Assessing Monetary Policy Surprises in Brazil: A High-Frequency SVAR Approach*

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April 2, 2024

Abstract

This paper employs a novel structural vector autoregression framework to investigate the transmission of monetary policy in Brazil. Empirical analysis reveals that monetary policy surprises can be predicted using macroeconomic and financial indicators, necessitating an orthogonalization approach to isolate truly exogenous monetary shocks. The resulting impulse response functions display statistically significant and theoretically coherent dynamics, particularly at medium-to-long-term horizons. Additionally, the analysis uncovers that spillovers originating from US shocks predominantly impact Brazilian financial variables, whereas effects on broader macroeconomic indicators are relatively muted. Thus, by integrating Brazil's institutional evolution into a robust SVAR framework, this study advances a replicable methodology for analyzing monetary policy efficacy in economies navigating volatile capital flows and structural breaks.

1. Introduction

Monetary policy decisions exert significant and far-reaching consequences on both financial markets and real economic activity. In emerging economies such as Brazil, this relationship takes on additional complexity due to the country's exposure to global financial conditions, as well as its political and economic instability. Understanding the impacts of monetary policy is critical for policymakers, market participants, and researchers alike; yet, the extent to which these surprises are genuinely exogenous or confounded by anticipated market responses remains an open question.

*Two-term senior essay written for the Economics major at Yale University.

†BA in Economics and BS in Computer Science and Mathematics; gabriel.thomazvieira@yale.edu. I am deeply grateful to my advisor, Zhen Huo, for his invaluable guidance and thoughtful insights throughout this project. I thank the Yale Economics Department for offering me my first research opportunity through the Tobin Undergraduate Research Assistantships program under Cameron LaPoint. I also appreciate the generous assistance of Allison Gallaspy and Erin Wachowicz in helping me access critical data, and I am especially thankful to my family, friends, and girlfriend for their unwavering support. All errors are my own.

Over the past two decades, high-frequency fluctuations in interest rates surrounding monetary policy announcements—commonly referred to as *monetary policy surprises*—have emerged as a key instrument for gauging monetary policy's immediate and longer-term effects on asset prices and macroeconomic variables. Against this backdrop, the present study adopts a novel high-frequency structural vector autoregression (SVAR) framework to examine such surprises in Brazil, drawing insights from the state-of-the-art methodology of Bauer and Swanson (2022) to assess how shifts in US policy reverberate within Brazil's open economy, acknowledging the well-documented influence of US monetary policy on emerging market economies Ahmed et al. (2018).

This analysis builds on a growing literature that integrates high-frequency identification into the study of monetary policy (e.g., Bauer and Swanson, 2022; Gertler and Karadi, 2015; Stock and Watson, 2018). While previous work has focused predominantly on the United States, fewer studies apply similar frameworks to economies with pronounced volatility and structural breaks like Brazil. Existing Brazilian research often relies on specific model assumptions or places less emphasis on disentangling unanticipated rate changes from foreseen policy shifts. By bridging these gaps, the present work offers a fresh perspective on how policy surprises can be systematically extracted and interpreted in a small open economy with a more unstable environment.

Monetary policy surprises are valuable identification tools because they isolate interest rate movements within narrow windows around central bank announcements, thus minimizing issues of reverse causality and endogeneity. Additionally, they have traditionally been seen as unpredictable from publicly available information, given that any predictable components would be quickly arbitraged away by market participants. Consequently, they are considered plausibly exogenous relative to known macroeconomic variables, making them suitable instruments within structural VAR and local projection methodologies. Recent studies, however, have challenged this assumption by demonstrating substantial predictability of monetary policy surprises from pre-announcement macroeconomic and financial data both in the US (Bauer and Swanson, 2022; Cieslak, 2018; Miranda-Agrippino and Ricco, 2021) and in Brazil (da Costa Filho, 2017), raising concerns about their true exogeneity. As emphasized by Stock and Watson, 2018 (2018), both exogeneity and instrument relevance are critical for robust estimation of monetary policy effects, and emerging evidence calls into question whether standard monetary policy surprises consistently fulfill these conditions.

To address concerns about exogeneity, monetary policy surprises are first shown to be predictable using publicly available macroeconomic data releases and financial market variables. Following the approach of Bauer and Swanson (2021), the predictable component of

each surprise is removed by regressing the raw shocks on a set of economic and financial indicators that precede the announcement and exhibit predictive power. The residuals from this regression are then used as orthogonalized monetary policy surprises, which are less likely to suffer from endogeneity and help eliminate attenuation bias and common anomalies such as the *price puzzle*, where inflation briefly rises in SVAR estimates after a contractionary shock.

The next four chapters establish the conceptual and methodological foundation for this research, culminating in Section 5, which presents the theoretical framework underpinning this empirical analysis. It draws on insights from Bauer and Swanson (2022) on private-sector learning, adapting them to the Central Bank of Brazil's (BCB) regime-switching behavior documented in F. G. Carvalho and Muinhos (2022). It develops a model in which the policymaker's reaction alternates between hawkish and dovish regimes, prompting agents to update their beliefs about monetary policy in real time. This formulation clarifies how policy surprises can reflect both unanticipated shocks and systematic learning errors: as beliefs evolve with observed policy choices, surprise measures may end up correlated with pre-announcement macroeconomic conditions. By resolving the apparent *ex post* predictability of surprises and guiding the isolation of exogenous shocks, the model offers a solid theoretical foundation for interpreting high-frequency identification and evaluating the real economic effects of monetary policy.

Once the theoretical basis is in place, Section 6 begins the empirical analysis by exploring the effects of US monetary policy tightening on the Brazilian economy, applying the identification scheme from Bauer and Swanson (2022) to isolate a purely exogenous policy shock orthogonalized to concurrent US economic news. By focusing on how key Brazilian indicators respond over the 2000–2019 sample, the discussion highlights both the immediate, pronounced adjustments that materialize in financial markets and the more gradual, often statistically elusive, transmission to real economic activity. As such, the ensuing impulse responses underscore the asymmetry between the fast-moving reactions of risk-asset valuations and exchange rates, compared to the relatively ambiguous responses of output and inflation, thereby illuminating both the channels and the lag structure through which external US monetary surprises propagate to Brazil's open-economy setting.

The focus then shifts exclusively to Brazil in Section 7, which demonstrates that monetary policy surprises exhibit a clear structural break in 2003 and are predictable using key macroeconomic and financial indicators. Moreover, it shows that Brazil's stock market benchmark, the Ibovespa, declines significantly in response to such surprises in the announcement window, verifying their usefulness for estimating the impact of monetary policy on financial

markets. Specifically, this analysis employs two complementary measures of monetary policy shocks to uncover systematic correlations between surprises and preceding economic news: one based on the difference between realized and survey-forecast interest rates, following Oliveira and Simon 2023, and another derived from changes in One-Day Interbank Deposits (DI1) futures, similarly to Bauer and Swanson (2022). These findings underscore the importance of accounting for the 2003 break and orthogonalizing observed policy responses to isolate genuinely exogenous shocks, thus, establishing a rigorous foundation for the SVAR identification strategy that follows.

Finally, Section 8 concludes the discussion by presenting impulse response functions from multiple SVAR specifications that incorporate macroeconomic, trade, and fiscal variables. These formulations address both the short-lived price puzzle and open-economy dynamics. The estimated responses exhibit long-run patterns consistent with standard economic theory, and the use of an orthogonalized policy instrument enhances interpretability without substantially weakening statistical significance.

Therefore, this study provides a comprehensive analysis of monetary policy surprises in Brazil, a setting where domestic policy dynamics and global spillovers intersect in nuanced ways. By combining robust identification strategies with a SVAR framework, the research advances two critical contributions: first, it clarifies how exogenous monetary shocks transmit through Brazil's economy, accounting for both endogenous policy shifts and external influences from US monetary tightening. Second, it addresses longstanding concerns about the exogeneity and predictability of high-frequency surprises in emerging markets, applying a novel orthogonalization procedure to isolate genuine policy shocks. The findings not only refine our understanding of Brazil's monetary transmission mechanism but also offer broader methodological insights for open-economy research.

2. Literature Review

Several recent studies use high-frequency monetary policy surprises around US Federal Open Market Committee (FOMC) announcements to investigate the effects of monetary policy in an SVAR framework. Early contributions such as Cochrane and Piazzesi (2002), Faust et al. (2003), and Faust et al. (2004) rely on federal funds rate futures to identify exogenous policy components. More recent literature has shown that ignoring potential predictability may lead to omitted variable bias and price puzzles in SVAR estimates. Notably, Cieslak (2018) and Miranda-Agrippino and Ricco (2021) document significant predictability of these surprises using publicly available data, which poses a challenge to the assumption

that they capture purely exogenous policy shocks. Related work by Bauer and Swanson (2021) demonstrates that standard high-frequency measures often correlate with macroeconomic and financial information preceding the announcement, potentially biasing impulse response functions. Recent contributions offer corrections for this endogeneity problem, concluding that orthogonalizing policy surprises on macroeconomic releases or forecast revisions mitigates predictable variation in the high-frequency shocks (Bauer and Chernov, 2021; Miranda-Agrippino and Ricco, 2021; Sastry, 2024). When this predictability is properly addressed, the resulting shocks align more closely with genuine policy surprises, causing output and inflation to respond in ways more consistent with standard macroeconomic models.

Bauer and Swanson (2022) represents the state of the art high-frequency identification of monetary policy shocks, and the present study adapts its methodology to the Brazilian context. Beyond advancing earlier findings on the bias induced by unadjusted monetary policy surprises, the authors comprehensively survey multiple competing empirical strategies and identify which approaches yield the most robust estimates of policy impacts on both financial markets and real activity. By demonstrating that orthogonalizing FOMC surprises against pre-announcement macro-financial indicators substantially enhances identification, they propose a unified methodology that enhances explanatory power. Moreover, by substantially expanding the set of policy-related events to include Chair speeches and other key communications, their approach delivers both improved shock identification and a deeper assessment of policy transmission.

Existing studies for Brazil, many of which employ VAR-based methods, generally confirm that monetary policy actions exert the expected contractionary impact on economic activity. However, the response of inflation remains ambiguous. For instance, Minella (2001) reports a price puzzle in response to interest rate increases, while Cysne (2005) find that inflation often rises within the first two quarters before eventually declining. By contrast, M. Carvalho and Rossi Júnior (2009) find that a factor-augmented VAR specification attenuates this result and yields largely negative baseline responses, albeit with wide confidence intervals crossing zero, and Luporini (2008) likewise observes that confidence intervals routinely include zero for the response of inflation. Taken as a whole, these mixed findings suggest that conventional monetary policy shocks in Brazil can be difficult to reconcile with the textbook prediction of an immediate, unequivocal decline in inflation.

In subsequent research, da Costa Filho (2017) introduces a suite of new measures of Brazilian monetary policy shocks, drawing upon both Romer and Romer (2004) forecast

errors from Focus surveys[1], as well as a "yield curve shock" approach following Barakchian and Crowe (2013). While the estimated shocks reliably indicate a decrease in economic activity after a standard contractionary policy surprise, most specifications also yield a price puzzle—except the yield curve shock, which leads to a more conventional decline in inflation. This pattern leads to the hypothesis that reshaping the yield curve may be more effective for stabilizing prices than simply moving the short rate. Relatedly, da Costa Filho (2021) extends these findings by concluding that monetary policy decisions associated with steeper yield curves lead to higher future economic activity. Unlike these references, which rely on specific term structure models such as Diebold and Li (2006) to estimate monetary policy expectations and their effects, the present paper adopts a largely model-free strategy, constructing shocks directly from observed yield curve movements and forecast errors.

Thus, SVAR research underscores the power of high-frequency identification while emphasizing the need to purge anticipated elements from monetary policy surprises. This effort improves estimates by avoiding spurious puzzles and clarifying the robustness of policy-transmission findings. Continued refinements in shock measurement—whether through richer macroeconomic controls, expanded event sets, or careful orthogonalization procedures—help reconcile theoretical predictions with the observed impacts of monetary policy on the economy.

3. Background

3.1 Turbulence in Brazil's Monetary Policy (1999–2003)

This section examines Brazil's transition to an inflation targeting regime, focusing on the turbulent period of 1999 to 2003, marked by significant challenges in monetary policy and financial markets. Frequent shocks, currency volatility, and political uncertainties tested the new framework's credibility and forced authorities to adapt targets and policy tools to maintain macroeconomic stability. The outcome was a precarious balance between restoring investor confidence and keeping inflation on track.

The National Monetary Council (CMN) sets inflation targets and major monetary directives, while the Central Bank of Brazil (BCB) is responsible for achieving these goals through its Monetary Policy Committee (Copom). The adoption of an inflation-targeting regime in

[1]The Focus Survey is conducted daily by the BCB and collects macroeconomic forecasts from financial institutions, asset managers, and corporations across indicators such as inflation, economic activity, exchange rates, and monetary policy. The data is conveniently accessible through the Python package, *python-bcb* (Freitas, 2025).

1999 followed the collapse of Brazil's exchange-rate anchor, which had previously supported the Plano Real's price stabilization efforts[2]. After allowing the currency to float in January 1999, the government introduced explicit inflation targets and granted the BCB the operational autonomy to pursue price stability under Copom's guidance[3]. Thus, although the BCB operates under a dual mandate, its legal framework explicitly prioritizes price stability over full employment, in contrast to the more balanced mandate of the US Federal Open Market Committee (Arestis et al., 2009).

Early challenges arose as the the Asian financial crisis (1997) and the Russian default (1998) triggered speculative attacks on the Brazilian real, whose sharp depreciation in 1999 fueled inflation through higher import prices, forcing the BCB to tighten monetary policy aggressively. Although inflation ended the year within the 6–10% target band, subsequent external shocks created renewed pressures. The 2001 global slowdown, Argentina's crisis, and a domestic energy shortage weakened economic activity and undermined investor sentiment, causing the real to depreciate and pushing inflation above the 6% ceiling by the end of 2001 (Ayres et al., 2019).

The most severe turbulence emerged in 2002, ahead of the presidential election. Investor fears regarding possible debt restructuring, combined with spillovers from regional crises, led to capital flight and a sharp exchange-rate depreciation that drove inflation to 12.5% (Ayres et al., 2019). According to Minella et al. (2003), exchange-rate pass-through effects accounted for nearly half of the price increase, reflecting the regime's vulnerability to currency shocks. By 2003, macroeconomic stability gradually improved under tighter monetary and fiscal policies, although inflation remained above the adjusted target of 8.5%.

Thus, the volatile 1999–2003 period underscored the challenges of cementing credibility under inflation targeting. Policymakers widened tolerance bands, revised targets upward, and issued public explanations linking inflation overshoots to exceptional external pressures. These adjustments eventually helped anchor expectations, allowing the inflation-targeting framework to gain traction once external conditions stabilized.

[2]The Plano Real was introduced in 1994 following a series of unsuccessful stabilization attempts and marked a turning point in Brazil's economic history, successfully halting hyperinflation through the introduction of the real currency and a temporary dollar peg (Pastore et al., 2024).

[3]It is noteworthy that the BCB only gained complete technical and operational autonomy in 2021; prior to this, it operated in close alignment with the prevailing political climate, with leadership appointments often reflecting presidential terms and partisan priorities.

3.2 Correlation of Macroeconomic Indicators: Brazil vs. US

This section analyzes the correlation patterns among key macroeconomic indicators for Brazil and the United States over the period from October 2003 to February 2020, which avoids COVID-induced distortions and the structural issues outlined in Section 3.1. Understanding these dynamics is important for assessing how domestic and external conditions might propagate through different sectors of the economy. Given that the relationships are not necessarily linear, the results should be interpreted carefully, emphasizing general tendencies rather than definitive causal mechanisms.

In Brazil, the one-year yield is positively correlated with sovereign risk proxies such as five-year credit default swaps (CDS) and the EMBI+ Brazil spread[4], suggesting that rising domestic interest rates are often accompanied by heightened perceptions of sovereign risk (Figure 2a). This interpretation is further supported by the notable negative correlation between short-term rates and gross domestic product (GDP), the stock market (proxied by the S&P 500), and trade variables, suggesting that tighter monetary conditions tend to suppress economic activity and investor confidence. Interestingly, the negligible correlation with the trade balance suggests that simultaneous declines in imports and exports tend to offset each other, leading to a contraction in trade volumes without a significant net effect on the overall balance.

Conversely, the US one-year yield in Figure 2b is positively correlated with the S&P 500 and industrial production (IP), a pattern that remains consistent with standard economic theory if rising short-term rates reflect expectations of stronger growth rather than purely signaling tighter monetary policy. Although rate hikes typically indicate a tightening stance, initial increases may coincide with robust output and equity gains when driven by strong demand rather than a deliberate effort to constrain the economy. Notably, in both Brazil and the United States, GDP and IP do not move in perfect unison, underscoring the complexity of using these variables interchangeably as proxies for overall economic activity.

In terms of economic activity, Brazil exhibits strong correlations between GDP and several key variables: inflation (IPCA, non-administered prices), commodity prices (IC-Br[5] and BCOMSP[6]), the stock market (IBOV[7]), and trade variables. This pattern partially aligns

[4]EMBI+: Emerging Market Bond Index Plus, JPMorgan. This spread represents the difference between the weighted average yields of Brazilian external debt securities and the yields of US Treasury securities with comparable maturities.

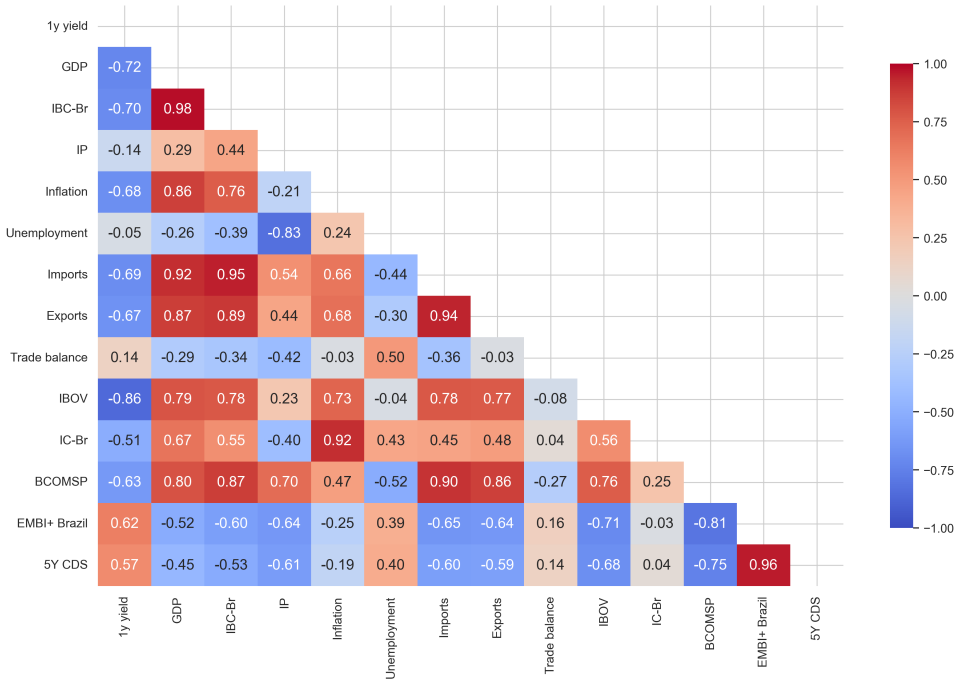
[5]IC-Br: Commodity Price Index. It is published monthly by the BCB and captures fluctuations in the international commodity prices most relevant to Brazil's domestic inflation dynamics (de Melo, 2013).

[6]BCOMSP: Bloomberg Commodity Spot Index.

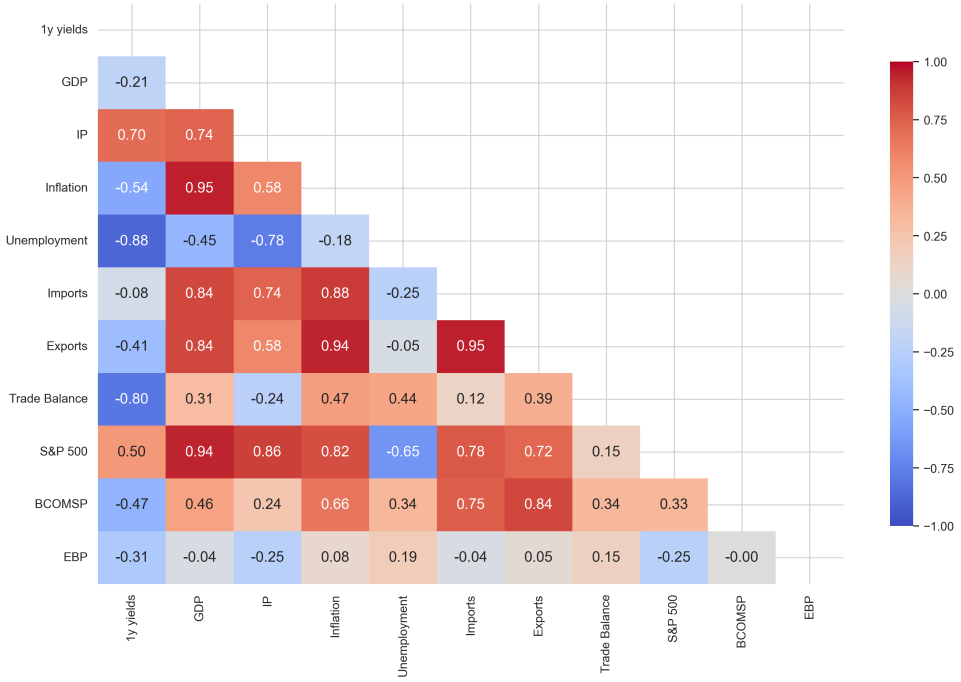
[7]IBOV: Bovespa Index or Ibovespa. Benchmark index tracking the performance of the most liquid Brazilian stocks.

Figure 1

Correlation Matrices of Brazil and US Economic Variables



(a) Brazil's Correlation Matrix



(b) United States' Correlation Matrix

Note. Sample: 10/2003 – 02/2020. This excludes Brazil's pre-2003 volatility and the effects of the COVID-19 pandemic. Non-percentage variables are log-transformed, except for trade balances.

with predictions from open-economy models that emphasize the central role of exports and commodity markets. However, the unusually low correlation of industrial production with GDP at 0.29 underscores a potentially atypical relationship, contrasting with the near-perfect alignment of IBC-Br[8] at 0.98. Nonetheless, negative correlations between Brazil's GDP and sovereign risk measures are consistent with the notion that stronger output lowers risk perceptions. In the United States, GDP follows more traditional patterns, exhibiting higher correlation with industrial production at 0.74, which suggests a tighter alignment with standard business-cycle theory.

Therefore, the correlation matrices reveal clear contrasts between Brazil and the United States, underscoring the complexity of drawing connections between distinct institutional and structural contexts. In Brazil, rising interest rates are linked to higher sovereign risk and weaker economic activity, while trade flows contract without materially affecting the trade balance. By contrast, in the United States, higher short-term rates are associated with stronger equity performance and industrial production, which may reflect early-cycle growth expectations or underlying nonlinearities. These results highlight the need for caution when interpreting such relationships in emerging markets, where deviations from textbook predictions often point to unconventional or regime-dependent dynamics.

3.3 The SVAR Framework

As in Gertler and Karadi (2015), the reduced-form VAR follows the form

$$Y_t = \alpha + B(L)Y_{t-1} + u_t, \tag{3.1}$$

where Y_t is a vector of macroeconomic variables, such as the logarithm of the consumer price index (CPI) or industrial production, and $B(L)$ is a matrix polynomial in the lag operator L. The residuals u_t are modeled as linear combinations of serially uncorrelated structural shocks ε_t,

$$u_t = S\varepsilon_t \quad \text{and} \quad SS' = \Omega, \tag{3.2}$$

with $\Omega = \text{Var}(u_t)$ not necessarily diagonal. One of these shocks, denoted ε_t^{mp}, captures unanticipated monetary policy shocks, which emerge from "close call" scenarios between two monetary policy options (Bauer and Swanson, 2022).

Since many solutions for S can satisfy $SS' = \Omega$, additional assumptions are required to uncover the impact of ε_t^{mp}. As described in Gertler and Karadi (2015), let z_t denote a set

[8]IBC-Br: Central Bank Economic Activity Index. It is published monthly by the BCB and aggregates data from industry, services, agriculture, and taxes to anticipate official GDP figures.

of monthly high-frequency monetary policy surprises, obtained by summing over all of the high-frequency surprises within each month. Such an instrument must correlate with the monetary policy shock ε_t^{mp} (instrument relevance) and be uncorrelated with other shocks ε_t^{-mp} (instrument exogeneity). Formally,

$$\mathbb{E}\left[z_t \varepsilon_t^{mp}\right] \neq 0 \quad \text{and} \quad \mathbb{E}\left[z_t \varepsilon_t^{-mp}\right] = 0. \tag{3.3}$$

As shown by Bauer and Swanson (2022), the first principal component of price fluctuations in the initial four Eurodollar futures contracts (ED1–ED4), measured within a narrow window around FOMC announcements, captures the expected trajectory of short-term interest rates over approximately the next four quarters. Thus, this measure reflects both the current policy rate and an element of forward guidance. One key advantage of these high-frequency surprises is that they plausibly satisfy the relevance and exogeneity conditions above. Specifically, the total quantity of monetary policy news in month t, ε_t^{mp}, can be captured by central bank announcements, implying $\mathbb{E}\left[z_t\ \varepsilon_t^{mp}\right] > 0$. Moreover, restricting attention to narrow windows around those announcements renders it unlikely that other shocks ε_t^{-mp} coincide, helping ensure $\mathbb{E}\left[z_t\ \varepsilon_t^{-mp}\right] = 0$. Under these conditions, regressing the reduced-form residuals on the interest-rate residual using z_t as an instrument via two-stage least squares generates an unbiased and consistent estimate of the impact effect s_1 of a structural monetary policy shock.

3.4 Orthogonalized Instruments

Following the literature in Section 2, the predictability of monetary policy surprises hinders exogeneity and causes biases in the resulting impulse response estimates. Bauer and Swanson (2022) demonstrate that failing to disentangle genuine policy shocks from predictable policy responses can attenuate or even invert the estimated effects of a monetary tightening. To address this issue, they project the raw policy surprise mps_t onto a set of relevant predictors X_{t-} that market participants observe prior to t, such as surprises in macroeconomic data releases and stock market fluctuations, as follows:

$$mps_t = \alpha + \beta X_{t-} + \varepsilon_t. \tag{3.4}$$

The residual ε_t from this regression constitutes the orthogonalized surprise $mps_t^{\perp}$, which is now purged of any correlation with the regressors X_{t-}. That is,

$$mps_t^{\perp} = mps_t - \hat{\alpha} - \hat{\beta} X_{t-}. \tag{3.5}$$

Consequently, $mps_t^{\perp}$ becomes a more reliable external instrument for identifying ε_t^{mp}. By ensuring that ε_t^{mp} reflects a purely exogenous shift in policy rather than the central bank's systematic response to expected macroeconomic developments, researchers obtain impulse responses that accurately capture how industrial production, inflation, or other variables evolve in response to genuine surprises.

4. Methodology

4.1 Analyzing US Monetary Policy Spillovers

Section 6 extends the US-focused SVAR framework of Bauer and Swanson (2022) by incorporating Brazilian macroeconomic and financial variables to analyze the transmission of US monetary policy shocks to Brazil. The original specification employed a monthly dataset running from 1988 to February 2020, which includes 322 FOMC announcements and draws upon the high-frequency dataset by Swanson and Jayawickrema (2024)[9]. To identify U.S. monetary policy surprises, the paper focuses on interest-rate changes observed over a 30-minute window spanning 10 minutes before and 20 minutes after each FOMC announcement, following the approach of Nakamura and Steinsson (2018), Gertler and Karadi (2015), and others. These narrow intradaily changes are aggregated into a single measure of policy surprises by taking the first principal component of the ED1–ED4 Eurodollar futures contracts and scaling it so that a one-unit variation corresponds to a 1 percentage point shift in the 4-quarter-ahead interest rate. Furthermore, the authors demonstrate that these raw surprises exhibit significant predictability based on macroeconomic and financial indicators observed prior to the announcement. To address this, they apply the orthogonalization procedure outlined in Section 3.4, effectively removing components that reflect anticipated policy actions.

The authors estimate a reduced form VAR with four macroeconomic variables as a baseline specification: the log of industrial production, the log of the consumer price index, the Gilchrist and Zakrajšek (2012) excess bond premium (EBP)[10] and the two-year Treasury yield. The authors employ a 12-month lag in Equation (3.1) and estimate all impulse reaction functions over a 48-month horizon after the initial shock. This simple specification allows the

[9]The majority of the data is publicly available on the San Francisco Fed website. On October 11, 2024, the dataset was updated to include Fed announcements through 2023; however, data from this update is excluded to more closely replicate the results presented in Bauer and Swanson (2022). As of March 2025, data containing Fed Chair speeches has not been made publicly available.

[10]The excess bond premium (EBP) measures shifts in investor sentiment and risk appetite within corporate bond markets, reflecting the residual component of credit spreads not accounted for by projected default risk.

inclusion of extra variables, such as US unemployment or commodity prices. To adapt this SVAR framework for analyzing the impact of US monetary policy shocks on Brazil, the variables listed in Section B are aggregated at a monthly frequency and individually appended to the model. The sample prior to October 2003 is excluded to account for the heightened macroeconomic and financial instability in Brazil, as detailed in Section 3.1.

4.2 Constructing Brazil's Monetary Policy Shocks

There are typically eight Copom meetings per year, with approximately 45 days between them, and they always occur on a Wednesday. A period of silence begins one week before each meeting and ends four working days after the meeting, when the BCB releases its formal statement about the target rate decision. During this silence period, Copom members are forbidden from publicly discussing or hinting at the upcoming policy decision. The Copom decision is disclosed after the close of Brazil's stock market and the BCB does not provide an immediate post-decision press conference.

Hence, in order to fully capture the nuances of Brazilian monetary policy shocks and test the robustness of the shock identification strategy, two distinct measures are employed. The first measure is derived from DI1 futures price changes and is designed to maintain methodological consistency with Bauer and Swanson (2022), although the standard 30-minute intraday window around announcements cannot be directly implemented. The second instrument is based on the difference between the realized Selic rate and Bloomberg-based forecast estimates before the announcement, following the approach outlined in Oliveira and Simon (2023).

4.3 Survey-Based Identification: Bloomberg Forecast Errors

Oliveira and Simon (2023) argue that these procedural constraints do not allow the use of a high-frequency event-study window. Instead, they define the monetary policy surprise as the difference between the actual policy rate decision and professional forecasters' expectations before the announcement, collected via the Bloomberg Terminal. In instances where the subsequent Thursday coincides with a public holiday, the following Friday is recognized as the next business days. Should both days be non-working days, the surprise value for the relevant meeting is automatically adjusted to zero, which occurs only for the meeting on April 20th, 2011.

All available forecasts preceding Copom meeting from October 2000 to January 2025 are compiled from the Bloomberg Terminal. The sample includes only one month—October

2002—with multiple Copom meetings, marking the final extraordinary meeting in the committee's history. As this was an unscheduled session, Bloomberg did not gather market expectations before it. Thus, only the regularly scheduled meeting of October 22nd is incorporated into the sample dataset. Finally, all meetings between March 2020 and December 2020 are removed from the sample to minimize the effects of the COVID-19 pandemic. Thus, the final sample consists of 209 observations.

4.4 Market-Based Identification: DI1 Futures Principal Components

A second approach, which closely mirrors the methodology of Bauer and Swanson (2022), involves extracting latent shock factors from DI1 futures maturing in March, June, September, and December, similarly to ED1–ED4 contracts. DI1 futures are one of the most liquid instruments traded on B3, with robust trading volumes and relatively narrow bid–ask spreads, ensuring that the measured price variations accurately reflect market expectations. Since Copom meetings occur after market close, it is not feasible to capture intraday market movements around the announcement. As a result, the close prices on meeting dates are used as pre-shock prices, which are programmatically collected from the official daily adjusted values at Ajustes do Pregão (B3).

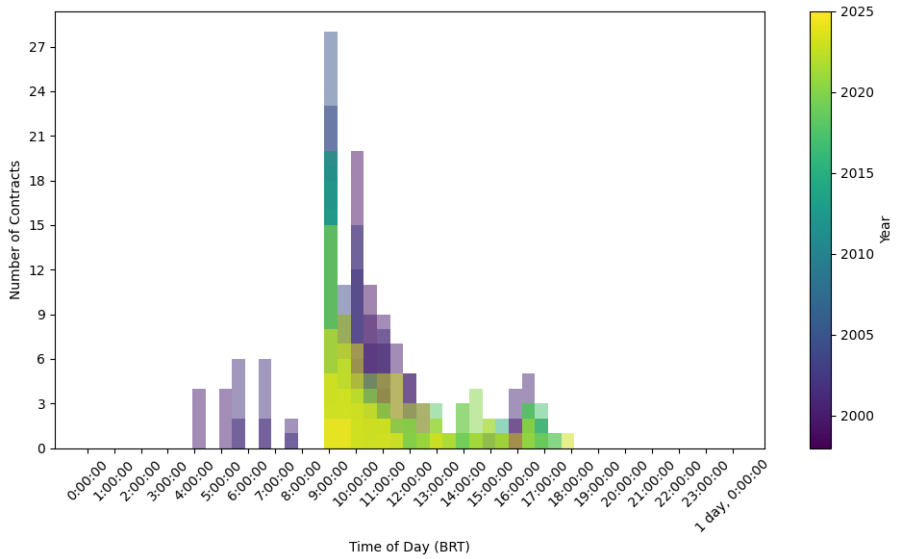
For the post-meeting shock, the next business day's intraday trade data are extracted from the LSEG Tick History API using consecutive 5-minute windows starting at market open. When available, data from up to two 5-minute windows are used to compute a representative post-shock price, provided the second window begins within five minutes of the first. The midpoint of these prices then serves as the post-meeting price, thereby balancing liquidity with the need to capture the immediate market reaction to the Copom decision. In cases where contracts with the exact quarterly maturities corresponding to ED1–ED4 futures are unavailable, a substitute contract with the nearest maturity is used provided the difference does not exceed two months. If no appropriate trade data are available for a given contract, its price variation is set to zero. The April 2011 Copom meeting is excluded from the sample for the reasons detailed in Section 4.3. Finally, all meetings between March 2020 and December 2020 are removed from the sample to minimize the effects of the COVID-19 pandemic. This procedure yields a total of 240 Copom meetings between October 1998 and January 2025. This data set is aggregated to a monthly frequency by summing shocks from Copom meetings on the same month.

Figure 2 presents a histogram of the times at which the first trades occur for each Copom meeting date. The figure reveals that a significant number of the first trades occur hours after the market opens, indicating that including those would likely compromise the sample's

quality. It also shows outliers before market opens, which are ignored. Figure 3 shows the distribution of maturity substitutions performed, which occur in roughly 31% of DI1 contracts.

Figure 2

Distribution of First DI1 Futures Trades Following Copom Announcements



Note. The figure shows the distribution of timestamps for the first available DI1 futures trades following Copom meetings. A significant concentration of trades occurs near market close. Excluding these late trades mitigates contamination from confounding signals.

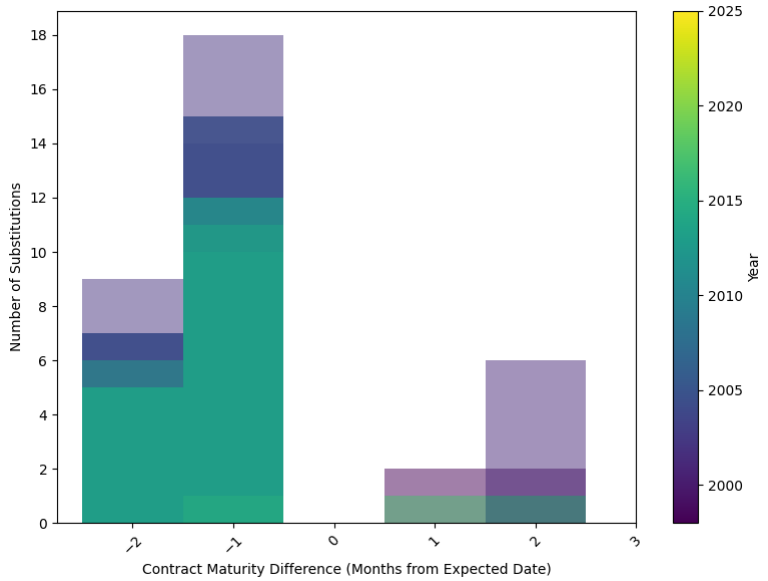
Finally, for each Copom meeting in the sample, the first principal component of the changes in DI1 futures is then computed following the procedure of Nakamura and Steinsson (2018). This principal component is subsequently rescaled such that a one-unit change corresponds to a one percentage point change in the farthest maturity rate. As demonstrated by Gürkaynak et al. (2005), central bank announcements induce surprises regarding both the current federal funds rate target and the expected path of future rates. Given that the first principal component effectively represents a weighted average of these two factors, it encapsulates the main features of monetary policy surprises.

4.5 Orthogonalizing Monetary Policy Surprises

Monetary policy surprises are measured by initially extracting a raw shock measure, $mps_t^{\perp}$, constructed using one of the approaches from Section 4.3 and Section 4.4 above. To ensure exogeneity, the raw measure is regressed on a set of relevant macroeconomic and financial variables that are observable prior to time t. For each Copom meeting t, we estimate the

Figure 3

Frequency and Timing of DI1 Futures Maturity Substitutions



Note. Substitutions occur in 31.3% of DI1 contracts, mostly before 2015, as the options of maturities was significantly lower. This preserves sample size without materially altering rate expectations, as nearby maturities exhibit strong co-movement.

regression from Equation (3.4), whose residual ε_t constitutes the orthogonalized shock series, which we denote by $mps_t^{\perp}$.

The literature cited in Section 2 has documented several variables capable of predicting monetary policy surprises. After evaluating an extensive set of 18 candidate predictors, a final subset was selected by balancing meaningful economic interpretations with optimal statistical criteria, specifically minimizing the Bayesian or the corrected Akaike information criteria. Ultimately, the following predictors were selected:

- *Inflation surprise*: the unexpected component of the latest IPCA release prior to the Copom meeting, calculated as the difference between the released figure and the median Bloomberg Terminal forecast.

- *Economic activity surprise*: the IBC-Br[8] is a statistically significant predictor, though its publication began in 2011. To reconcile this timeline, the analysis employs a covariate combining two components: before June 2011, it reflects the difference between the latest quarterly GDP release and the median Bloomberg Terminal forecast prior to Copom meetings; after June 2011, it uses the IBC-Br indicator under the same methodology.

- *Exchange rate expectations*: the year-end USD/BRL exchange rate forecast from the BCB's

Focus Survey closest to the Copom meeting[1].

- *National debt expectations*: the analogous year-end forecast for net national debt from the Focus Survey.
- *Yield curve slope*: the change in the slope of the yield curve over the three months preceding the Copom meeting, measured as the difference between one- to ten-year zero-coupon yields from ANBIMA's Estimated Interest Rate Term Structure (ANBIMA, 2021).
- *Commodity prices*: the log change in the BCOMSP[6] index over the three months preceding the Copom meeting.
- *Lagged inflation indicator*: the difference in six-month seasonally adjusted IPCA growth rates, computed as

$$\big((\log \mathrm{IPCA}_{t-2} - \log \mathrm{IPCA}_{t-8}) - (\log \mathrm{IPCA}_{t-8} - \log \mathrm{IPCA}_{t-14})\big) \times 200. \tag{4.1}$$

Section 7 presents the results of the regression in Equation (3.4) using these variables, while Section 8 discusses the SVAR impulse reaction functions using both conventional and orthogonal surprises following this specification.

5. A Theoretical Model of Incomplete Information

In the framework of Bauer and Swanson (2022), a key observation is that monetary policy surprises can stem from a wedge between the true and perceived sensitivity of the central bank's rate-setting rule to macroeconomic conditions. For instance, if the central bank places greater weight on recent inflation figures than the public believes, then a higher-than-anticipated inflation reading would tend to result in a positive monetary policy surprise. In a learning framework, if agents persistently underestimate the true inflation sensitivity over multiple periods, these surprises ultimately become correlated with inflation data when viewed *ex post*, despite having been unforecastable from the public's perspective *ex ante*.

Bauer and Swanson (2022) prove empirically that the Fed's reaction function has trended upward over time, implying that the true sensitivity to macroeconomic conditions has increased. However, empirical findings for Brazil reveal that the BCB does not exhibit a uniformly increasing responsiveness (F. G. Carvalho and Muinhos, 2022). Instead, its reaction function underwent distinct regime shifts—displaying a highly hawkish stance during

2003–2010, transitioning to a markedly dovish approach in 2011–2015, and subsequently exhibiting only a partial recovery. To address this discrepancy, the current work modifies the original framework by allowing the policy reaction coefficient α_t to switch regimes rather than to drift monotonically upward. This adjustment preserves the learning mechanism underlying monetary policy surprises while more accurately reflecting the non-monotonic evolution of policy responsiveness observed in Brazil.

Suppose the state of the economy in the discrete period t is summarized by the procyclical scalar variable x_t, which follows a backward-looking linear process,

$$x_t = \rho x_{t-1} - \theta i_{t-1} + \eta_t, \tag{5.1}$$

where i_t denotes the interest rate and η_t is an exogenous *i.i.d.* Gaussian process with mean zero and variance σ_η^2. The parameter $|\rho| < 1$ determines persistence in x_t, while $\theta \geq 0$ captures how higher past interest rates depress future real activity. The central bank is assumed to set the period-t interest rate i_t according to

$$i_t = \alpha_t \, x_t + \varepsilon_t, \tag{5.2}$$

where α_t indicates how aggressively monetary policy responds to x_t, and ε_t is an exogenous *i.i.d.* mean-zero Gaussian process. Unlike the original specification in which α_t drifts upward, here α_t is assumed to follow a regime-switching process. Specifically, let

$$\alpha_t = \begin{cases} \alpha_H, & \text{if } s_t = H, \\ \alpha_L, & \text{if } s_t = L, \end{cases} \quad \text{with} \quad \Pr\big(s_t = j \mid s_{t-1} = i\big) = \pi_{ij}, \quad i, j \in \{H, L\}, \tag{5.3}$$

where α_H ($\alpha_H > \alpha_L$) corresponds to a hawkish regime and α_L to a dovish regime. The Markov transition probabilities π_{ij} govern the switches between regimes.

The central bank observes all variables and the regime state perfectly, whereas the private sector sees only $\{x_t, i_t\}$ and must form Bayesian beliefs about the current policy regime, and hence about α_t. Let a_t denote the public's prior for α_t before the current period's policy is revealed. Then the monetary policy surprise at date t is defined as

$$\begin{aligned} mps_t &= i_t - \mathbb{E}\left[i_t \mid x_t, \mathcal{H}_{t-1}\right] \\ &= \big(\alpha_t - a_t\big) x_t + \varepsilon_t. \end{aligned} \tag{5.4}$$

This expression reflects both the exogenous policy shock ε_t and the imperfect information

component $\alpha_t - a_t$. After observing i_t, the private sector updates its belief by applying a Hamilton filter to update the posterior probabilities of the regimes (Hamilton, 1989). In this context, the updated conditional expectation of α_t is given by

$$a_{t+1} = \mathbb{E}\left[\alpha_t \mid \mathcal{H}_t\right] = \pi^H_{t|t}\,\alpha_H + \pi^L_{t|t}\,\alpha_L, \tag{5.5}$$

where $\pi^j_{t|t}$ denotes the posterior probability of regime $j \in \{H, L\}$ at time t given the history $\mathcal{H}_t$. The corresponding gain k_t in the updating rule is then defined by the sensitivity of the posterior expectation to the new information:

$$a_{t+1} = a_t + k_t\, mps_t, \tag{5.6}$$

with k_t being determined by the relative variances of the measurement and the transition process.

Thus, surprises persist as long as the public's belief a_t systematically deviates from the true regime-dependent policy parameter α_t. In particular, if the public underestimates the reaction in a hawkish regime or overestimates it in a dovish regime, then equation (5.4) implies that, on average,

$$\mathrm{Cov}\left(mps_t, x_t\right) = (\alpha_t - a_t)\,\mathrm{Var}\left(x_t\right) > 0. \tag{5.7}$$

In other words, in a learning framework, if agents persist in underestimating the true reaction parameter—whether the central bank is in a high or low responsiveness regime—over multiple periods, these surprises become correlated with x_t when viewed *ex post*, despite having been unforecastable *ex ante*.

This dynamic of incomplete information carries notable empirical implications. First, monetary policy surprises may exhibit predictability when looking backward, as they correlate with macroeconomic or financial indicators available before the announcement. Second, event-study regressions over narrow windows around announcements can validly measure the immediate effects on asset prices because once one controls for mps_t in such a window, there is no separate role for ε_t. Thus, high-frequency regressions of the form

$$\Delta\mathbb{E}_t\left(i_{t+n}\right) = b_0 + b_1\, mps_t + e_t, \tag{5.8}$$

capture the interest-rate or equity-price responses on announcement days. Third, caution is necessary when employing these surprises in structural VARs or local projections because

mps_t may be correlated with the macro conditions that affect output or inflation, thereby violating the exogeneity condition required for an external instrument. Consequently, Bauer and Swanson (2022) suggest orthogonalizing surprises with respect to the relevant pre-announcement macroeconomic variables to isolate the purely exogenous shock component.

The modified framework demonstrates that when α_t switches regimes—leading the public to misperceive the central bank's reaction function—monetary policy surprises reflect both random shocks and systematic learning errors. Therefore, even though the BCB does not become uniformly more responsive over time, the incorrect estimation of the true regime-specific reaction leads to predictable patterns in policy surprises.

6. US Monetary Policy Spillovers

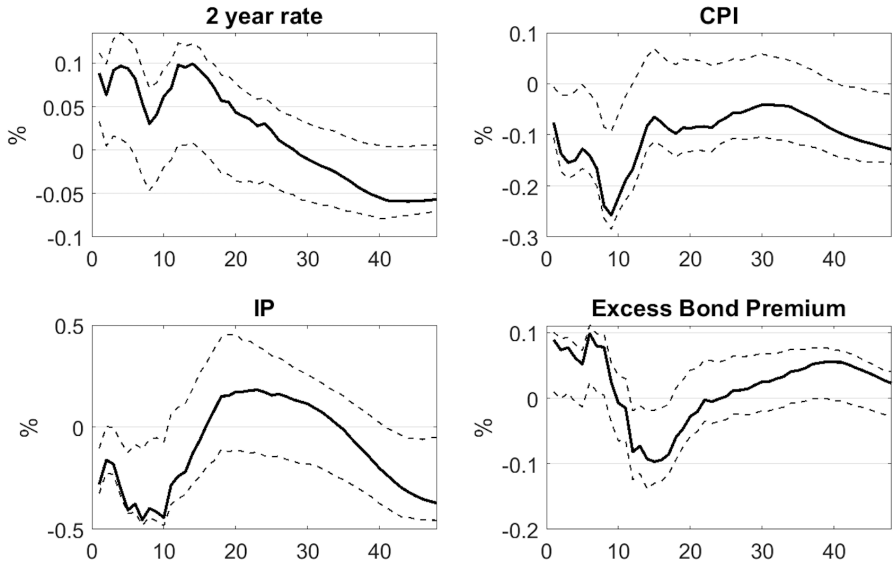
This section investigates the economic and financial repercussions of a one standard deviation tightening in US monetary policy on Brazil, following the methodology outlined in Section 4.1. By identifying a purely exogenous monetary policy shock, orthogonalized to US macroeconomic news and financial market developments, the analysis examines impulse response functions of key Brazilian variables from October 2003 to February 2020. This period excludes the volatile, initial phase of Brazil's inflation-targeting regime discussed in Section 3.1. The solid black lines report the estimated impulse response functions, while the dashed lines report 90% standard-error bands around those point estimates, computed using 10,000 bootstrap replications[11].

The impulse responses of US variables in the post-2003 baseline specification are presented in Figure 4. The substantial reduction in sample size relative to the full dataset yields markedly different dynamic responses compared to those reported by Bauer and Swanson (2022), particularly at medium and longer horizons. Notably, most effects appear to dissipate within approximately two years. Despite these differences, the first-stage F-statistics across all specifications remain close to the benchmark value of 2.44 reported in the original study, fluctuating modestly between 3 and 4. This indicates that the identification strength is broadly comparable, yet still marginal, warranting cautious interpretation of the results. Emphasis should thus be placed on general trends rather than precise causal inferences. Incorporating Fed Chair speeches through 2023 should strengthen the robustness of these findings and constitutes a valuable avenue for future research once the data becomes available.

[11]Standard error bands follow the wild bootstrap procedure from Gertler and Karadi (2015), which is also employed by Bauer and Swanson (2022). This method accounts for the uncertainty both in the estimated impact effect vector s_1 and in the reduced-form VAR coefficient matrices $B(L)$.

Figure 4

US Baseline Impulse Response Functions (Post-2003)



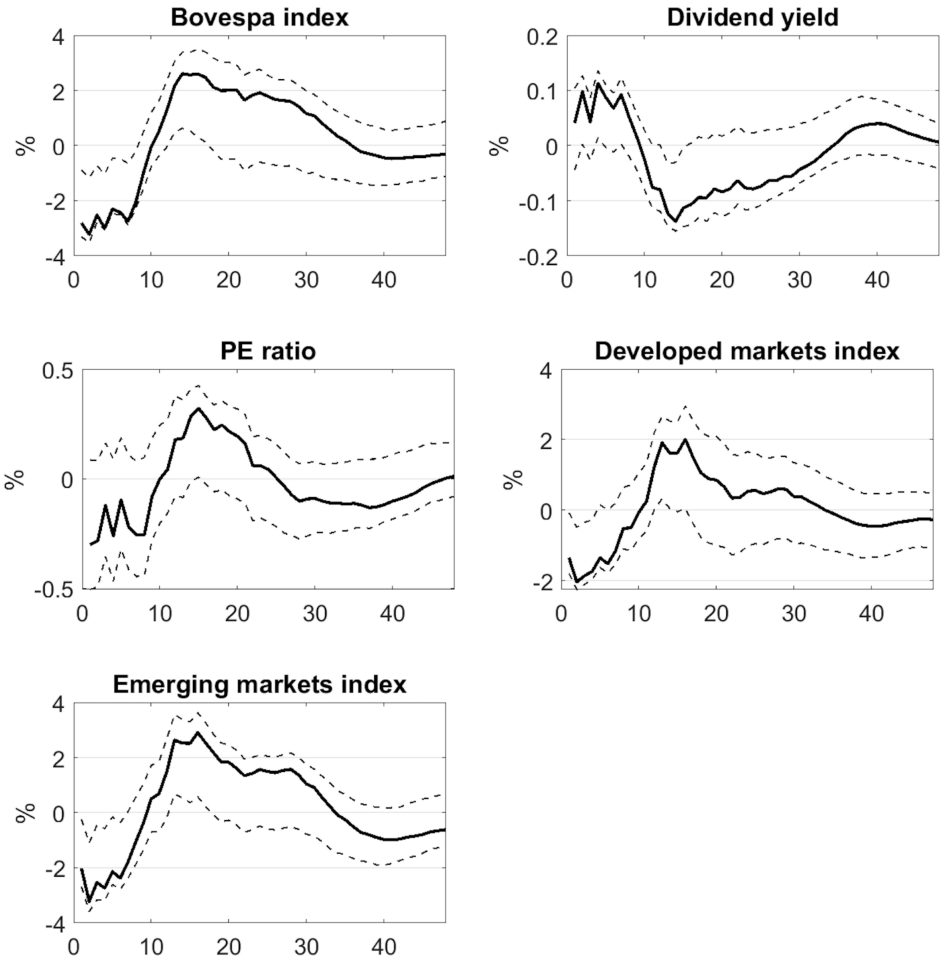
Note. Impulse responses of Brazilian and global equity market variables to a one standard deviation US monetary tightening shock. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 02/2020.

6.1 Financial Markets

Financial markets display swift and statistically significant responses to the US shock (Figure 5), with the Bovespa index plunging 3% on impact—a magnitude aligning with a global flight-to-safety dynamic. Despite wide confidence intervals, the contraction is statistically significant, reflecting the transmission of Fed tightening to international risk assets as investors retreat from emerging market (EM) equities amid rising global risk premiums. The rapidity of the response, indicative of instantaneous portfolio re-balancing, mirrors broader risk-off behavior that suppresses equity valuations through both capital reallocation and downward revision of earnings expectations. Notably, the Bovespa's simultaneous decline in price-earnings (P/E) ratios and rise in dividend yields signals investor anticipation of compressed corporate earnings or elevated discount rates, highlighting a marked repricing of equity risk premiums. This narrative is supported by a similar decline in the EM index, while developed markets experience comparable losses, albeit slightly less severe, highlighting spillovers even to advanced economies.

Figure 5

US Spillover Effects – Financial Markets



Note. Impulse responses of Brazilian and global equity market variables to a one standard deviation US monetary tightening shock. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 02/2020.

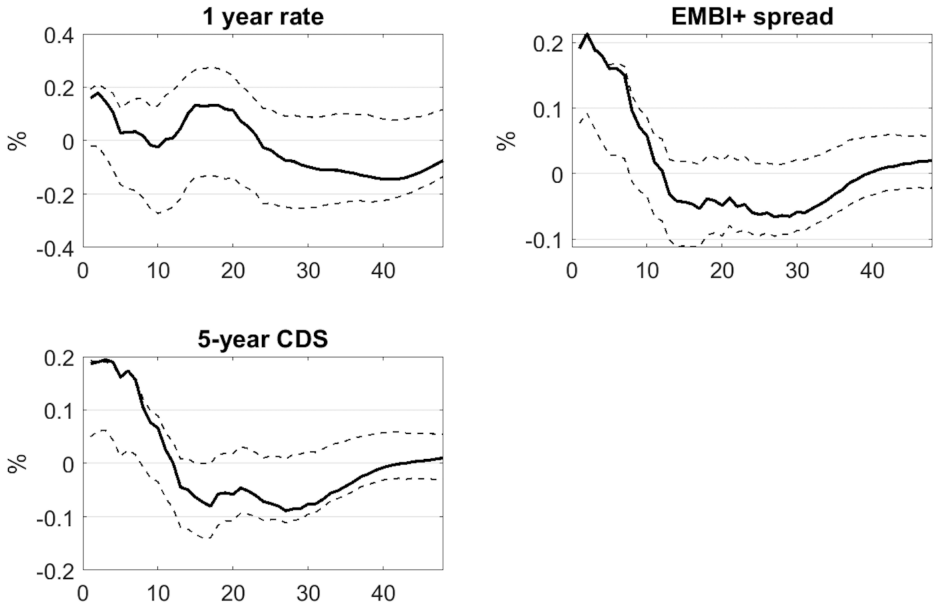
6.2 Interest Rates and Sovereign Risk

In Figure 6, Brazil's one-year sovereign yield shows an initial 20 bps increase in response to the Fed's monetary tightening shock that quickly reverts to initial levels; however, the wide confidence intervals contain zero and the long-term reaction is unclear. A viable explanation for this muted overall response is that fixed-income investors in Brazil may prioritize local macroeconomic issues, such as persistently high inflation rates and elevated levels of public debt, over external monetary shocks. Given the significant domestic challenges these investors already face, external developments—such as shifts in US monetary policy—might be of secondary importance in influencing short-term yield dynamics.

Meanwhile, indicators of sovereign risk show pronounced and statistically significant adjustments. The five-year CDS and the EMBI+ Brazil spread increase immediately, reflecting heightened investor concerns about Brazil's credit risk amid tightening global financial conditions.

Figure 6

US Spillover Effects – Sovereign Risk



Note. Impulse responses of Brazilian sovereign risk variables to a one standard deviation US monetary tightening shock. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 02/2020.

6.3 Exchange Rates and International Trade

The real depreciates rapidly, losing approximately 2% against the US dollar immediately after the shock, but gradually reverting to levels slightly above the initial level (Figure 7). This depreciation reflects the expect transmission of external monetary tightening, which triggers capital outflows as global investors seek protection in the US dollar, exerting downward pressure on the real.

Furthermore, the similar responses observed across all trade variables—characterized by an initial negative shock followed by ambiguous long-term dynamics—suggest the presence of common transmission channels and underlying structural disturbances, strengthening the relationships observed in Section 3.2. For instance, factors such as a contraction in global demand, a stronger US dollar, and overall economic slowdown may be influencing all four. However, their wide confidence intervals leave considerable uncertainty about the exact size and persistence of the declines, which in turn complicates the task of isolating the distinct effects of exchange-rate competitiveness versus global demand factors.

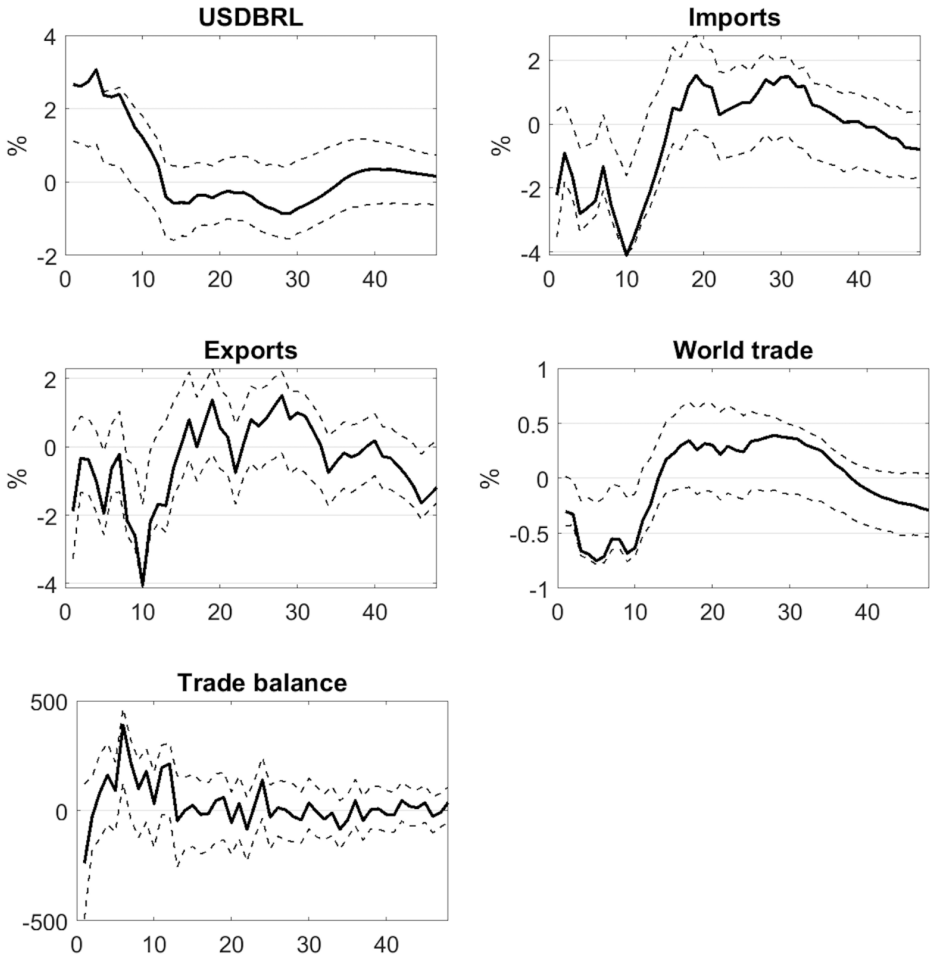
6.4 Economic Activity and Price Responses

The US monetary tightening shock induces comparable patterns across Brazilian economic activity indicators, with all three variables exhibiting an initial contraction, followed by a recovery starting roughly one year after the shock (Figure 8). This initial downturn may be attributed to reduced investment and consumption driven by tighter global financing conditions and heightened uncertainty. Conversely, the subsequent rebound could reflect delayed adjustments or sectoral reallocations toward export-oriented and import-substituting industries, stimulated by currency depreciation and improved external competitiveness.

Inflation demonstrates a distinct dynamic, characterized by a gradual decline over the 48-month horizon without an evident short-term reaction. On one hand, exchange rate depreciation induced by tighter US monetary policy places upward pressure on domestic prices through imported inflation. On the other hand, the contractionary effects on aggregate demand exert downward pressure on prices, offsetting the exchange rate effect. Over the longer term, persistent demand-side weakness appears to dominate, progressively lowering inflation. Nonetheless, the wide confidence intervals associated with these four estimates encompass zero throughout most of the response horizon, rendering statistical significance unclear.

Figure 7

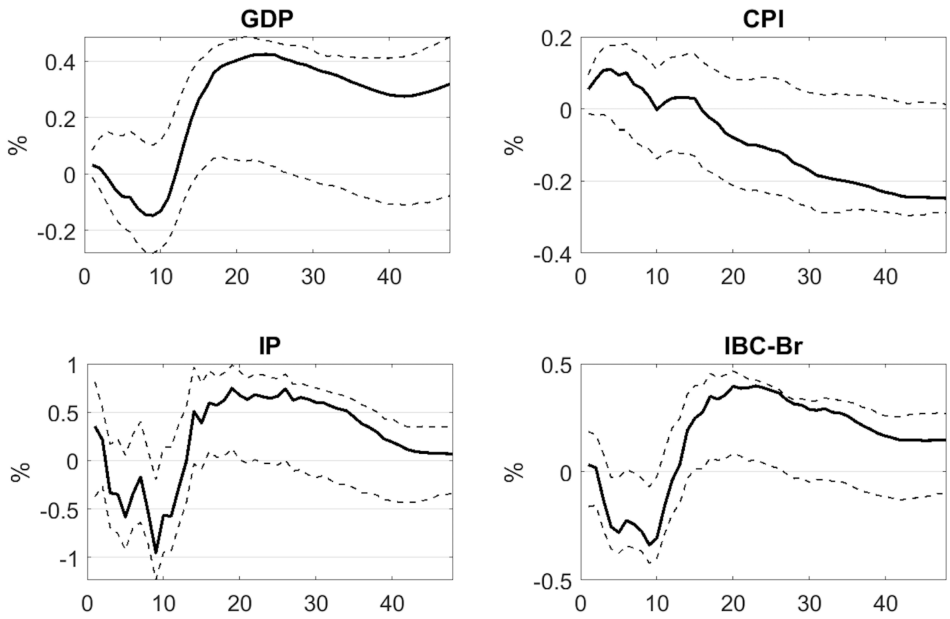
US Spillover Effects – Trade



Note. Impulse responses of exchange rate and trade variables to a one standard deviation US monetary tightening shock. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 02/2020.

Figure 8

US Spillover Effects – Economic Activity



Note. Impulse responses of Brazil's macroeconomic activity and prices to a one standard deviation US monetary tightening shock. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 02/2020.

6.5 Structural Implications

This section's findings underscore pronounced heterogeneity between financial and real economic responses. Financial indicators demonstrate immediate and statistically significant adjustments, consistent with rapid global portfolio reallocation and heightened risk aversion following external monetary tightening. The sharp declines in local equity indices, accompanied by significant reductions in price-earnings ratios and elevated dividend yields, highlight investor repricing of risk premiums and downward revisions of future earnings expectations. Sovereign risk metrics further confirm near-term risk repricing, reflected in substantial increases in credit default spreads.

Conversely, real economic variables often display unclear responses, indicative of more complex macroeconomic channels. Notably, the Brazilian real's depreciation, which typically enhances export competitiveness, does not immediately stimulate trade volumes. Both exports and imports decline similarly, reflecting dominant global demand contraction effects rather than improved exchange-rate-driven competitiveness. The parallel decline observed in world trade volumes reinforces the hypothesis of common structural shocks and international spillover effects, although the wide confidence intervals across these variables significantly challenge precise inference and interpretation.

Finally, the production variables exhibit nuanced dynamics, with GDP, industrial production, and the IBC-Br index all initially contracting but subsequently rebounding after roughly one year. Meanwhile, inflation gradually declines over the long-term with no clear immediate reaction, likely reflecting a balancing of inflationary pressures from currency depreciation and disinflationary effects stemming from weakened domestic demand. As before, wide confidence intervals throughout the response horizon preclude definitive conclusions regarding statistical significance, suggesting considerable uncertainty.

In sum, the analysis reveals a clear asymmetry in the transmission of US monetary policy shocks, with financial variables responding more rapidly and with greater statistical precision than their macroeconomic counterparts. This divergence aligns with theoretical expectations surrounding information frictions and transmission mechanisms: while financial markets react swiftly to external shocks due to high liquidity and the immediacy of price adjustments, macroeconomic variables tend to adjust more gradually, shaped by structural rigidities, policy implementation lags, and sectoral heterogeneity. The considerable uncertainty surrounding medium- and long-term responses of the real economy further underscores the limitations of drawing strong causal inferences. Thus, these findings highlight the importance of complementing baseline identification strategies with alternative

approaches and extended time series to enhance robustness in future research.

7. Brazil's Monetary Policy Surprises

This section shows that economic news can predict monetary policy surprises. As described in Section 3.4, this study considers two complementary measures: the first is constructed from forecast errors between the realized Selic rate and Bloomberg-based expectations, as in Oliveira and Simon (2023), while the second is derived from DI1 futures price changes, following the approach of Bauer and Swanson (2022). Table 1 reports results from this regression for both samples with standardized predictors[12] and heteroskedasticity-consistent (HC3) errors.

7.1 Verifying the 2003 Structural Break

Following the discussion in Section 3.1, a standard Chow test framework is applied to assess whether the sample starting in October 2000 exhibits a structural break in October 2003. The procedure begins by setting October 1, 2003, as the hypothesized break date. The dataset is then divided into observations prior to and before this date. Separate OLS regressions with the predictors in Section A are estimated on each subsample, yielding two sums of squared residuals (SSR)—namely, $\mathrm{SSR}_{\mathrm{pre}}$ for the earlier subsample and $\mathrm{SSR}_{\mathrm{post}}$ for the later one. Finally, a pooled regression is estimated over the entire sample, resulting in a combined sum of squared residuals, $\mathrm{SSR}_{\mathrm{pooled}}$.

Let n_{total} be the total number of observations and$k$ the count of parameters in the regression, including the intercept. The Chow test statistic is given by

$$F_{\mathrm{stat}} = \frac{\left(\mathrm{SSR}_{\mathrm{pooled}} - (\mathrm{SSR}_{\mathrm{pre}} + \mathrm{SSR}_{\mathrm{post}})\right)/k}{\left(\mathrm{SSR}_{\mathrm{pre}} + \mathrm{SSR}_{\mathrm{post}}\right)/\left(n_{\mathrm{total}} - 2k\right)}, \tag{7.1}$$

which follows an F-distribution with k and $(n_{\mathrm{total}} - 2k)$ degrees of freedom.

The Chow test yielded an F-statistic of 4.38 and a corresponding p-value of 3.56×10^{-4}, which is considerably below the conventional 1% significance level. This provides strong statistical evidence to reject the null hypothesis of no structural break. Therefore, the regression relationship governing the data undergoes a significant change after this break, suggesting that the underlying dynamics of the model differ meaningfully between the pre- and post-break periods.

[12]Standardized coefficients reflect the expected change in the outcome variable per one-standard-deviation increase in each predictor, enabling direct comparison of effect magnitudes across variables.

7.2 Predicting Monetary Policy Surprises

Table 1 confirms the hypothesis that economic news serve as a significant predictor of monetary policy surprises, as demonstrated by both regressions' significant F-statistics and R^2 of 15.6% and 23.1%, respectively, using heteroskedasticity-consistent standard errors. For reference, Bauer and Swanson (2022) reported an R^2 of 16.1% for their main regression. These results confirm that macroeconomic and financial indicators carry meaningful predictive power for monetary policy surprises, consistent with the discussions in Section 3.4 and Section 5.

Table 1

Predictive Regressions Using Macroeconomic and Financial Data (Post-2003)

	Monetary policy surprise	
	(1) DI1 shocks	(2) Forecast shocks
Economic activity surprise	0.015**	0.011
	(0.006)	(0.016)
Inflation surprise	0.022*	0.006
	(0.013)	(0.019)
National debt expectations (1y)	-0.024*	0.050*
	(0.013)	(0.027)
Exchange rate expectations (1y)	0.036***	-0.029
	(0.012)	(0.026)
Lagged change in inflation	0.011	-0.086***
	(0.019)	(0.031)
$\Delta \log$ BCOM (3m)	0.019**	0.022
	(0.009)	(0.015)
Δ Slope (3m)	-0.012	0.032
	(0.008)	(0.027)
Const	0.001	0.017
	(0.008)	(0.016)
Observations	172	172
R^2	0.156	0.231
Adjusted R^2	0.120	0.198
F Statistic	3.588***	2.305**

Note. Heteroskedasticity-consistent (HC3) errors reported in parentheses. The table reports the coefficient estimates from the regression $mps_t = \alpha + \beta X_{t-} + \varepsilon_t$. See Section 4.5 for a description of the regressors. All predictors are standardized. Sample: 10/2003 – 01/2025.
*p<0.1; **p<0.05; ***p<0.01.

Fiscal concerns are significant across both approaches, confirming that uncertainty around

debt sustainability has a measurable impact on monetary policy surprises. As discussed by Oliveira and Simon (2023) and F. G. Carvalho and Muinhos (2022), Brazil's monetary policy is deeply interwoven with fiscal conditions, shaped by historical patterns of high expenditures and persistent inflationary pressures, requiring aggressive interest rate hikes from the central bank.

In the futures-based specification, economic activity surprises and commodity prices fluctuations underscore the role of real-sector and external-price shocks in shaping policy responses, while the strong significance of exchange rate expectations reflects Brazil's particular sensitivity to exchange-rate pressures. Inflation surprises also exhibit a smaller yet meaningful effect, consistent with the intuition that unexpected inflation prompts tighter policies via higher interest rates. Meanwhile, in the survey-based specification, the most prominent predictor is lagged inflation, suggesting that recent inflation momentum is priced into market forecasts, so any divergence from the expected pattern increases the likelihood of policy surprises.

As discussed in Section 3.3, a valid instrument in a proxy-VAR framework must satisfy two criteria: relevance (correlation with the VAR's structural monetary policy shock) and exogeneity (orthogonality to other structural shocks), as in Equation (3.3). While relevance is empirically substantiated, given that the surprises capture the exogenous Copom meeting shock ε_t, a key driver of monthly policy news, exogeneity remains tenuous. As demonstrated theoretically in Section 5 and supported by this section's empirical evidence, post-meeting correlations between macroeconomic and financial variables induce confounding relationships with non-policy structural shocks. To mitigate this endogeneity, this paper adopts the projection methodology of Bauer and Swanson (2021), constructing an orthogonalized monthly instrument $z_t^{\perp}$ by aggregating purified shocks $\text{mps}_t^{\perp}$. This adjustment helps remove predictable variation tied to economic news, thereby enhancing exogeneity under Equation (3.3) while preserving relevance, as the residual variation predominantly reflects unanticipated policy path revisions.

Finally, Figure 9 highlights an intriguing issue with survey-based identification. As Brazil's economic and political instability improved and central banks became increasingly integrated with financial markets, the incidence and magnitude of forecast errors have diminished over time. Notably, the top panel in Figure 10a reveals a clustering of large shocks in the early sample period, while later observations are mostly zero. Furthermore, economic forecasts are either correct—yielding no shock—or incorrect by multiples of 25 bps, which severely hinders the variability in the data. In contrast, the DI1 futures approach continues to capture these policy surprises as small, yet discernible, movements. Consequently,

Section 8 will focus on the futures-based instrument as the primary identification strategy. For robustness, full-sample results employing both instruments under a dummy-interaction regression model are presented in Section A.

7.3 Asset Prices and Copom Announcements

The theoretical framework developed in Section 5 posits that monetary policy shocks are predictable based on publicly available economic information known before policy meetings, and that these shocks, in turn, can explain asset price responses within the announcement window. To empirically assess these conclusions, the effects of monetary policy surprises on stock prices are estimated using event-study regressions of the form

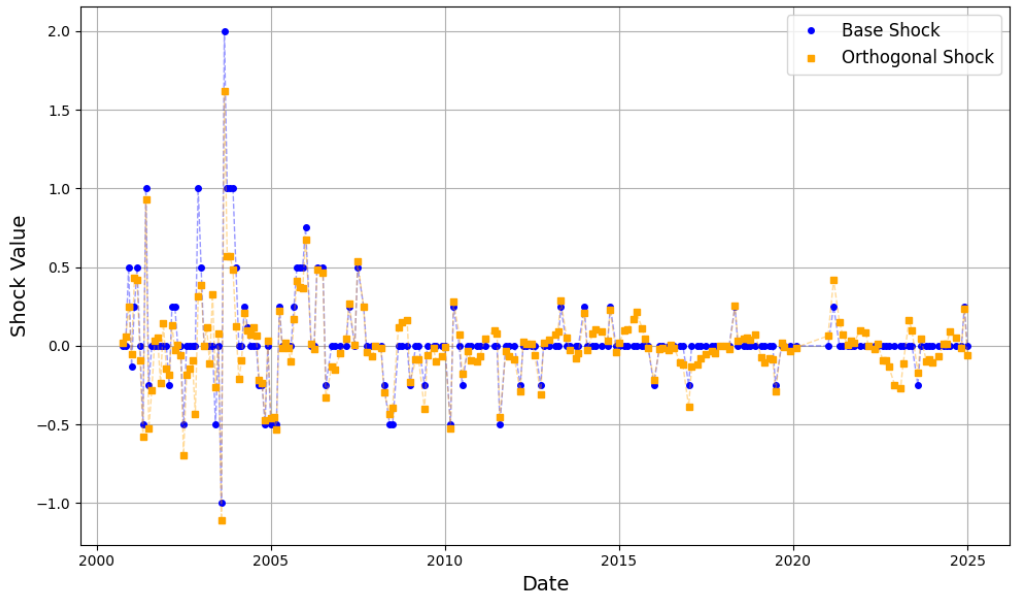
$$y_t = \alpha + \beta mps_t + \varepsilon_t, \tag{7.2}$$

where t indexes Copom announcements, mps_t represents the monetary policy shock, and y_t denotes the change in an asset price over the announcement window. The log-transformed Ibovespa is used as a proxy for the stock market, with asset price responses measured according to the methodology outlined in Section 4.4 for constructing the shocks.

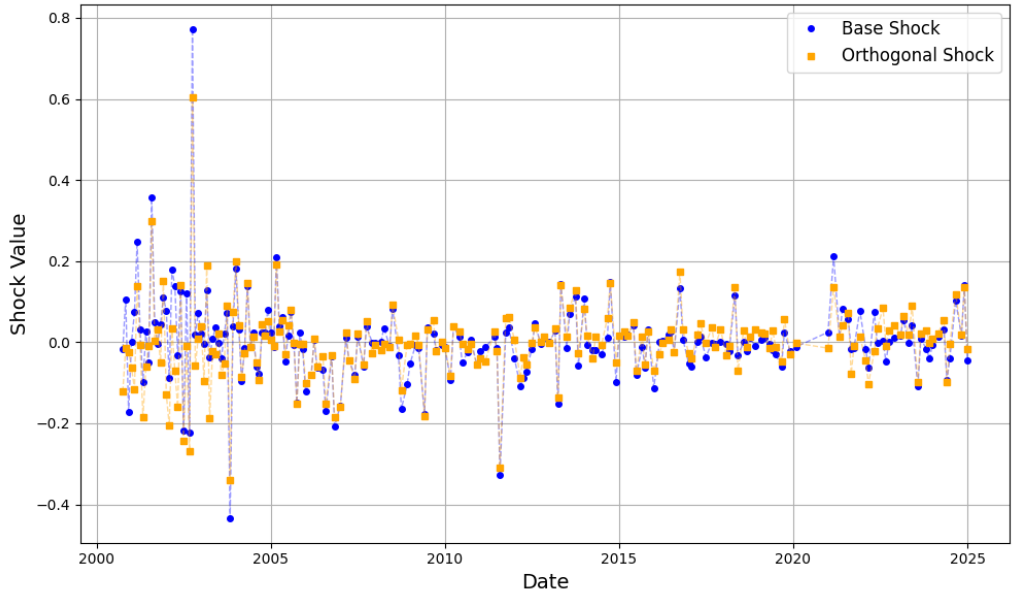
The results for the unadjusted monetary policy surprises are presented in the first column of Table 2. Stock prices exhibit a strong negative response to these shocks, declining by nearly 300 basis points over the announcement window for each 100 basis point monetary policy surprise. This finding indicates that tighter-than-expected monetary policy leads to a statistically and economically significant drop in equity prices. The orthogonalized shocks, shown in the second column, yield a qualitatively similar response—approximately 260 basis points per 100 basis point shock—but with slightly lower explanatory power. This attenuation is expected, as the orthogonalized measure isolates the shock's unanticipated component. These results suggest that monetary policy surprises can be used to estimate the impact of monetary policy on financial markets, despite being partially predictable, in line with the theoretical framework proposed in Section 5.

Figure 9

Brazil Monetary Policy Shocks: Base vs. Orthogonalized Measures



(a) Bloomberg-based forecast shocks and their orthogonalized counterparts.



(b) DI1-based shocks and their orthogonalized counterparts.

Note. The top panel shows shocks constructed using Bloomberg survey-based forecasts, while the bottom panel shows those based on DI1 interest rate futures. Note how most of the large shocks occur at the start of the sample, especially for the survey-based measure. See Section 3.1 for a historical discussion. Sample: 10/2000 – 01/2025.

Table 2

Stock Market Responses to DI1 Monetary Policy Surprises

	Monetary policy surprise	
	(1) DI1 shock	(2) Orthogonal DI1 Shock
Ibovespa	-2.944***	-2.613***
	(0.782)	(0.805)
Constant	0.190***	0.184***
	(0.067)	(0.068)
Observations	172	172
R^2	0.129	0.086
Adjusted R^2	0.123	0.080
F-Statistic	14.17***	10.54***

Note. Heteroskedasticity-consistent (HC3) errors reported in parentheses. The table reports the coefficient estimates from the regression of the form (7.2). Sample: 10/2003 – 01/2025.
*p<0.1; **p<0.05; ***p<0.01.

8. Brazil's Monetary Policy Effects on the Macroeconomy

Recent empirical work frequently employs high-frequency fluctuations in interest rates surrounding central bank announcements as instruments for estimating the macroeconomic effects of monetary policy on output, inflation, and risk measures (Bauer and Swanson, 2022; Ramey, 2016). However, as demonstrated in Section 7, these instruments exhibit systematic correlations with the very economic indicators they aim to explain, thereby contravening the exogeneity condition critical for instrument validity. To address this endogeneity, the orthogonalization methodology introduced earlier adjusts these surprises by purging their predictable linkages to macroeconomic fundamentals, thereby mitigating potential biases. This analysis subsequently utilizes these instruments to quantify the causal effects of orthogonalized monetary policy shocks.

As discussed in Section 7, survey-based identification suffers from a marked decline in forecast errors over time. This deterioration raises concerns about weak-instrument bias, thereby rendering the resulting shock series unreliable for robust empirical inference across all sample periods. While this chapter's impulse reaction functions were also generated for this instrument, they have been omitted due to the prevalence of first-stage F-statistics below zero. Thus, this chapter focuses on the futures-based measure, which does not exhibit these issues.

Moreover, the sample prior to October 2003 exhibits extraordinarily high economic and political instability, so this section excludes this early portion of the data (see Section 3.1 and Section 7.1 for details). Nonetheless, full-sample results using both instruments are reported in Section A. The primary conclusion drawn from this discussion is that while survey-based shocks are robust in the full sample, restricting the data to exclude the high-volatility period significantly reduces the instrument's F-statistics, thereby undermining their reliability.

Hence, this chapter considers multiple specifications to assess monetary policy transmission in Brazil, each designed to address distinct identification challenges. All variables are log-transformed unless otherwise specified. First, the baseline model in Section 8.1 includes the IBC-Br[8], the IPCA market prices inflation index (non-administered prices), the IC-Br[5] commodity price index, and the one-year yield and five-year CDS expressed in percentage points. GDP and IBC-Br are nearly perfectly correlated (Section 3.2) and produce similar results but the latter is preferred due to its monthly frequency. Moreover, the IBC-Br was selected instead of industrial production because it is the benchmark used by da Costa Filho (2017) and usually produces tighter confidence bands. Finally, selecting the five-year CDS as the sovereign risk proxy was ultimately arbitrary, as it mostly yields no significant differences

from the EMBI+ Brazil spread.

Then, Section 8.2 explores removing commodity prices from the instruments' list to study their effectiveness in mitigating the price puzzle, in which interest rate hikes paradoxically appear to increase inflation in the short term. Finally, the open-economy specification in Section 8.3 inspired by Luporini (2008) introduces the USD/BRL exchange rate, Brazil's trade balance, and gross debt-to-GDP ratio as endogenous variables alongside one-year yields, output, and inflation. This approach examines how external shocks propagate through international trade and capital flows, possibly reducing omitted variable bias in inflation dynamics. Brazil's trade balance and debt are introduced into the model in first-differences to address non-stationarity concerns. Together, these specifications disentangle domestic policy shocks from global and fiscal forces, offering a multitude of controls to reconcile Brazil's inflationary persistence and exchange rate pass-through mechanisms.

Across the various SVAR specifications, impulse responses exhibit standard macroeconomic patterns in the medium to long run, with inflation eventually reverting below or near baseline and real activity declining before gradually recovering. Orthogonalizing the high-frequency policy surprises further mitigates the short-term price puzzle and enhances interpretability, underscoring the importance of removing predictable variation in order to isolate truly exogenous monetary shocks and provide more credible insights into Brazil's policy transmission.

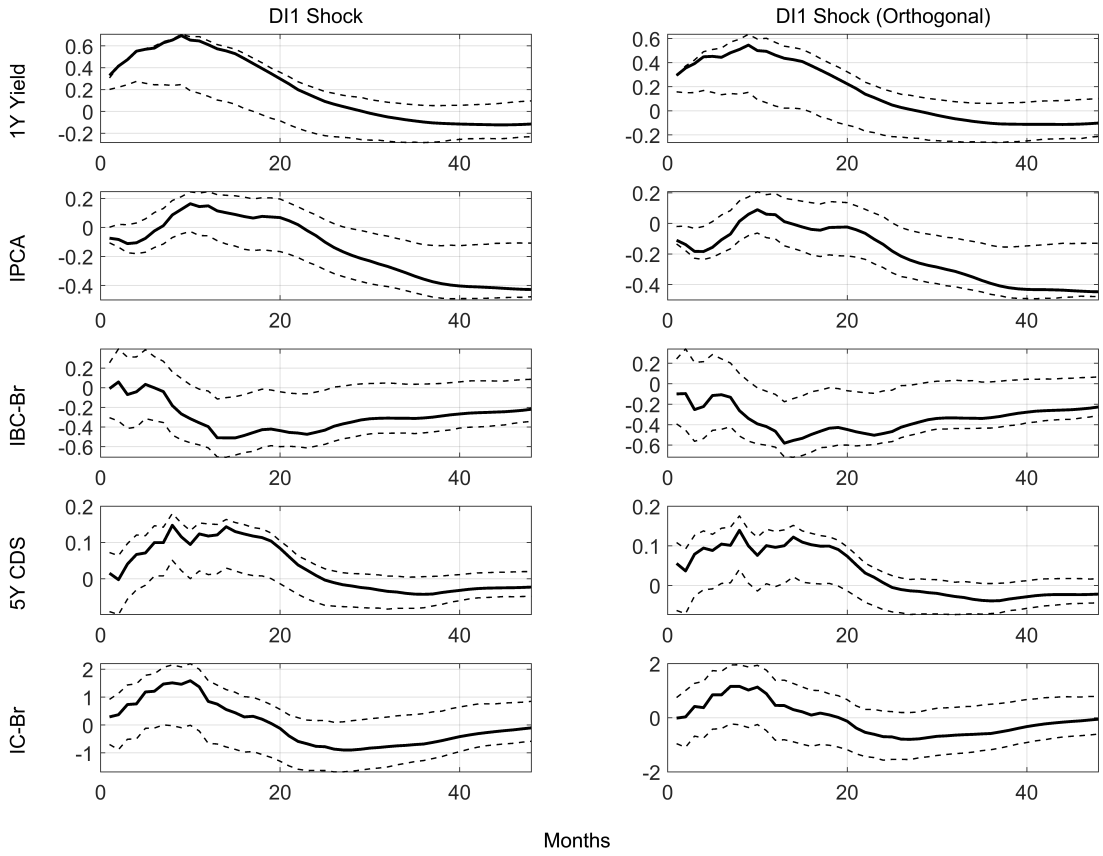
8.1 Baseline SVAR Specification

Figure 10 presents the impulse response functions (IRFs) of the main, baseline model. A one standard deviation monetary tightening shock causes one-year yields to rise by around 40 bps, ultimately nearing 60 bps at the one-year mark before tapering back. Moreover, note that the yield's IRF point estimate lies near the upper boundary of its bootstrapped 90% confidence bands, prompting caution about potential overestimation or unmodeled uncertainties. Gertler and Karadi (2015) report an immediate increase of roughly 25 bps in the US one-year yields that gradually reverts to zero after a similar shock, which suggests that Brazil's short-term yields exhibit a more pronounced and persistent response to monetary tightening. This stronger reaction likely reflects Brazil's higher inflation risk and risk premium embedded in domestic yields relative to the United States. The delayed peak, which is absent in US yields, further implies that the full impact of the shock materializes over time, likely reflecting staggered portfolio reallocation, forward guidance signaling, or adaptive inflation expectations.

The short-run price puzzle emerges as inflation increases through the first year but then

Figure 10

Baseline SVAR Specification – IBC-Br, 5-Year CDS, and Commodity Prices



Note. Impulse reaction functions after a one standard deviation monetary tightening shock. DI1 shock: base (F=7.94 [6.72]), orthogonal (F=6.34 [6.78]). Robust F-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 01/2025.

drifts below baseline, reflecting conventional contractionary effects on aggregate demand. Orthogonalizing the shock measure helps clarify this long-term movement, as inflation exhibits a significantly more pronounced negative tendency in the right column, which indicates that removing the endogenous response of monetary policy to anticipated inflation dynamics reduces bias and reveals a more consistent disinflationary effect in the medium to long term. Nevertheless, it is important to acknowledge that neither instrument yields 90% confidence bands that exclude zero, indicating that the estimated inflation response remains statistically indistinguishable from zero.

Furthermore, economic activity exhibits a gradual decline over the 48-month horizon, stabilizing approximately 40 bps below initial levels after just over one year, with signs of reverting toward baseline in the long run. This pattern is consistent with standard economic theory, wherein contractionary monetary policy reduces aggregate demand, inducing a protracted decline in output, followed by a gradual recovery as the restrictive effects of tighter monetary conditions wane over time. Consistent with these findings, Brazil's five-year CDS exhibits a short-term increase before reverting to its initial levels after about two years, suggesting that the initial deterioration in credit risk perceptions subsides as market conditions stabilize and expectations adjust to the new monetary policy stance. All point estimates show signs of gradually returning to initial levels around the 20th month, indicating that the shock's effects dissipate around the same time.

Finally, it is noteworthy that Bauer and Swanson (2022) faced considerable challenges with weak instrumentation, necessitating an expanded sample that included Fed Chair speeches alongside FOMC meeting announcements. Although a comparable expansion could bolster the relevance and robustness of identification in the Brazilian context, such an adjustment is not deemed critical in this analysis. Despite this specification's marginally significant F-statistics[13], the full-sample IRFs in Section A produce sufficiently high F-statistics while yielding similar dynamic responses, thereby easing concerns about weak instruments. Nonetheless, inspired by Bauer and Swanson (2022), an attempt was made to expand the data set by incorporating shocks due to Copom meeting minutes, but their inclusion reduced first-stage F-statistics to levels below 1. This is likely because minutes are released one week after the decision is announced, so their informativeness is lower. Future research could explore further communication channels, such as press conferences, though that lies beyond the scope of the present analysis.

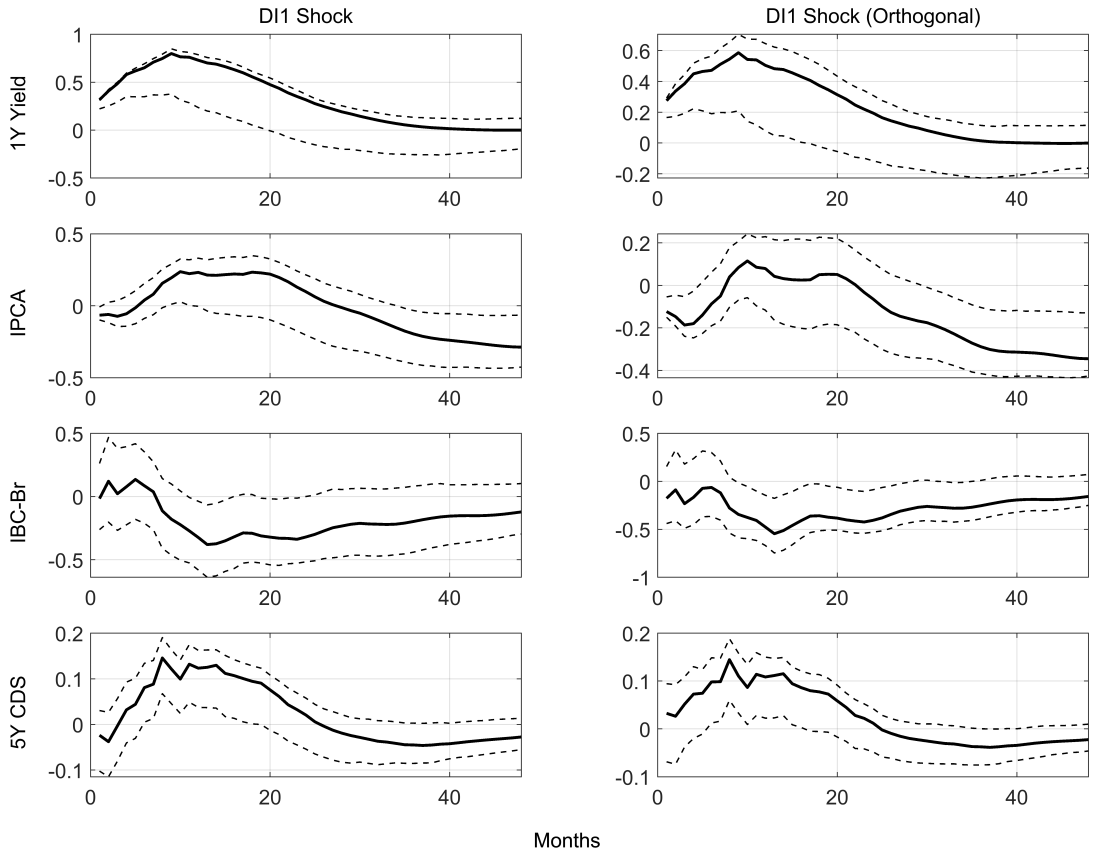
[13]Stock and Watson (2012) propose a rule of thumb stating that an instrument is considered weak if the first-stage F-statistic in the two-stage least squares regression is below 10.

8.2 Analyzing the Influence of Commodity Prices

Since Sims (1992), commodity price series have frequently been included in VARs to mitigate the price puzzle, as they serve as leading indicators of future inflation and account for global supply and demand shocks that influence domestic price dynamics, thereby reducing omitted variable bias. Accordingly, Figure 11 presents the impulse response functions of the model estimated without commodity prices. The most salient difference emerges in the inflation response, which now exhibits a price puzzle under the raw, non-orthogonalized instrument. In contrast, there is no clear change in the inflation response when using the orthogonalized measure, reinforcing the view that it improves identification by isolating the truly exogenous component of the policy shock. The responses of all other variables remain broadly consistent with those observed in the baseline specification presented in Figure 10.

Figure 11

Baseline SVAR Specification Without Commodity Prices



Note. Impulse reaction functions after a one standard deviation monetary tightening shock. DI1 shock: base (F=7.07 [5.35]), orthogonal (F=5.25 [5.68]). Robust F-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 01/2025.

8.3 Including Trade and Fiscal Variables

The SVAR specification incorporating fiscal and trade variables (Figure 12) yields impulse responses for one-year yields, inflation, and activity that are broadly consistent with those from the baseline model. Moreover, its slightly higher F-statistics reinforce the findings by Luporini (2008), who argue that including fiscal and trade dynamics can improve robustness. Nevertheless, this analysis prioritizes the baseline model (Figure 10) due to its superior interpretability.

According to standard economic theory, a contractionary monetary policy shock is expected to induce an immediate currency appreciation through heightened capital inflows; indeed, the Brazilian real appreciates initially before gradually reverting toward its baseline level. Theoretical predictions suggest that such an exchange rate appreciation would temporarily narrow the trade balance, but its response is unclear in the SVAR besides an immediate, short-lived decline. As discussed in Section 6, trade variables often exhibit ambiguous responses due to the diverse set of determinants affecting external balances and exchange rate dynamics. Finally, higher interest rates on government liabilities increase debt service costs, while the resulting slowdown in GDP growth revealed in the baseline specification further raises the gross debt-to-GDP ratio, justifying the gradual increase observed in Figure 12.

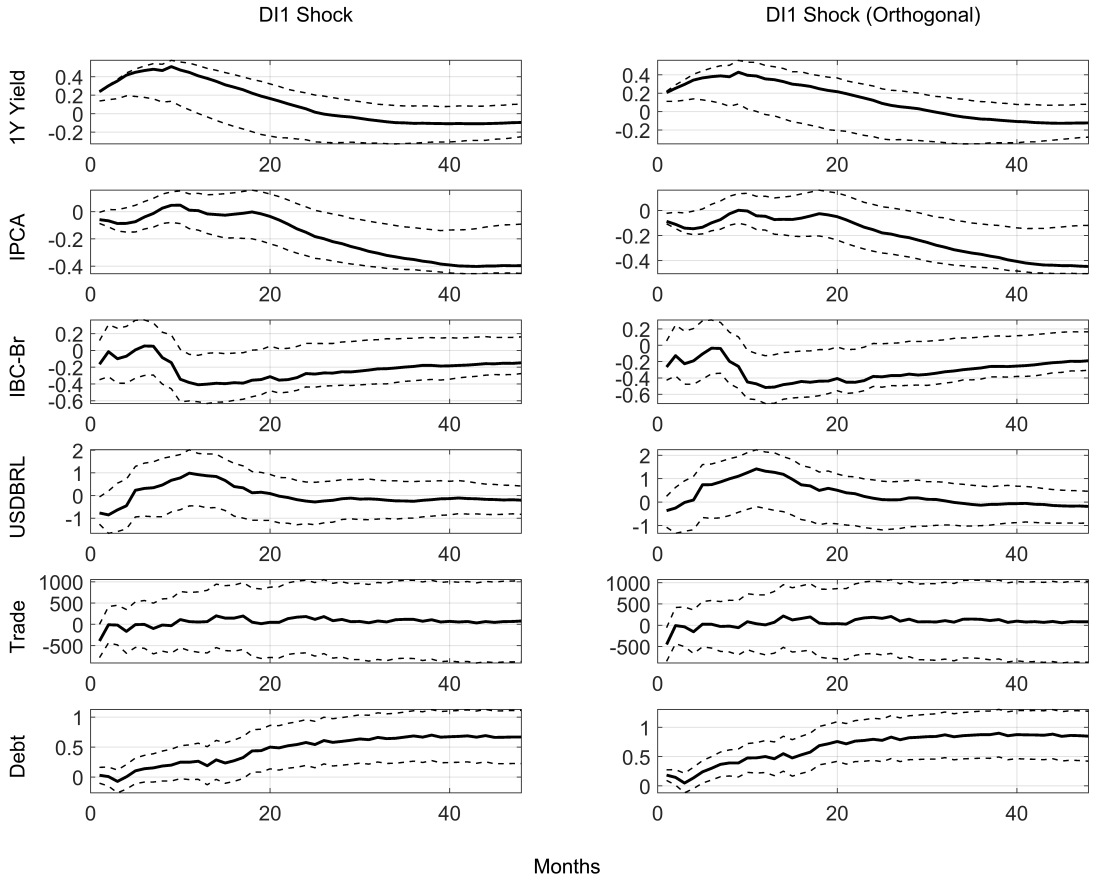
Finally, Figure 13 incorporates all instruments discussed thus far and yields a robust F-statistic of 20.30, indicating strong instrument relevance. While the short-term responses of inflation and GDP display a somewhat more pronounced puzzle, the medium- and long-term dynamics remain consistent with the baseline specifications. Despite the superior F-statistic, the analysis retains the baseline model as the primary specification due to its simplicity. Nonetheless, the full specification may be preferable in contexts where maximizing explanatory power is of greater importance.

8.4 Additional Impulse Reaction Functions

Figure 14 provides supplementary impulse responses within the baseline SVAR specification described in Section 8.1. The left panel shows the unemployment rate response, which exhibits no distinct immediate reaction, yet progressively increases over the medium to long term, consistent with theoretical expectations that monetary tightening dampens economic activity and raises unemployment with a lag. However, confidence intervals are wide. Meanwhile, the right panel shows the response of Ibovespa, Brazil's primary stock market index, to the monetary policy tightening. Somewhat counterintuitively, the index rises

Figure 12

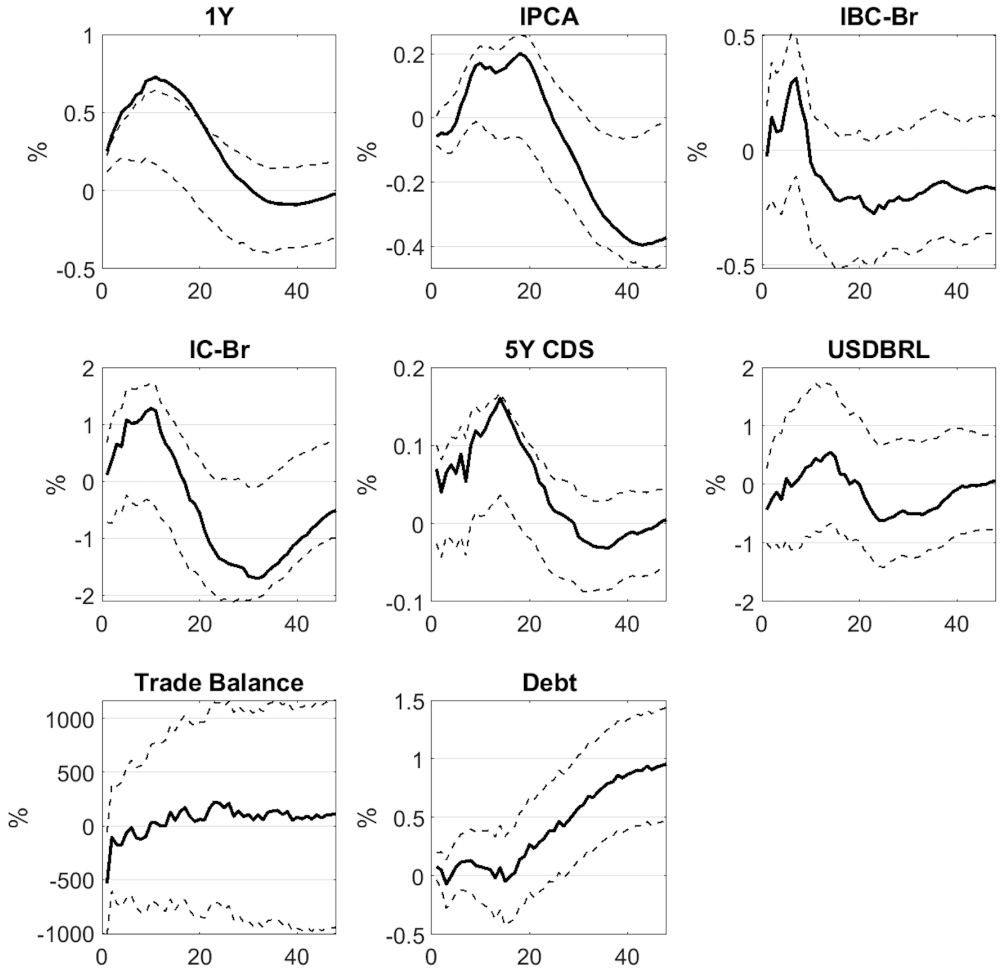
Impulse Reaction Functions – Model with Trade and Fiscal Variables



Note. Impulse reaction functions after a one standard deviation monetary tightening shock. DI1 shocks: base (F=9.95 [9.71]), orthogonal (F=6.84 [8.23]). Robust F-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Trade balance (US$ millions) and the ratio of gross debt-to-GDP (percent) included in differences. Sample: 10/2003 – 01/2025.

Figure 13

Impulse Reaction Functions – Full Orthogonal Specification

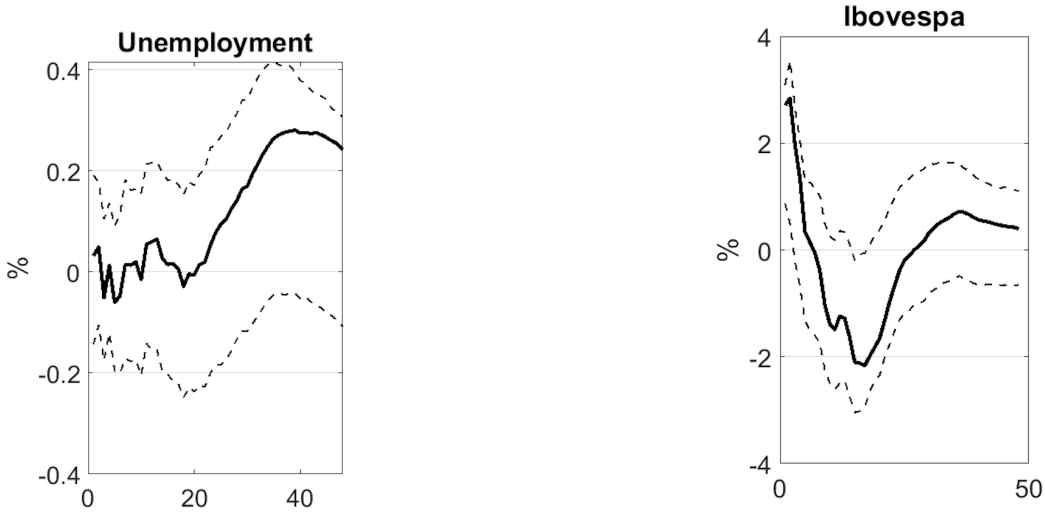


Note. Impulse reaction functions after a one standard deviation monetary tightening shock. Orthogonal DI1 shocks: F=15.06 [20.30]. Robust *F*-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Trade balance (US$ millions) and the ratio of gross debt-to-GDP (percent) included in differences. Sample: 10/2003 – 01/2025.

initially following the shock, which can occur if investors interpret the central bank's action as a credible commitment to containing inflation—thus temporarily boosting confidence—or if the policy shift is perceived as mitigating risk premia in future periods. After this brief upswing, the Ibovespa subsequently undergoes a pronounced decline of approximately 2% within the first two years. This downturn aligns with standard asset-pricing intuition, as higher interest rates raise discount factors and dampen profit expectations, lowering equity valuations. After reaching its trough, the Ibovespa gradually recovers and converges back toward its baseline level around the third year.

Figure 14

Additional Responses – Unemployment and Ibovespa



(a) Unemployment rate's response to a one standard deviation monetary policy shock in the baseline model.

(b) Bovespa Index's (Ibovespa) response to a one standard deviation monetary policy shock in the baseline model.

Note. Both panels show the reaction of additional variables when appended separately to the baseline specification in Section 8.1. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2003 – 01/2025.

9. Conclusion

Motivated by the pivotal role that monetary policy plays in steering both financial markets and real economic activity—especially in emerging economies like Brazil—this study sets out to resolve long-standing ambiguities regarding the exogeneity of policy surprises. By leveraging a state-of-the-art SVAR framework and orthogonalization procedure, this research isolates truly unexpected shifts in policy from those anticipated by market participants. This approach not only refines the measurement of monetary shocks but also bridges the gap

between international spillover effects and domestic structural idiosyncrasies, thereby contributing a robust analytical framework that enhances our understanding of both immediate financial adjustments and gradual real economic responses.

Section 6 demonstrates that external monetary tightening from the United States transmits to Brazil through distinct channels for financial markets versus the real economy. The equity market and sovereign risk indicators register pronounced and statistically significant impacts soon after the shock, reflecting swift global portfolio rebalancing and a rise in risk aversion, especially for emerging market assets. By contrast, short-term sovereign yields in Brazil experience a muted reaction, possibly due to stronger weighting of domestic macroeconomic factors—such as persistently high inflation and elevated public debt—alongside structural features of the Brazilian bond market. The observed simultaneous declines in exports and imports further point to adverse shifts in global demand overshadowing the potential export-boosting effects of currency depreciation, suggesting that the reallocation of international capital rapidly affects broader conditions for trade and investment, although the shock's magnitude is unclear.

Meanwhile, real economic indicators, particularly aggregate activity and prices, exhibit more gradual or inconclusive responses, underscoring the complexity and lagged nature of output and inflation adjustments in small open economies. Real GDP does eventually contract by a considerable margin, although industrial production displays a puzzling short-term uptick potentially driven by sectoral dynamics or measurement issues. Inflationary pressures remain subdued, as depreciation-driven cost-push factors appear largely neutralized by contracting demand. Overall, the heterogeneity in timing and magnitude of these impulse reaction functions underlines the importance of distinguishing high-frequency financial spillovers from the slower-moving channels influencing real economic outcomes.

Section 7 highlights three main findings. First, a structural break in 2003 necessitates careful selection of sample periods and instruments. The strong Chow test results demonstrate that monetary policy reactions before and after this date differ substantially, underscoring the need to handle the data in two distinct regimes rather than imposing a single, unified structure. Hence, due to a sustained reduction in forecast errors over time, survey-based shocks are not recommended for policy analysis. Second, the consistency of economic and financial variables in predicting high-frequency policy surprises confirms that such shocks often reflect ongoing macro-financial trends—ranging from fiscal pressures to commodity price fluctuations—rather than purely exogenous monetary surprises. Third, the Ibovespa responds strongly to monetary policy surprises during the announcement window, confirming their usefulness for estimating the impact of monetary policy on financial markets.

Thus, these results emphasize the need to address the endogeneity inherent in Brazilian policy announcements. Orthogonalization techniques similar to those proposed by Bauer and Swanson (2022) can prune out predictable movements that arise from broader economic dynamics and ensure cleaner identification of genuine policy shocks. In doing so, researchers can more reliably attribute observed impacts on inflation, output, and financial markets to authentically unanticipated monetary policy changes, particularly in the context of post-2003 structural alterations.

The impulse response functions reported in Section 8 across multiple specifications reveal theoretically consistent reactions to monetary policy shocks, particularly in the long term. Although inflation exhibits a modest price puzzle, all models indicate that tighter monetary policy ultimately exerts a contractionary force on output and inflation over the longer run, consistent with standard macroeconomic theory. Moreover, while the untreated measure exhibits a pronounced sensitivity to the inclusion of commodity prices in the SVAR, the inflation response under the orthogonalized identification remains largely unchanged—further reinforcing the effectiveness of orthogonalized instruments in isolating exogenous monetary policy shocks. Future research could extend the analysis by applying a Markov-switching SVAR framework to Brazil, which would allow for a more accurate modeling of regime-dependent dynamics and better capture the inherent macroeconomic volatility characteristic of emerging markets.

Thus, the orthogonalization procedure significantly reduces such puzzles and improves interpretability. By purging predictable variation tied to macroeconomic fundamentals, the orthogonalized instrument ensures that observed dynamics more closely reflect truly exogenous policy actions. This improvement in exogeneity enhances credibility in attributing the estimated impacts on inflation, output, and financial indicators to genuine monetary policy shocks rather than endogenous responses to economic conditions.

A potential concern with the futures-based identification strategy arises from the timing of Copom meetings. Since they occur after financial markets close, the policy shock is measured using the difference between the market close and the next day's open rather than intraday prices. This raises the possibility that factors other than the Copom's decision may influence overnight price movements. However, given the Copom's primary role in Brazil's fixed-income-dominated financial markets, it is reasonable to expect that the decision remains the primary driver of these price changes. Future research could enhance this approach's robustness by incorporating a measure of influential market news in the regression at Section 7 to further isolate the impact of the Copom announcement. Another promising candidate would be a measure of central bank credibility, which is a core issue

in emerging markets and has been shown by Oliveira and Simon (2023) to significantly influence how economic agents react to monetary policy surprises. Including these variables could help capture key dimensions of market perception that may otherwise confound the measurement of monetary shocks.

Finally, Bauer and Swanson (2022) address weak-instrument concerns by supplementing their baseline specification with Fed Chair speeches in addition to FOMC announcements, thereby enhancing the informational richness of the identified shocks. A similar strategy could strengthen identification in the Brazilian context, although the complete specification presented in Figure 13 and the full-sample impulse response functions in Section A already generate robust F-statistics and consistent dynamics. In contrast, incorporating Copom meeting minutes substantially weakens instrument relevance, with associated F-statistics falling below 1—likely a consequence of the week-long delay in their release, which limits their ability to capture contemporaneous market expectations. To address this limitation, future research might consider integrating alternative sources such as real-time press conferences or public speeches, which could provide more timely and informative signals of the BCB's evolving policy stance.

Therefore, this study advances the analysis of monetary policy transmission in emerging markets by adapting state-of-the-art SVAR and orthogonalization techniques to Brazil's unique macroeconomic context. It rigorously disentangles exogenous domestic and international policy shocks, revealing stark contrasts in their propagation: global spillovers trigger immediate financial market reactions—equity selloffs and risk repricing—while domestic shocks exert gradual, structurally mediated impacts on output and inflation. By addressing endogeneity through regime-aware methods and isolating surprises, the analysis provides a robust framework for evaluating monetary policy efficacy in economies shaped by volatile capital flows and institutional transitions.

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Appendices

A. Full-Sample SVAR

Following the discussion in Section 7, this appendix utilizes the full sample beginning in October 2000 to construct orthogonalized monetary policy shocks and generate the SVAR impulse response functions. To account for the structural break in 2003, the regression specification is modified to a dummy-interaction model, which allows both the intercept and the slopes to vary across regimes. The complete model is expressed as:

$$mps_i = \begin{cases} \beta_0 + \sum_{j \in S} \beta_j X_{ij} + \varepsilon_i, & \text{if } D_i = 0, \\ \left(\beta_0 + \beta_1\right) + \sum_{j \in S} \left(\beta_j + \gamma_j\right) X_{ij} + \varepsilon_i, & \text{if } D_i = 1. \end{cases} \tag{A.1}$$

Here, D_i is a dummy variable for the post-break period, β_j and γ_j denote the pre- and post-break effects of predictor X_j, respectively, while β_0 and β_1 capture the intercepts before and after the break. This specification appropriately accommodates regime changes by allowing relationships to differ between the pre- and post-break periods.

The set of regressors employed in this specification differs slightly from those used in Section 7 due to data being unavailable or concerns about multicollinearity and overfitting. The results of the regression are presented in Table 3, where the significance of the post-break indicator provides further support for the existence of a structural break. Note that this approach effectively performs two regressions on smaller subset of the data, thus, decreasing the sample size and slightly increasing individual predictors' standard errors.

Figure 15 presents impulse response functions based on orthogonalized monetary policy shocks constructed from the residuals of the dummy-interaction regression. Due to data limitations, the EMBI+ Brazil spread is used in place of the five-year CDS. Overall, the results closely resemble those from the baseline specification in Figure 10, with the notable exception of a more pronounced price puzzle in the inflation response. This outcome, however, should not be interpreted as a shortcoming of the model specification. Rather, it reflects the highly inflationary and unstable macroeconomic environment in Brazil prior to 2003. As a robustness check, Figure 16 replicates the SVAR analysis beginning only one year later, already showing a less pronounced inflation puzzle. Nonetheless, Figure 17 demonstrates that incorporating trade and fiscal controls further attenuates this dynamic, consistent with the hypothesis that such variables are relevant drivers of the period's instability. Finally, the F-statistics for the futures-based instrument are highly significant across all specifications,

Table 3

Predictive Regressions Using Macroeconomic and Financial Data (Post-2000)

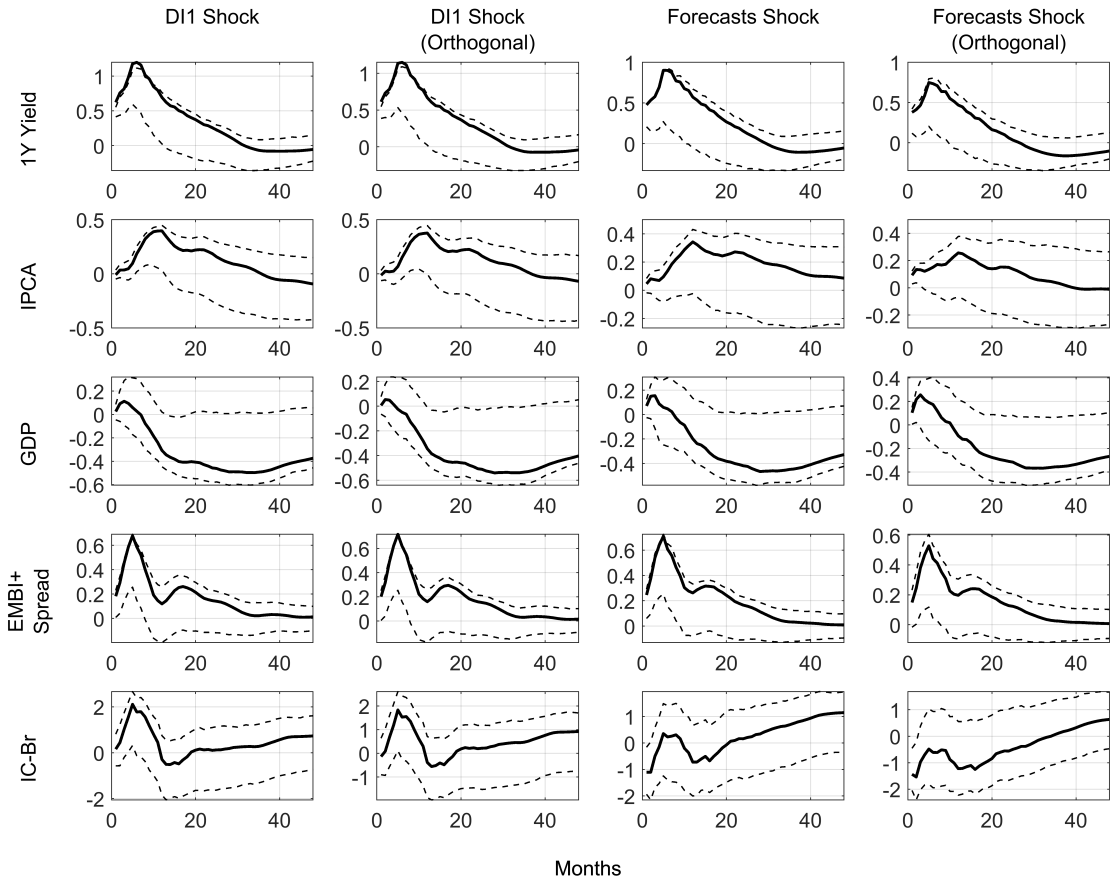
	Monetary policy surprise	
	(1) DI1 shocks	(2) Forecast shocks
Pre-break:		
Economic activity surprise	-0.031	0.040
	(0.020)	(0.064)
Inflation surprise	0.041*	0.064
	(0.024)	(0.048)
Inflation expectations (1m)	-0.024	0.081
	(0.019)	(0.067)
Lagged change in inflation	-0.001	-0.101
	(0.019)	(0.112)
$\Delta \log$ BCOMSP (3m)	0.081	-0.010
	(0.058)	(0.075)
Constant	0.005	0.030
	(0.008)	(0.020)
Post-break:		
Economic activity surprise	0.030*	-0.037
	(0.017)	(0.053)
Inflation surprise	-0.019	-0.041
	(0.021)	(0.043)
Inflation expectations (1m)	0.033*	-0.103*
	(0.019)	(0.066)
Lagged change in inflation	0.010	-0.006
	(0.019)	(0.094)
$\Delta \log$ BCOMSP (3m)	-0.066	0.034
	(0.055)	(0.073)
Post-break indicator	-0.049**	0.049
	(0.021)	(0.057)
Observations	209	209
R^2	0.195	0.189
Adjusted R^2	0.150	0.143
F Statistic	2.009**	1.825*

Heteroskedasticity-consistent (HC3) errors are reported in parentheses. Coefficient estimates β from regression in Equation (A.1). All predictors are standardized. Sample: 10/2000 – 01/2025.
*p<0.1; **p<0.05; ***p<0.01.

while the survey-based results exhibit greater robustness when trade and fiscal variables are included. Therefore, including these controls helps describe such periods of heightened instability driven partially by external market conditions.

Figure 15

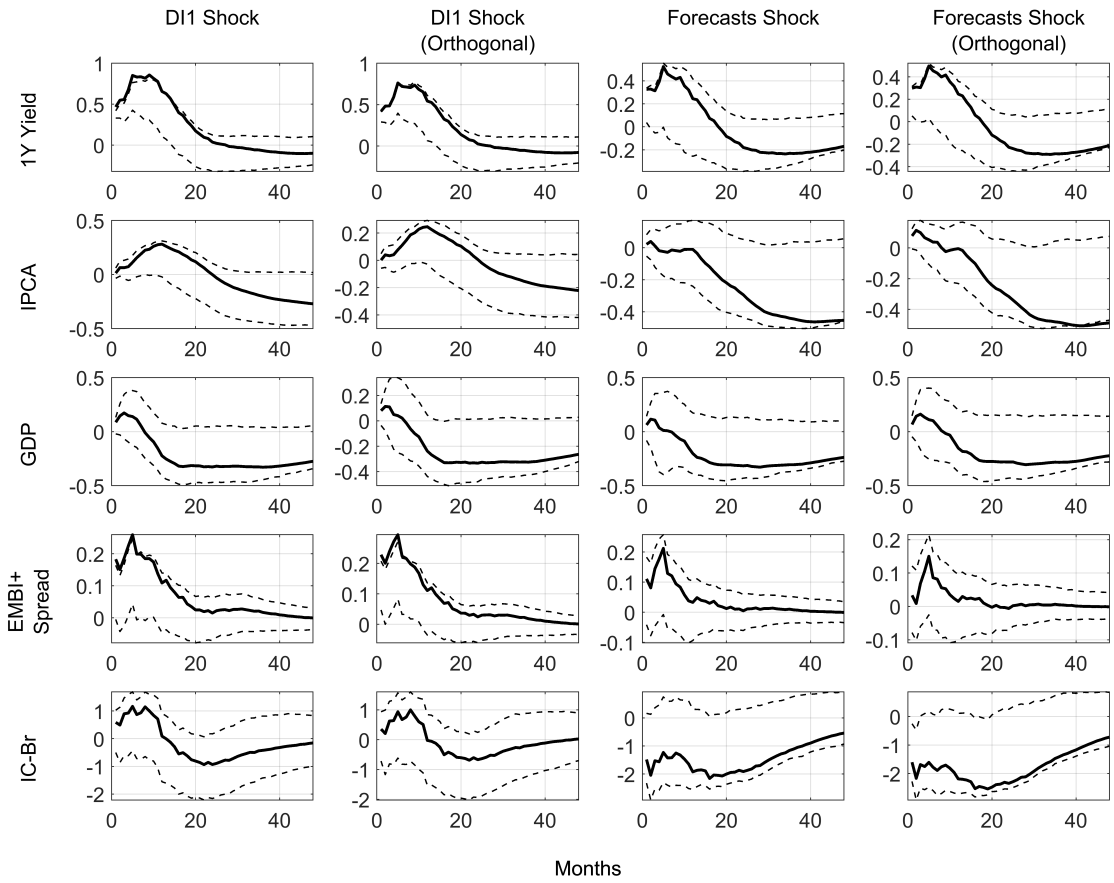
Baseline SVAR Specification (Post-2000) – GDP, EMBI+ Brazil, and Commodity Prices



Impulse reaction functions after a one standard deviation monetary tightening shock. DI1 shock: base (F=19.20 [12.23]), orthogonal (F=16.00 [6.33]). Forecasts shock: base (F=6.96 [11.05]), orthogonal (F=3.94 [5.02]). Robust F-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2000 – 01/2025.

Figure 16

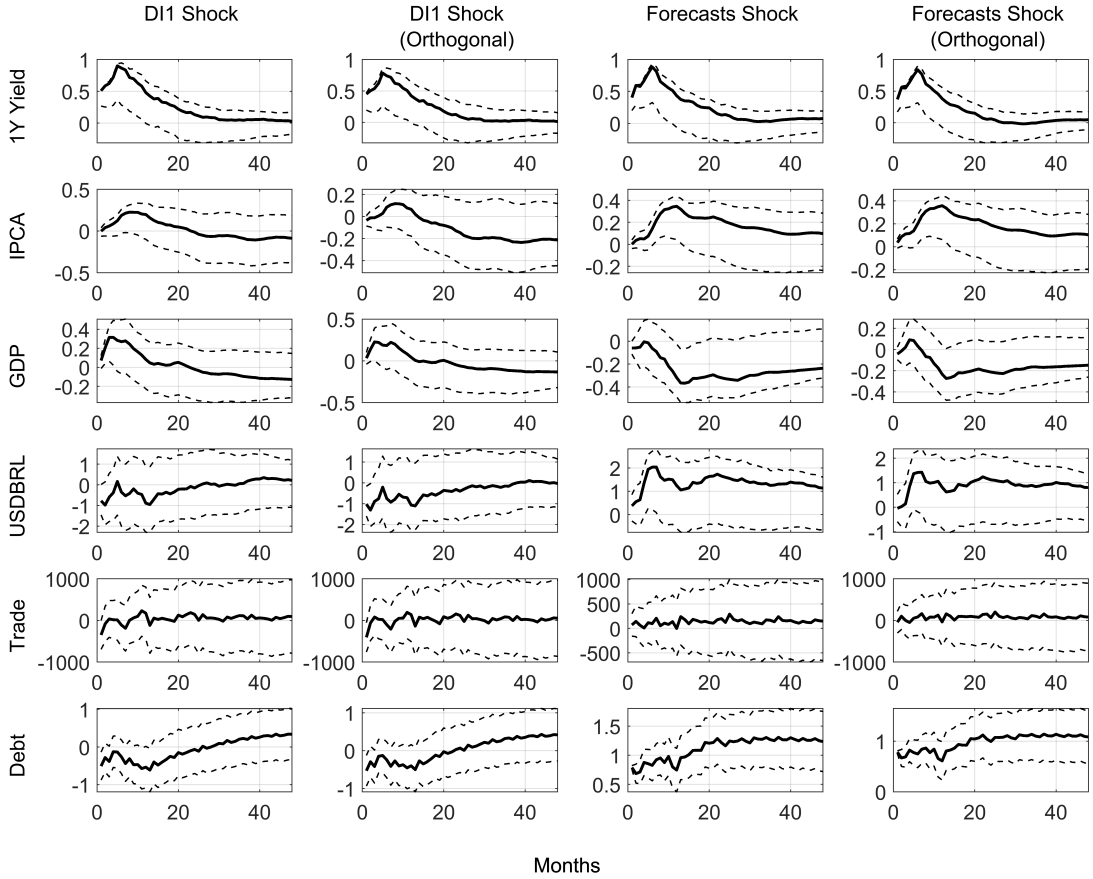
Baseline SVAR Specification (Post-2001) – GDP, EMBI+ Brazil, and Commodity Prices



Impulse reaction functions after a one standard deviation monetary tightening shock. DI1 shock: base (F=16.67 [18.64]), orthogonal (F=10.40 [7.30]). Forecasts shock: base (F=3.87 [3.60]), orthogonal (F=3.79 [4.40]). Robust F-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Sample: 10/2001 – 01/2025.

Figure 17

Impulse Reaction Functions (Post-2000) – Model with Trade and Fiscal Variables



Impulse reaction functions after a one standard deviation monetary tightening shock. DI1 shock: base (F=11.62 [6.10]), orthogonal (F=9.76 [4.16]). Forecasts shock: base (F=9.12 [12.27]), orthogonal (F=10.43 [13.72]). Robust F-statistics reported in brackets. Dashed lines report bootstrapped 90% standard error bands. Trade balance (US$ millions) and the ratio of gross debt-to-GDP (percent) reported in differences. Sample: 10/2000 – 01/2025.

B. Data Sources

The data utilized in Section 6 and Section 8 are detailed below:

1. Financial markets:
   - Bovespa Index (Finaeon; log-transformed).
   - Dividend yield and price-earnings (P/E) ratio (Finaeon).
   - Global indices: Developed and emerging markets (Finaeon; log-transformed).
2. Interest rates and sovereign risk:
   - 1-year National Treasury Bills (ANBIMA[14]).
   - EMBI+ Brazil Government Bond Spread[4] (Finaeon).
   - Brazil 5-year credit default swaps (Bloomberg Terminal).
3. Exchange rates & trade:
   - USD/BRL commercial exchange rate (SGS[15] series 1; log-transformed).
   - Imports and exports (IPEA[16]; log-transformed).
   - World trade volume (CPB Netherlands Bureau for Economic Policy Analysis via LSEG Workspace; log-transformed).
   - Brazil's trade balance (IPEA; US$ millions).
4. Macroeconomic activity:
   - Brazil GDP (IBGE [17] series 1621; log-transformed and linearly interpolated to monthly frequency).
   - Broad national consumer price index (IPCA) – unmonitored prices (monthly; SGS series 11428; log-transformed index).
   - Industrial production index (IBGE series 8887; log-transformed).
   - IBC-Br economic activity index[8] (BCB SGS series 24363).

[14] ANBIMA: Brazilian Financial and Capital Markets Association.
[15] SGS: Time Series Management System, Central Bank of Brazil.
[16] IPEA: Brazilian Institute of Applied Economic Research.
[17] IBGE: Brazilian Institute of Geography and Statistics.