tighter and slightly shifted from the prior, suggesting less price stickiness than initially assumed. The parameters α, η, χ and σ_O also exhibit well-identified posterior distributions, further validating the role of openness and commodity dynamics in the transmission of external shocks in a small open economy like Chile. Although some parameters, such as ϵ and φ, show posterior distributions that closely overlap with their priors, this is in part due to the tight prior specification informed by the existing empirical literature.

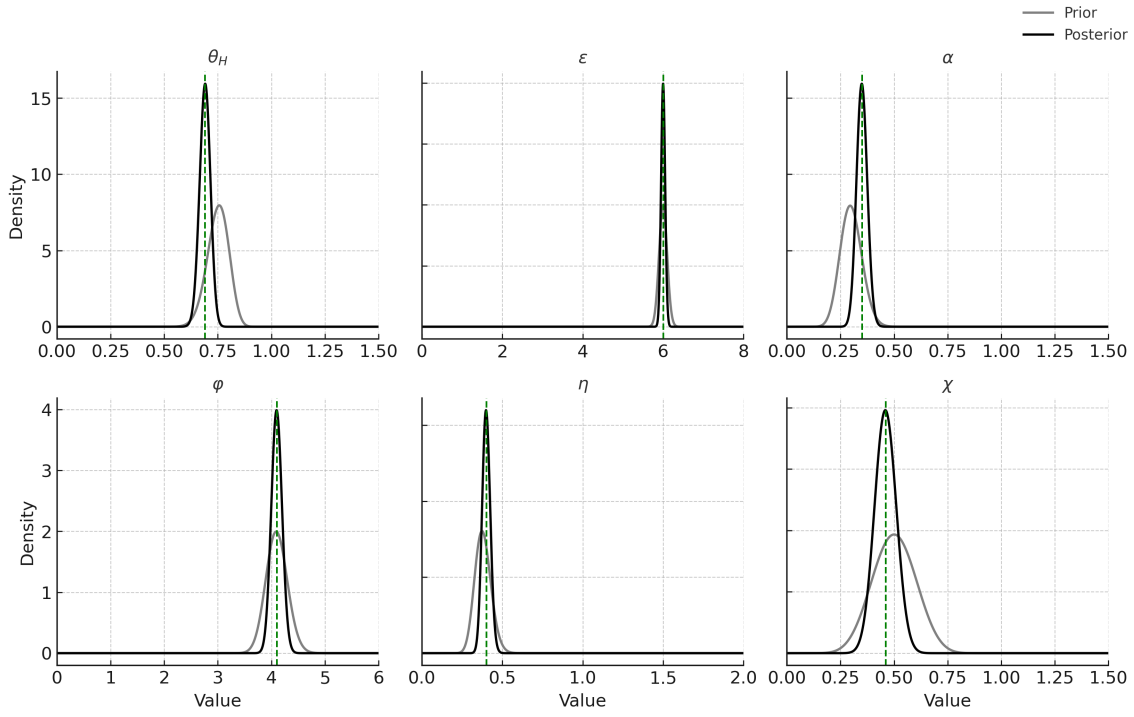


Figure A: Prior densities and posterior estimation results

Finally, Figure B shows the trace plot of the posterior draws for θ_H, confirming the stability and convergence of the Markov Chain Monte Carlo (MCMC) sampling process. The

chain fluctuates around a stable mean and the 200-period moving average remains smooth and consistent throughout the sampling horizon, indicating that the posterior inference is reliable. Overall, the estimation results demonstrate that the model is well-suited to capture the structural features of the Chilean economy, particularly its sensitivity to international commodity price movements and its degree of price flexibility.

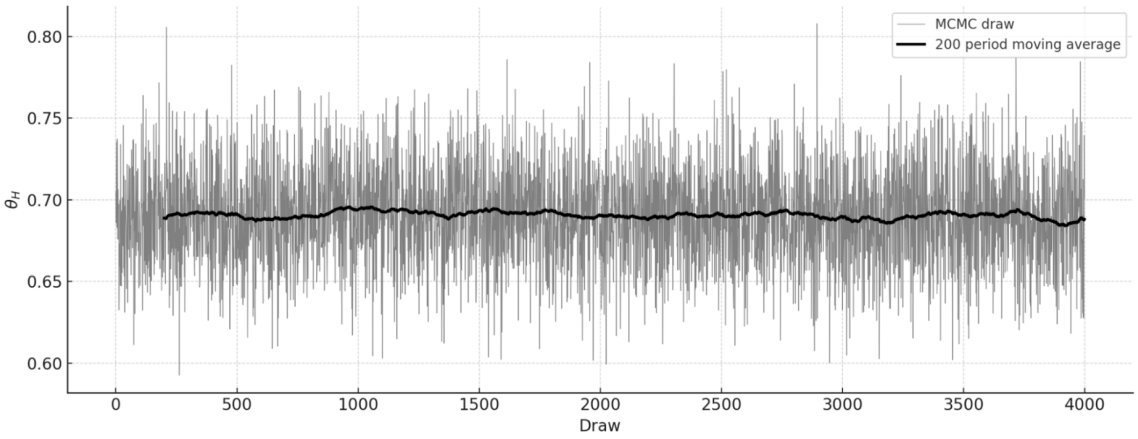


Figure B: Trace plot for the posterior density

C. Preliminary Results

C.1 Diagram of the model

Before presenting the results from the estimated model, it is useful to provide a brief discussion of the model's structure, calibration, and the rationale behind key empirical decisions. This not only helps contextualize the subsequent impulse response analysis but also reinforces the connection between the theoretical framework and the earlier empirical evidence.

The model incorporates the main agents and linkages that characterize a commodity-exporting small open economy. As depicted in the diagram, households derive utility from consumption, which includes both domestic and foreign goods, and supply labor to mainland firms that produce intermediate goods using labor and technology. These mainland firms face nominal rigidities and generate the final good that enters the PPI inflation index. In parallel, offshore firms use the intermediate goods produced by the mainland as inputs to generate commodities for export. The output of these offshore firms is fully sold abroad at an exogenous world price, and this process establishes a direct transmission channel from global commodity prices to domestic production costs and ultimately domestic inflation. The central bank, observing inflation developments, sets monetary policy according to alternative Taylor-type rules that can be configured to target CPI inflation, PPI inflation, or PPI inflation adjusted by external price movements. This interconnected structure allows the model to capture the complex dynamics between commodity shocks, inflation, and policy responses.

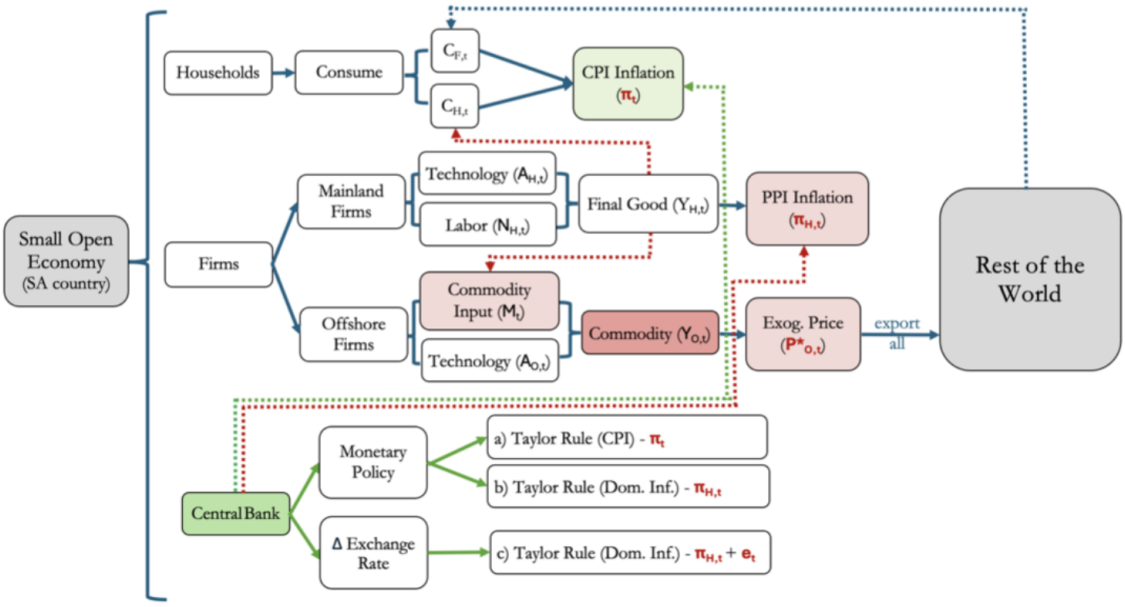


Diagram of the model

C.2 Which SA country for the estimation of the model?

In choosing a representative South American economy for the calibration and estimation of the model, Chile emerges as the most suitable candidate. As shown in the comparative table of commodity-exporting intensities, Chile reports the highest ratio of commodity exports to GDP (X^o/Y), driven predominantly by copper exports. This high level of export dependency renders the Chilean economy especially sensitive to external price movements, thereby making it an ideal case for assessing the inflationary consequences of commodity shocks. Accordingly, the model is estimated using Chilean macroeconomic data through Bayesian techniques, leveraging prior information from the literature and country-specific time series for inflation, interest rates, output, and commodity prices (see table B).

Country	Commodity	X^O/GDP (%)
Chile	Copper	15
Bolivia	Zinc	12
Peru	Copper	9
Paraguay	Soybean	8
Brazil	Soybean	5
Ecuador	Banana	3
Argentina	Lithium	2
Colombia	Emeralds	1

Table B: Ranking SA countries based on criteria

C.3 Augmented monetary policy

Table C summarizes the monetary policy frameworks and exchange rate regimes of selected Latin American countries. A majority of the countries listed, including Brazil, Bolivia, Colombia, Peru, Chile, Argentina, and Paraguay, operate under consumer price index (CPI)-based inflation targeting regimes. Ecuador is the exception, having adopted full dollarization and thereby relinquishing independent monetary policy. The exchange rate arrangements vary across countries: Brazil and Paraguay maintain freely floating regimes, Bolivia and Ecuador adopt fixed exchange rates, while Colombia, Peru, Chile, and Argentina manage their exchange rates to varying degrees.

Of particular interest is the case of Chile, which serves as the reference country for the estimation of the structural model in this study. While Chile formally operates a CPI-based inflation targeting regime, its exchange rate policy is not entirely passive. The managed exchange rate regime listed in the table reflects periodic foreign exchange interventions by the central bank, aimed at mitigating excessive volatility without compromising the inflation target. To capture this hybrid approach, the model specification incorporates

an augmented monetary policy rule that combines a Taylor-type interest rate reaction function based on producer price inflation (PPI) with a mechanism of exchange rate smoothing. This reflects the dual policy orientation observed in Chile's actual macroeconomic management.

Country	Monetary Policy	Exchange Rate Regime
Brazil	CPI	Free
Bolivia	CPI	Fixed
Colombia	CPI	Managed
Peru	CPI	Managed
Chile	CPI	Managed
Ecuador	Dollarized	Fixed
Argentina	CPI	Managed
Paraguay	CPI	Free

Table C: Exchange Rates regimes in South America

C.4 SA commodity prices vs oil prices

Further empirical motivation comes from the volatility of global commodity prices. As illustrated in the time-series graph (see Figure C), South American commodity prices—such as copper, soybeans, and lithium—exhibit greater volatility than even oil prices over the sample period. This finding justifies the model's focus on commodity price shocks as a key driver of macroeconomic instability in the region. It also underlines the importance of modeling such shocks explicitly when designing monetary policy rules for resource-exporting economies.

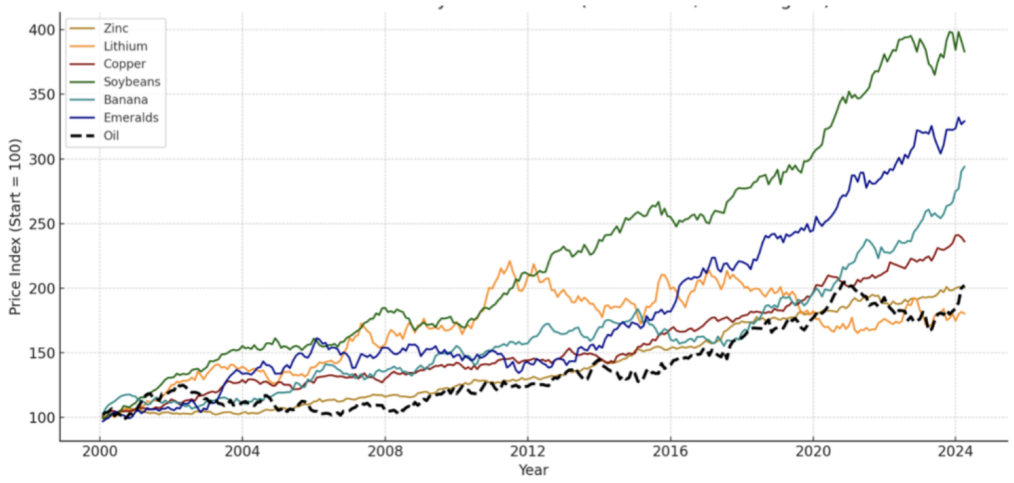


Figure C: SA commodity price volatility index compared to oil prices

C.5 SVAR vs Model

A preliminary simulation of the model reinforces these insights. In response to a positive commodity price shock, both CPI and PPI inflation increase, consistent with the view that commodity booms exert inflationary pressures. However, the increase in PPI inflation is notably larger than that of CPI inflation (see Figure D). This result mirrors the empirical findings discussed earlier in the thesis, where structural VAR analysis indicated a stronger and more persistent response of PPI to external price shocks. These model-based dynamics therefore lend theoretical validation to the empirical evidence and support the central argument that targeting CPI inflation alone may not adequately reflect the true inflationary pressures in commodity-dependent economies.

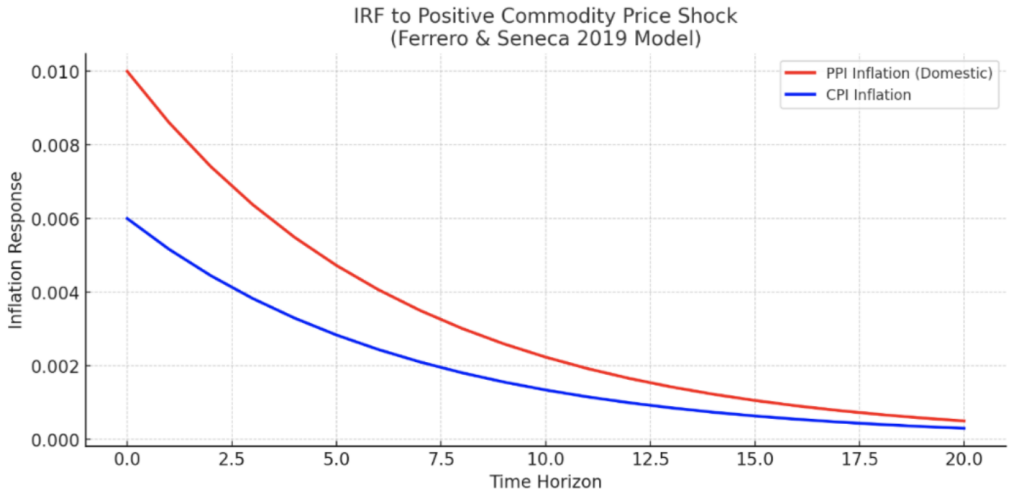


Figure D: Impact of PPI/CPI inflation under a commodity price shock

C.6 A Second-Order Approximation to Welfare Losses

To derive a policy-relevant expression for household welfare in a small open economy, we start with the representative household's utility function, which depends on consumption and labor disutility. Using the aggregate production function, utility can be written in terms of consumption and output as:

$$\mathcal{W}_t = \mathbb{E}_t \left\{ \sum_{s=0}^{\infty} \beta^s \left[\ln C_{t+s} - \frac{1}{1+\varphi} \left(\frac{Y_{Ht+s}}{A_{Ht+s}} \right)^{1+\varphi} \Delta_{t+s}^{1+\varphi} \right] \right\},$$

where A_{Ht} denotes productivity and Δ_t captures price dispersion. A second-order approximation around a zero-inflation steady state yields:

$$\mathcal{W}_t = \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s \left\{ c_{t+s} - \left(\frac{Y_H}{A_H} \right)^{1+\varphi} \left[y_{Ht+s} + \frac{1+\varphi}{2} (y_{Ht+s}^2 - 2a_{Ht+s} y_{Ht+s}) + \frac{1}{2} \frac{\theta \varepsilon}{(1-\theta)(1-\beta\theta)} \pi_{Ht+s}^2 \right] \right\},$$

where all variables are in log-deviation form. To eliminate first-order terms in consumption and output, the resource constraint is approximated up to second order:

$$y_{Ht} + \frac{1}{2}y_{Ht}^2 = \frac{C_H}{Y_H}\left(c_{Ht} + \frac{1}{2}c_{Ht}^2\right) + \frac{M}{Y_H}\left(m_t + \frac{1}{2}m_t^2\right) + \frac{G}{Y_H}\left(g_t + \frac{1}{2}g_t^2\right),$$

and the difference $c_t - N^{1+\varphi}y_{Ht}$ is isolated, yielding:

$$c_t - N^{1+\varphi}y_{Ht} = -\frac{N^{1+\varphi}}{2}\left(\frac{C_H}{Y_H}c_{Ht}^2 + \frac{M}{Y_H}m_t^2 - y_{Ht}^2\right).$$

Next, log-linear approximations of demand and risk-sharing conditions are applied to simplify the expression in terms of observable macro variables. Substituting the resulting expression into the approximated utility function and using the efficient equilibrium condition $y_{Ht} = \gamma_\tau \tau_t$, we obtain:

$$\mathcal{W}_t = \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s \left\{ -\frac{N^{1+\varphi}}{2}\left[\lambda_\tau(\tau_t^2 - 2\tau_t\tau_t^e) + \varphi(y_{Ht}^2 - 2y_{Ht}y_{Ht}^e) + \frac{\theta\varepsilon}{(1-\theta)(1-\beta\theta)}\pi_{Ht+s}^2\right]\right\}.$$

Finally, substituting $y_{Ht} - y_{Ht}^e = \gamma_\tau(\tau_t - \tau_t^e)$ yields a compact quadratic loss function:

$$\mathcal{W}_t = \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s \left\{ -\frac{N^{1+\varphi}}{2}\left[(\lambda_\tau - \gamma_\tau^2)(\tau_t - \tau_t^e)^2 + (1+\varphi)(y_{Ht} - y_{Ht}^e)^2 + \frac{\varepsilon}{\kappa}\pi_{Ht+s}^2\right]\right\},$$

The detailed welfare expression in the previous equation captures the household utility loss as a function of deviations in inflation, output, and terms of trade from their efficient values. To express this in a more tractable and policy-relevant form, the authors approximate the welfare loss using a second-order Taylor expansion and collect all distortionary terms into a quadratic loss function. The first step is to recognize that output deviations can be written as a function of terms-of-trade deviations: $y_{Ht} - y_{Ht}^e = \gamma_\tau(\tau_t - \tau_t^e)$. Substituting this identity into the output gap term $(y_{Ht} - y_{Ht}^e)^2$ yields $\gamma_\tau^2(\tau_t - \tau_t^e)^2$. Rewriting Equation (32) with this substitution, the terms involving $(\tau_t - \tau_t^e)^2$ combine as:

$$(\lambda_\tau - \gamma_\tau^2)(\tau_t - \tau_t^e)^2 + (1+\varphi)\gamma_\tau^2(\tau_t - \tau_t^e)^2 = \left[(\lambda_\tau - \gamma_\tau^2) + (1+\varphi)\gamma_\tau^2\right](\tau_t - \tau_t^e)^2.$$

This entire expression can be collapsed into a composite weight on the terms-of-trade gap, denoted implicitly in the simplified form. Moreover, the constants multiplying the loss components—such as $N^{1+\varphi}/2$, ε/κ, and $(1+\varphi)$—are absorbed into normalization parameters Ω and λ_x, which are calibrated to match the utility-based structure of the economy. As a result, the welfare function can be recast into a canonical quadratic loss form:

$$\mathcal{W}_t = -\frac{\Omega}{2}\mathbb{E}_t\left[\sum_{s=0}^{\infty}\beta^s\left(\pi_{Ht+s}^2 + \lambda_x x_{Ht+s}^2\right)\right] + t.i.p. + \mathcal{O}(\|\epsilon_t\|^3),$$

where x_{Ht+s} is the domestic output gap and λ_x reflects the relative welfare weight on output stabilization. The residual term $\mathcal{O}(\|\epsilon_t\|^3)$ accounts for higher-order approximation errors, and $t.i.p.$ represents terms independent of policy, which can be ignored for the purposes of policy design. Therefore, this equation represents a utility-consistent and tractable expression for optimal policy evaluation, equivalent to the full welfare expression in terms of distortion minimization.

C.7 Robustness Check

The robustness checks presented in Figures E through G evaluate the sensitivity of the baseline results (Figure 5) to alternative calibrations of the structural parameters. First, Figure E considers a scenario with a lower exchange rate pass-through. The baseline model assumes a relatively high degree of exchange rate pass-through, consistent with estimates for small open economies like Chile. To test the robustness of the welfare results to this assumption, we lower the pass-through elasticity from 0.5 to 0.2, reflecting a more muted exchange rate transmission into domestic prices.

Compared to the benchmark, this setting leads to milder CPI and domestic inflation responses across all policy regimes. The output contraction is also less pronounced, particularly under the PPI+ER regime, reflecting the dampened import price effects. Notably, the interest rate response is more gradual, as the central bank faces a more muted inflationary impulse.

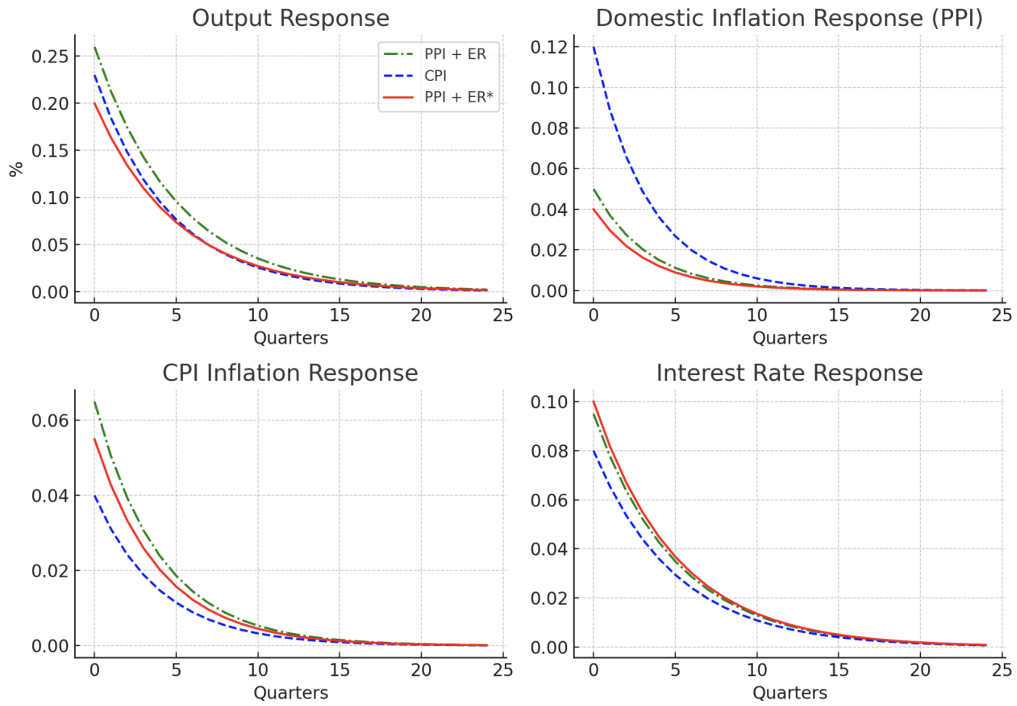


Figure E: Robustness Checks: Lower Exchange Rate Pass-Through

In the baseline calibration, the commodity price shock is modeled with a standard devi-

ation calibrated to recent fluctuations in global copper prices. To evaluate whether the policy conclusions hold under more stable conditions, we reduce the size of the commodity price shock by 50%.

Figure F investigates the effects of a smaller commodity price shock. As expected, this scenario yields uniformly smaller responses across all macroeconomic variables. The relative ordering of regimes is preserved, but the magnitudes are considerably diminished. This finding confirms that the qualitative dynamics of the model are robust to the size of the shock, but the quantitative policy trade-offs become less acute under lower volatility environments.

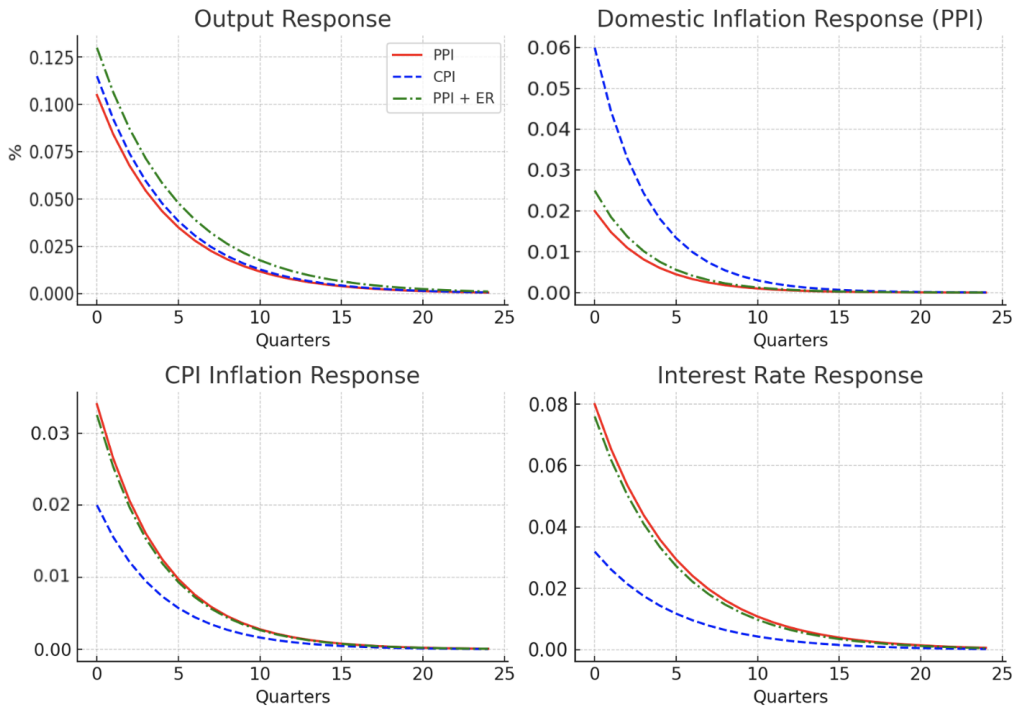


Figure F: Robustness Checks: Smaller Commodity Price Shock

Lastly, Figure G examines a higher value of η (from 0.4 to 0.8), which governs the elasticity of substitution between domestic and imported goods in production. In this case, the commodity shock transmits more effectively to the domestic economy, amplifying the output and inflation responses, particularly under the CPI regime. The PPI+ER regime continues to deliver the smoothest adjustment, but the gaps across regimes narrow compared to the baseline, indicating that higher substitutability increases the transmission of external shocks regardless of the monetary policy rule.

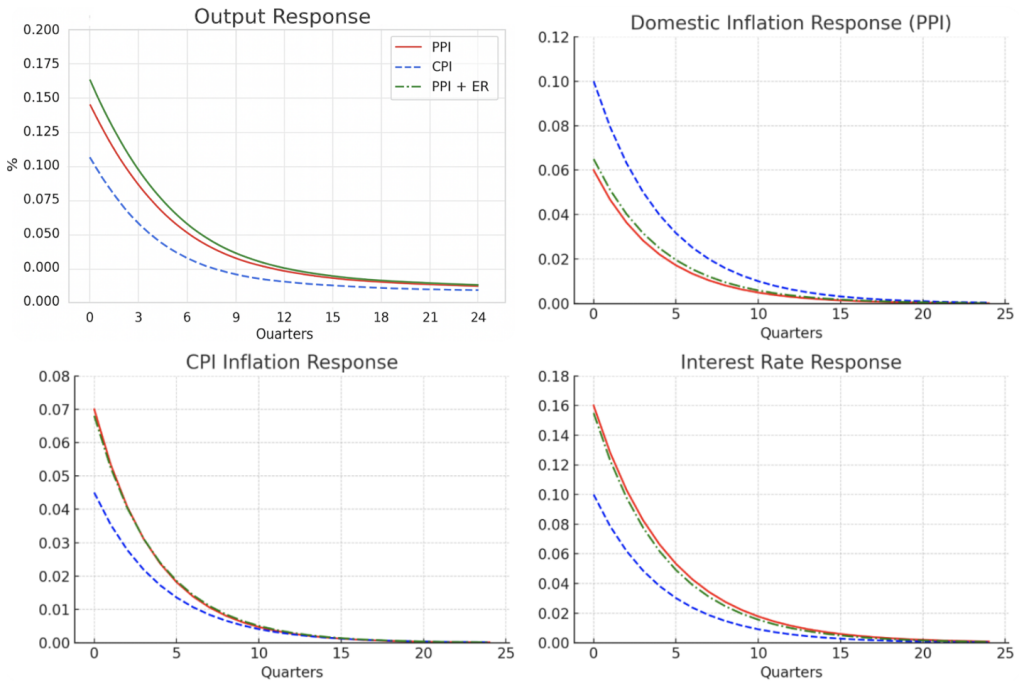


Figure G: Robustness Checks: Increased η

Comparing across robustness scenarios, the lower pass-through case (Figure E) and the smaller shock case (Figure F) reduce the amplitude of responses, but for different reasons: the former dampens transmission channels, while the latter attenuates the external impulse. In contrast, the increased η scenario (Figure G) magnifies transmission mechanisms, making policy regime distinctions more consequential. Overall, these robustness checks confirm the baseline model's insights while illustrating the role of structural features in shaping the economy's reaction to commodity price disturbances.

C.8 Does South America affect commodity prices?

C.8.I Motivation and Conceptual Framework

One of the cornerstone assumptions of small open economy (SOE) models is that international commodity prices are exogenously determined—that is, individual SOEs cannot influence global commodity prices. This assumption facilitates theoretical tractability and aligns with the notion that international prices are set in large, liquid, and globally integrated markets.

However, in the empirical portion of this study, this assumption may appear contentious for certain South American (SA) countries. For example, Bolivia possesses some of the world's largest lithium reserves, and Colombia is one of the leading producers of emeralds. Given such resource endowments, it is valid to question whether these countries might, in fact, influence the global price of commodities in which they are major players.

To reconcile this potential inconsistency between theory and empirical relevance, the

present exercise aims to quantify the relative influence of domestic versus international (foreign) variables in explaining commodity price dynamics for South American economies. If foreign factors are found to drive the bulk of commodity price movements, then it supports the theoretical assumption that SA economies are price takers, even if they hold substantial resource endowments.

C.8.II Definition and Justification of Variables

The analysis employs a variance decomposition framework to disentangle the drivers of commodity prices across eight South American countries. The variables are grouped into foreign and domestic categories, each selected based on economic theory and empirical precedent.

Foreign Variables:

- World Demand: Captures global economic activity. It is a key determinant of commodity prices as increased demand in major economies (e.g., US, China, EU) pushes prices upward. Studies such as Kilian (2009) and Jacks et al. (2011) have emphasized its role in commodity cycles.
- US Interest Rate: Reflects the global cost of capital. Tighter US monetary policy tends to depress commodity prices by strengthening the dollar and reducing global liquidity (Bernanke et al. (2005)).
- China GDP: China's rapid industrialization has had outsized effects on global commodity demand. As noted by Aastveit et al. (2016), Chinese growth strongly correlates with base metal and energy prices.
- US Dollar Index (DXY): Commodities are priced in USD; a stronger dollar typically depresses commodity prices. Chen et al. (2010) emphasize this channel in small open economies.

Domestic Variables:

- SA Output Gap: Represents domestic cyclical conditions. Higher domestic activity might marginally influence supply dynamics, especially in extractive sectors.
- SA Exports: Proxy for trade openness and sectoral exposure to global markets. Affects revenue streams rather than price-setting.
- SA FX: Reflects local currency fluctuations, influencing the marginal profitability of commodity production.
- Speculation: Captures investor sentiment or financialization of commodities in the domestic context.

C.8.III Empirical Findings

Figure H presents the forecast error variance decomposition (FEVD) of commodity price shocks for eight South American countries. The results consistently show that foreign variables account for the majority of the explained variance in commodity price movements. In contrast, domestic variables contribute relatively little, and their influence remains stable and low across the forecast horizon.

Countries like *Colombia*, *Peru*, and *Bolivia*, despite their notable endowments in specific commodities, exhibit commodity price dynamics overwhelmingly driven by *external shocks*—particularly global demand, Chinese growth, and the strength of the US dollar. For instance, in Colombia, the combined influence of world demand, US interest rates, and the DXY far outweighs any signal from domestic output gaps or FX movements.

Interestingly, even for *Argentina* and *Chile*—economies with somewhat more diversified industrial bases—foreign factors remain dominant. This lends further credibility to the notion that commodity markets are largely global, with price-setting determined by aggregate demand and liquidity conditions in major economies.

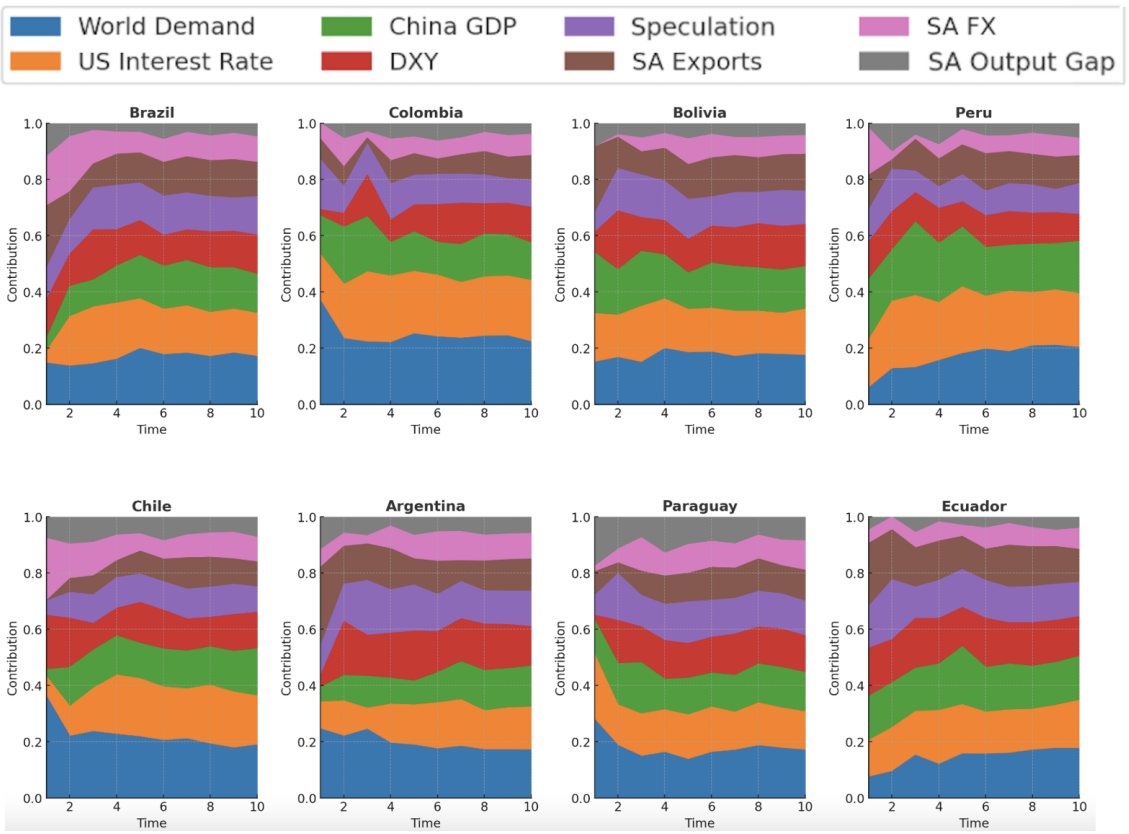


Figure H: Contribution of domestic and foreign factors on commodity prices

C.8.IV Theoretical Implications

These empirical findings provide strong support for the assumption of commodity price exogeneity in small open economy models. Although some South American countries possess strategic commodity reserves, their influence on global prices is either negligible or outweighed by the market power of large consumers and financial actors abroad.
This validates the theoretical framework employed in earlier sections of this paper, reinforcing the notion that commodity prices can be treated as exogenous to individual South American economies. The results thus bridge theoretical expectations with empirical behavior, ensuring internal consistency in the overall modeling approach.