Monetary Policy Surprises and House Prices: Evidence from Brazil*

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Abstract

This study investigates the dynamic effects of monetary policy shocks on property prices in Brazil, using a comprehensive data set of listed sales and rental prices, as well as interest rate futures. We employ local projection methods with external instrument to estimate the impact of monetary policy surprises on the housing market. The results indicate that, after a contractionary monetary shock, there is a noticeable decline in prices from three months after the event for listed sales prices and four months for listed rental prices, this effect is noticeable until the ninth month. Several specifications have been proposed to verify the robustness of the model.

Keywords: House prices. Monetary policy shocks. Local projection.
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1 Introduction

The connection between monetary policy shocks and their influence on housing prices has attracted significant attention and discussion in the field of macroeconomics. Past research has focused on the correlation between monetary policy and real estate markets, highlighting delayed impacts and gradual transmission mechanisms, as demonstrated by Williams (2016). However, recent empirical findings indicate that the impact of unexpected changes in monetary policy on house prices could be faster and more significant than previously believed, as shown by Gorea et al. (2023). Our article seeks to investigate these impacts and their consequences, examining the various effects within the framework of the Brazilian housing market.

In this research, we analyze data on listed sales and rental prices, as well as interest rate futures, to evaluate the effects of monetary policy shocks. Following the approach by Jordà (2005) using local projections, we propose two specifications: the Local Projection Ordinary Least Squares (LP-OLS) and the Local Projection Instrumental Variables (LP-IV). In the LP-OLS model, we treat the monetary policy surprise as a structural shock, whereas in the LP-IV model, we use the monetary policy surprise as an instrument for the interest rate changes without imposing this structural assumption. The data set comprises sales prices for 50 different cities and rental prices for 25 different cities.

Our results indicate that, following an unexpected 25 bps tightening of monetary policy, there is a decline in prices starting three months after the event for listed sales prices and four months for listed rental prices. The results were consistent in both estimations. Specifically, a reduction of around 0.5% in sales prices was observed in the third month with LP-OLS, while rental prices dropped by 1%. Similarly, LP-IV exhibited a decrease of approximately 1% in sales prices and 2% in rental prices. Both sectors hit their lowest point nine months after the unexpected event, after which the impact diminishes.

To investigate heterogeneity, we utilize the same setup for properties with different numbers of bedrooms. Additionally, we expand our examination to encompass properties located in various regions of the country and in the ten biggest cities in Brazil. These approaches encompass both the selling and renting prices. Interestingly, the results mirrored those of the earlier discoveries, albeit with varying magnitudes, suggesting that a decline in prices takes place around three to four months after the unexpected monetary event, bottom out eight to nine months later, and then gradually faded away.

Literature Review. Recently, there has been an increase in interest in the realm of monetary economics regarding the impact of surprises on monetary policy, with numerous research works delving into their implications on various economic facets. Kuttner (2001) was among the pioneering studies that explored the concept of monetary policy surprises by distinguishing between anticipated and unanticipated effects. The study revealed that reactions in bond yields were substantial and notable for the unanticipated component, whereas the response to the anticipated component was marginal.

In a research conducted by Nakamura and Steinsson (2018), high-frequency data was used to identify monetary policy surprises related to Federal Reserve announcements. It was found that monetary tightening exerts a substantial and enduring influence on real interest rates, has no immediate impact on inflation, and leads to an upsurge in anticipated output growth. Other notable contributions to the development of measures to assess monetary policy surprises are the studies by Gürkaynak et al. (2005) and Swanson (2021). The former posits that evaluating the effects of monetary policy surprises on asset prices requires considering two factors: changes in the federal funds rate target and the future policy trajectory, whereas the latter, as an extension of the former, incorporates three factors by introducing the element of large-scale asset purchases.

In a recent study, Bauer and Swanson (2023) proposed a novel approach to estimating monetary policy surprises by introducing an orthogonalized monetary policy surprise. This method involves eliminating the portion of the surprise that is associated with economic and financial indicators. The authors contend that this adjustment helps to address the issue of high-frequency endogeneity, as highlighted in recent research by Cieslak (2018), Bauer and Swanson (2023), and Miranda-Agrippino and Ricco (2021), indicating a correlation between monetary policy surprises and economic/financial data.

This leads to a consideration of whether monetary policy shocks represent exogenous alterations.

The research carried out by Williams (2016) in 17 countries revealed that changes in monetary policy have a notable impact on real estate prices. However, this impact tends to manifest itself only after a period of two years following a one-percentage point rise in the short-term interest rate. In a similar vein, Paul (2020) employed a VAR model to analyze how monetary policy shocks influence asset prices and the real economy, concluding that housing prices tend to decline after a tightening of monetary policy. In a more recent investigation, Gorea et al. (2023) evaluated the repercussions of unexpected monetary policy changes in the United States using weekly data. Their results indicated that the effects of such policy changes on housing prices could be observed within a mere two-week period.

On the other hand, Vicente et al. (2022) examined the impact of monetary policy surprises on the exchange rate in Brazil. They devised a surprise metric based on forward rates to compare future contracts with identical maturity periods. Their findings suggested that a negative surprise, signifying a greater than anticipated decrease in the SELIC target, would result in a depreciation of the Brazilian currency.

Outline. The upcoming sections of the article are structured as follows. In Section 2, the data used in the study for listed sales and rental prices are detailed, together with the data used to formulate the surprise measure and the controls in the alternative framework. Section 3 outlines the approach employed to generate the monetary policy surprise and the local projection specification. The results of our analyses are presented in Section 4. Finally, Section 5 provides the concluding remarks of the paper.

2 Data

Our data originate from three main data sets. The first covers the events of the Monetary Policy Committee (COPOM) and spans from July 2001 to March 2023, encompassing 193 different meetings. These meetings were mostly held at regular intervals of 45 days, with occasional extraordinary meetings taking place in earlier years.

The second data set refers to the price of interest rate futures contracts. The DI1 Future Contract has, as its underlying asset, the average daily Interbank Deposits (DI) rate, calculated and disclosed by B3 (Brazilian stock market), and it covers the period from the trading date, included, to the expiration date, not included. This financial instrument is widely used for the protection and risk management of interest rates of assets and liabilities referenced in DI.

The third data set is related to the price and rental value of listed properties. The FipeZAP + Index for Listed Property Prices is the first indicator to systematically track the evolution of prices in the Brazilian real estate market. It provides monthly data on listed property prices for both sale and rent, covering residential and commercial properties. Furthermore, the data is segmented by geographical region and the number of bedrooms, ranging from 1 to 4 bedrooms. The FipeZAP+ Index offers additional insights as it employs its own index to calculate prices, offering an aggregated national measure and specific measurements. Sales prices are available for fifty different cities and rental prices are available for 25 cities. The data for some capitals and the national index span the period from 2008 to 2022, while for most cities, available data starts from late 2011 or 2012, or from the beginning of 2018. Table 1 summarizes the data.

In order to adjust the listed prices in real terms, we utilize the General Market Price Index (IGP-M), which is widely used as an indicator for contractual adjustments in rents and sales in Brazil. This measure aims to provide a more accurate and comprehensive analysis of the evolution of property prices, taking into account market fluctuations and relevant economic factors over time.

In the estimation part, we have augmented our analysis by incorporating pertinent national data as control variables to assess the robustness of the estimated equations. This strategic approach allows us to explore the potential influence of various macroeconomic indicators on the target variables, by adding these variables, we are making our findings more robust and reliable.

Table 1: Data Summary

City	State	Capital	Region	Type		Obs	
				Sales	Rental	Sales	Rental
Brasília	DF	✓	Midwest	✓	✓	139	112
Goiânia	GO	✓	Midwest	✓	✓	72	48
Campo Grande	MS	✓	Midwest	✓	-	40	-
Maceió	AL	✓	Northeast	✓	-	40	-
Salvador	BA	✓	Northeast	✓	✓	139	112
Fortaleza	CE	✓	Northeast	✓	✓	103	48
João Pessoa	PB	✓	Northeast	✓	-	40	-
Jaboatão dos Guararapes	PE	-	Northeast	✓	-	40	-
Recife	PE	✓	Northeast	✓	✓	101	56
Manaus	AM	✓	North	✓	-	256	-
Vila Velha	ES	-	Southeast	✓	-	84	-
Vitória	ES	✓	Southeast	✓	-	84	-
Belo Horizonte	MG	✓	Southeast	✓	✓	182	128
Betim	MG	-	Southeast	✓	-	40	-
Contagem	MG	-	Southeast	✓	-	72	-
Niterói	RJ	-	Southeast	✓	✓	88	48
Rio de Janeiro	RJ	✓	Southeast	✓	✓	208	208
Barueri	SP	-	Southeast	✓	✓	40	40
Campinas	SP	-	Southeast	✓	✓	120	112
Diadema	SP	-	Southeast	✓	-	40	-
Guarujá	SP	-	Southeast	✓	-	80	-
Guarulhos	SP	-	Southeast	✓	✓	80	40
Osasco	SP	-	Southeast	✓	-	80	-
Praia Grande	SP	-	Southeast	✓	✓	80	40
Ribeirão Preto	SP	-	Southeast	✓	✓	40	40
Santo André	SP	-	Southeast	✓	✓	88	40
Santos	SP	-	Southeast	✓	✓	80	72
São Bernardo do Campo	SP	-	Southeast	✓	✓	88	72
São Caetano do Sul	SP	-	Southeast	✓	-	88	-
São José do Rio Preto	SP	-	Southeast	✓	✓	40	40
São José dos Campos	SP	-	Southeast	✓	✓	40	40
São Paulo	SP	✓	Southeast	✓	✓	208	208
São Vicente	SP	-	Southeast	✓	-	80	-
Curitiba	PR	✓	South	✓	✓	124	112
Londrina	PR	-	South	✓	-	40	-
São José dos Pinhais	PR	-	South	✓	-	40	-
Canoas	RS	-	South	✓	-	40	-
Caxias do Sul	RS	-	South	✓	-	40	-
Novo Hamburgo	RS	-	South	✓	-	40	-
Pelotas	RS	-	South	✓	✓	40	40
Porto Alegre	RS	✓	South	✓	✓	140	128
Santa Maria	RS	-	South	✓	-	40	-
São Leopoldo	RS	-	South	✓	-	40	-
Balneário Camboriú	SC	-	South	✓	-	40	-
Blumenau	SC	-	South	✓	-	40	-
Florianópolis	SC	✓	South	✓	✓	124	88
Itajaí	SC	-	South	✓	-	40	-
Itapema	SC	-	South	✓	-	40	-
Joinville	SC	-	South	✓	✓	40	40
São José	SC	-	South	✓	✓	40	40

Notes: The table provides information on real estate data used in the article, including details such as city, state, whether it is a capital or not, region, whether it is sales and/or rental price, and the number of observations.

3 Methodology

In this context, the notion of monetary surprise refers to an unforeseen alteration in the interest rate that goes against the market's anticipations at the time the committee finalizes its decision. Various techniques are available in the academic literature to quantify this surprise. Our selection of approach is based on the methodology proposed by Vicente et al. (2022), B. P. Gomes et al. (2023), among others. This decision is supported by the proven reliability of this method, which is distinguished by its emphasis on rate adjustments, facilitating a precise comparison of contracts with identical maturity periods. This process involves creating a distinct rate known as the forward rate, which allows the comparison of contracts with varying maturities by predicting the expected prevailing rate. The formula for the forward rate is as follows:

$$\text{Forward Rate}_t = \left(\frac{(1 + r_{future})^{\frac{n_{future}}{252}}}{(1 + r_{cdi})^{\frac{n_{cdi}}{252}}} \right)^{\frac{252}{n_{future} - n_{cdi}}} - 1 \quad (1)$$

where r_{future} is the future contract rate, r_{cdi} is the current DI rate, n_{future} is the number of working days until the maturity of the future contract and n_{cdi} is the number of days until the next Monetary Policy Committee (COPOM) meeting. In order to simplify this expression, we can resort to a first-order approximation, leaving us with the following:

$$\text{Forward Rate}_t \approx \frac{r_{future} \cdot n_{future} - r_{cdi} \cdot n_{cdi}}{n_{future} - n_{cdi}} \quad (2)$$

Now, with the forward rate, we then can compute the surprise as follows:

$$\text{Surprise}_t = \text{DI Future}_{t+1} - \text{Forward Rate}_t \quad (3)$$

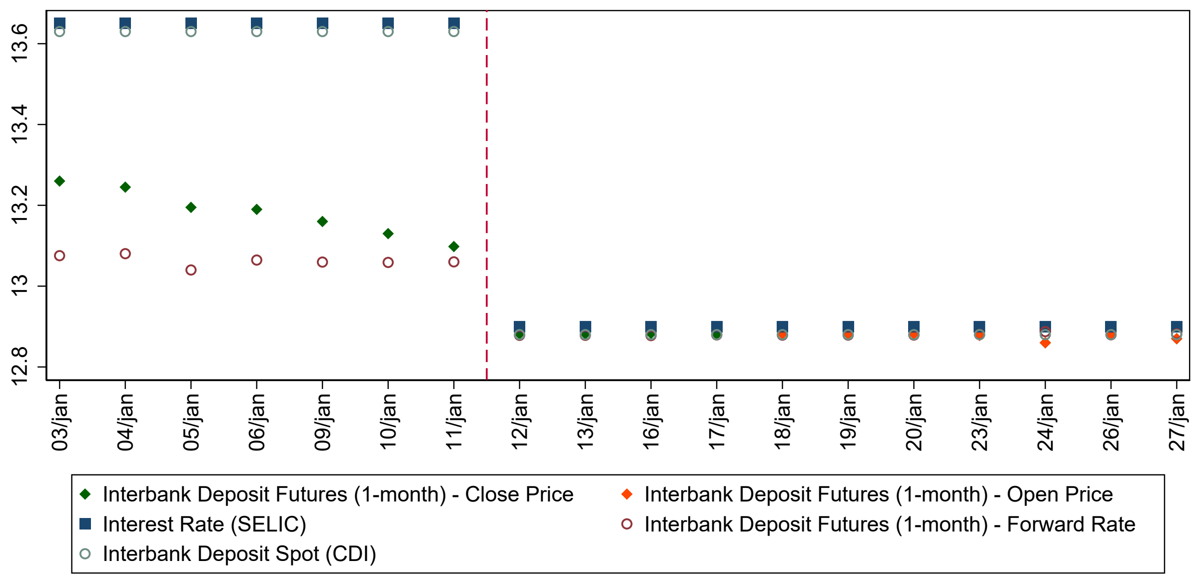
When addressing the meetings of the Monetary Policy Committee (COPOM) that take place on the last day of the month, we use the two-month future Interbank Deposit (DI2), which expires in the subsequent month[1] to calculate the forward rate and the one-

[1]For the COPOM announcements that happened between May 22, 2002 and August 20, 2003 and also April 14, 2004, the announcements happened while the market was still open. To deal with this, we

month future Interbank Deposit (DI1) as DI Future_{t+1} because we will already be in the following month.

For clarification, we present two examples that illustrate how the surprise is calculated. The first depicts a situation where an unexpected rate change meeting takes place after the COPOM meeting, and the second describes a scenario where there are no surprises.

Figure 1: Forward Rate, Futures, and Surprise - 11$^{\text{th}}$ of January, 2017



Notes: The figure illustrates the evolution of opening and closing prices of interest rate futures, SELIC, and DI rates before and after the announcement of the COPOM decision. The announcement of the COPOM is represented by the dashed red line, with values to the left indicating data before the announcement and to the right indicating data after the announcement.

Figure 1 depicts the initial case study. On the 11$^{\text{th}}$ of January, 2017, the DI rate was 13.63%. The settlement rate for the future DI, which matures in 15 business days, was 13.098%. Applying Equation (2) to calculate the forward rate, we get $[(13.63\% \times 15) - 13.098\%]/(15-1)$, yielding 13.06%. Consequently, the surprise is determined by subtracting the forward rate from the opening rate of the future DI on the following day, which was 12.889%, resulting in a negative surprise of 0.135 percentage points.

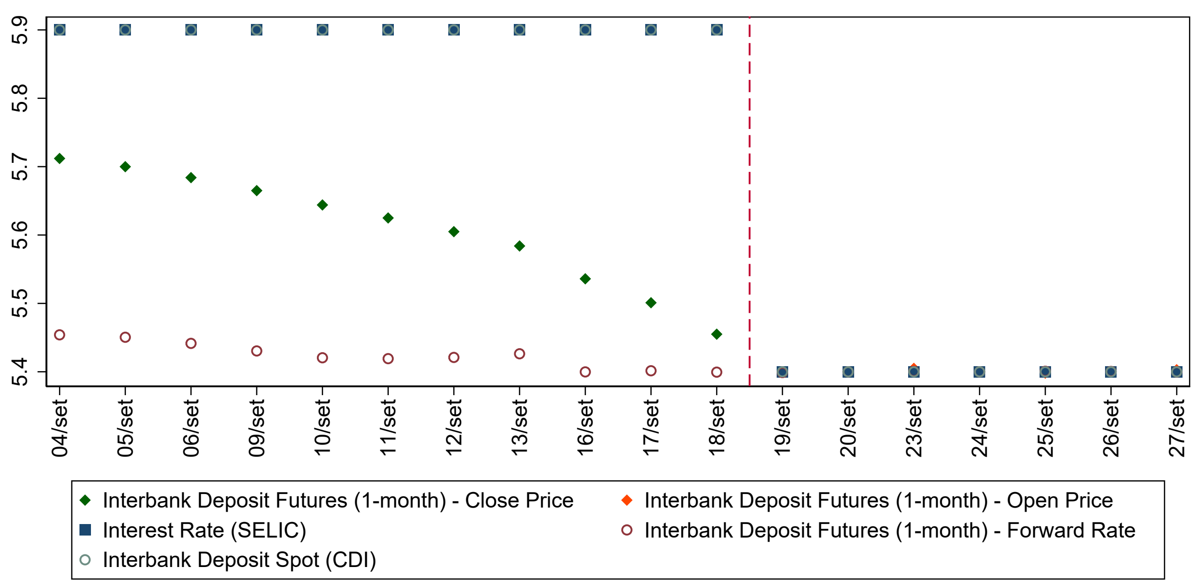
In the specific situation described, it is clear that at its 204$^{\text{th}}$ meeting in January 2017,

calculated the forward rate the same as before, but instead of using the closing price on the day of the announcement, we used the opening price.

the Monetary Policy Committee (Copom) decided to reduce the Selic rate by 75 basis points. However, the expected forecast (forward rate) derived from the nearest maturing futures contract on the day of the meeting indicated a decrease of approximately 50 basis points. As a result, a monetary surprise of -0.135 percentage points was observed during this session.

To illustrate a situation without any unexpected surprises, let us take September 18$^{\text{th}}$, 2019, as an example. On this particular day, the DI rate was 5.90%, while the DI future, with a maturity of 9 working days, settled at 5.455%. Applying the same calculation method as previously explained, the forward rate is calculated as $[(5.455\% \times 9) - 5.90\%]/(9-1)$, which gives 5.40%. In this case, there are no surprises, as evidenced by a zero percentage point difference when subtracting the forward rate from the initial rate of the DI future on the following day, which was 5.40%. This situation is shown in Figure 2.

Figure 2: Forward Rate, Futures, and Surprise - 18$^{\text{th}}$ of September, 2019



Notes: The figure illustrates the evolution of opening and closing prices of interest rate futures, SELIC, and DI rates before and after the announcement of the COPOM decision. The announcement of the COPOM is represented by the dashed red line, with values to the left indicating data before the announcement and to the right indicating data after the announcement.

It is evident that before the Monetary Policy Committee (COPOM) meeting, the forward rate of the Interbank Deposit (DI) was relatively stable at approximately 5.4 –

5.5%. This indicates that the market's implicit expectation had already been pointing towards a potential 50 basis points reduction in the Selic Rate target for meeting number 255. Subsequent to the COPOM meeting that confirmed the reduction of 50 basis points, both the effective Selic Rate and the Interbank Certificate of Deposit (CDI) rate, along with the daily adjustment of the forward rate of the contract, remained steady at around 5.4% until the end of the month.

3.1 Estimation approach

As stated by Plagborg-Møller and Wolf (2021), there is an equivalence between local projections and VAR impulse response estimates [2]. Because we are dealing with panel data, working with local projections is much simpler and more direct. Using Jordà (2005) local projections, we want to estimate the impact of monetary policy surprises in the housing market. To do that, we follow the same approach as Gorea et al. (2023):

$$\begin{aligned} \ln P_{i,t+h} - \ln P_{i,t-1} = \alpha^{(h)} + \beta^{(h)} MPS_t + \sum_{q=1}^{12} \gamma_q^{(h)} \left(\ln P_{i,t-q} - \ln P_{i,t-q-1}\right) \\ + \psi_i^{(h)} + \varepsilon_{i,t}^{(h)} \end{aligned} \tag{4}$$

where $P_{i,t}$ refers to the price for city i, in month t, MPS_t is the monetary policy surprise measure, ψ_i is the fixed effect for each city and h refers to the horizon in which we are estimating our impulse response function. In this specification, we assume that the monetary policy surprise is a structural shock. Following Ramey (2016), the shock must have the following characteristics: exogenous with respect to the other current and lagged endogenous variables in the model; uncorrelated with other exogenous shocks; and represent unanticipated movements in exogenous variables or news about future movements in exogenous variables.

According to Stock and Watson (2018), the measured shocks may capture only part

[2] According to Plagborg-Møller and Wolf (2021), in finite samples, and with finite lag lengths, the two estimation methods are expected to align closely at short horizons. However, selecting between procedures for longer horizons involves managing a bias-variance trade-off

of the shock or can be measured with error. In that case, the constructed variable is not the shock itself, but an instrument for it. So, instead of assuming that monetary policy surprises are structural shocks, we can now use them as instruments to estimate local projections. They proposed the inclusion of control variables in the IV regression for two reasons: (i) in cases where the instrument does not satisfy the LP-IV conditions, it might do so if the controls are added; (ii) if the instrument meets the conditions and controls are added, it can lead to a reduction in the variance of the error term.

Using the two-stage least squares with fixed effects, we estimate the LP-IV. For the first stage, we regress changes in the interest rate on the monetary policy surprise, that is, our instrument, along with the other control variables. We then used the fitted values from this regression as our surprise measure in the local projection framework. By doing this, we do not assume that our surprise is a structural shock but rather contains part of the shock. Therefore, we need to estimate a new equation. In this case, our specification becomes:

$$\begin{aligned}\ln P_{i,t+h} - \ln P_{i,t-1} = \alpha^{(h)} + \beta^{(h)} \widehat{\Delta i}_t + \sum_{q=1}^{12} \gamma_q^{(h)} \left(\ln P_{i,t-q} - \ln P_{i,t-q-1}\right) \\ + \text{Controls}_{i,t}^{(h)} + \psi_i^{(h)} + \varepsilon_{i,t}^{(h)}\end{aligned} \tag{5}$$

where $\widehat{\Delta i}_t$ is the fitted values from the first stage. We use two controls, the lagged difference of 1 and 3 months of unemployment and the lagged difference of 1 and 12 months of disposable income.

The next section provides an exposition of the results achieved regarding the impulse response function across various proposed specifications, supplemented by an analysis of the behaviors of these functions. To this end, graphical displays will be presented, covering not only sales prices but also rental prices of listed real estate properties after a monetary policy shock.

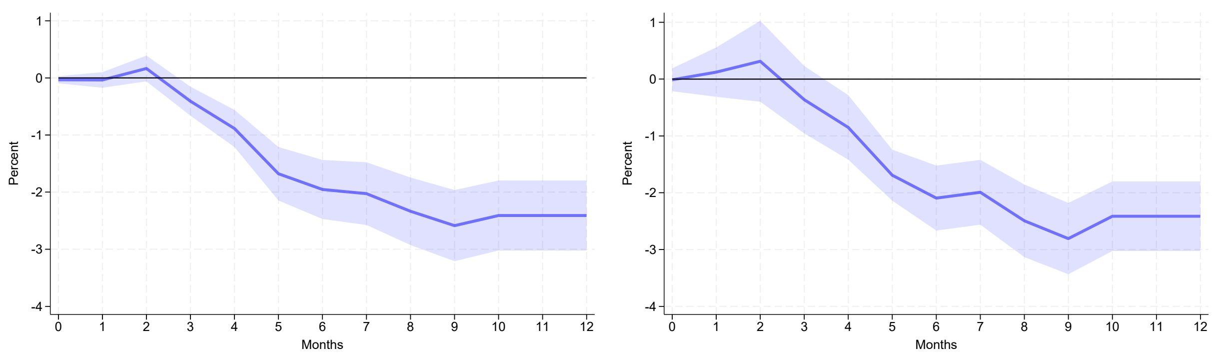
The impulse response function serves as a critical analytical tool as it enables the observation of how a particular variable responds over time to disturbances in another variable. For both specifications, the impulse responses are the estimates of $\beta^{(h)}$ and represent the cumulative price responses observed in the months after the COPOM meeting. In this fashion, it becomes feasible to analyze the impacts and adjustment dynamics present in the sales and rental prices of real estate in the face of the previously mentioned monetary perturbation.

4 Results

4.1 Baseline

Figure 3 illustrates the estimated value of listed prices to a 25 basis point impulse in the measure of monetary surprise (MPS). Examining first the sales price, Figure 3, panel (a), we can see that following the impulse, a reduction in prices is noticeable after three months. The listed sales prices reach their minimum after nine months (or three quarters), decreasing roughly by 2.5%.

Figure 3: Local Projections (OLS)



(a) Sales Prices **(b)** Rental Prices

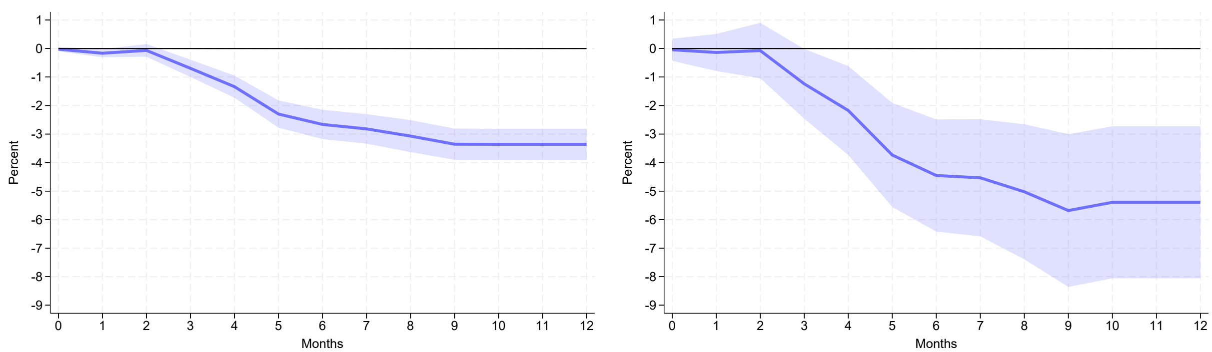
Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. Responses are estimated using the specification in Equation (4). Shaded areas represent the 90 percent confidence intervals with heteroskedasticity or within-panel serial correlation correction.

In terms of rent-listed prices, panel (b), the behavior of the impulse response function is quite similar. However, the influence of the impulse is noticed slightly later in this case, beginning from the fourth month. This suggests a temporal delay in the propagation of monetary surprises to rental prices, compared to their impact on sale prices. But once again, the prices reach their lowest points in the ninth month after the monetary policy surprise and remain the same in the subsequent months.

This empirical evidence yields two principal findings. The findings suggest that the sales and rental prices of listed properties respond to monetary policy shocks much earlier than previously believed in the literature, such as in Williams (2016). Furthermore, these responses exhibit large magnitudes.

Now, we take into account the results for the LP-IV with controls. Figure 4, panels (a) and (b) show that the results for both listed sales prices and rental prices are similar to those of the LP-OLS models, but the effect size is slightly larger. Yet again, for both cases, the lowest point is reached after nine months, with prices stabilizing afterward. This result is consistent with the baseline LP-OLS result that house prices respond rapidly to monetary policy surprises.

Figure 4: LP-IV



(a) Sales Prices **(b)** Rental Prices

Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. The responses are estimated using the specification in Equation (5). Shaded areas represent the 90 percent confidence intervals with heteroskedasticity or within-panel serial correlation correction.

Since we are dealing with listed prices rather than sales prices, one possible explanation for the decline in price could be that, confronted with higher interest rates, potential buyers may be less inclined to secure loans for home purchases. Consequently, sellers may be more inclined to lower the listed prices of their properties.

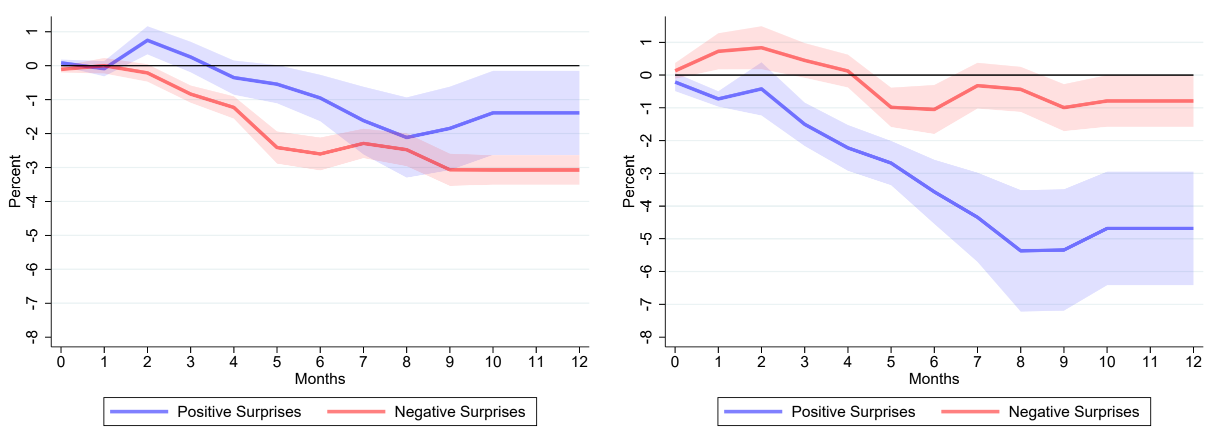
4.2 Asymmetry

The previously suggested specifications do not differentiate between positive and negative surprises. To examine any potential asymmetry between surprises, we suggest an extra specification that enables us to distinguish the sign of the surprise. Figure 5 illustrates the findings regarding the asymmetry of monetary policy surprises. Instead of estimating the LP-OLS using all surprises, we introduced two dummies: one for positive monetary policy surprises (contractionary) and another for negative surprises (expansionary).

$$\begin{aligned} \ln P_{l,t+h} - \ln P_{l,t-1} = \alpha^{(h)} + (\beta_{+}^{(h)} D_{+} + \beta_{-}^{(h)} D_{-}) \times MPS_t \\ + \sum_{q=1}^{12} \gamma_q^{(h)} \left(\ln P_{l,t-q} - \ln P_{l,t-q-1} \right) + \psi_l^{(h)} + \varepsilon_{l,t}^{(h)} \end{aligned} \tag{6}$$

where $D_{+}(D_{-})$ will be equal to 1 if the value of the surprise is positive (negative), and zero otherwise. In this case, the responses will be asymmetric if $\beta_{+}^{(h)} \neq \beta_{-}^{(h)}$.

Figure 5: Asymmetry Test - OLS



(a) Sales Prices

(b) Rental Prices

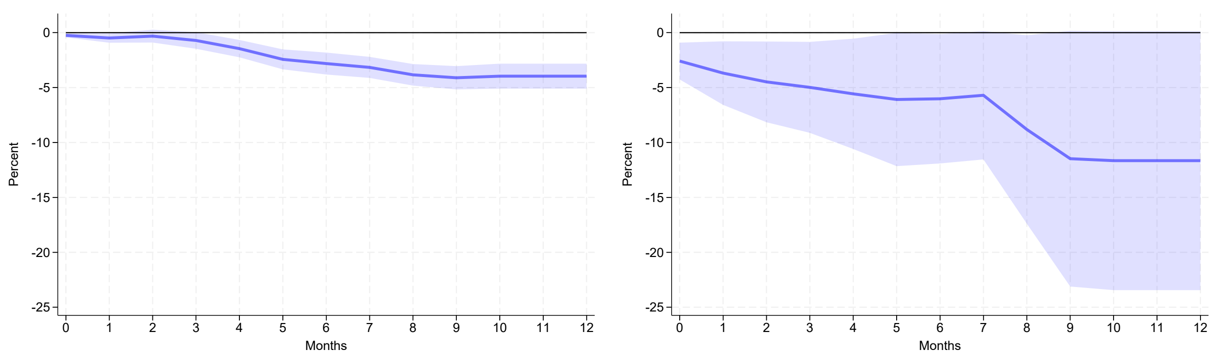
Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. The responses are estimated using the specification in Equation (6). Shaded areas represent the 90 percent confidence intervals with heteroskedasticity or within-panel serial correlation correction.

For the listed sales prices, the symmetry cannot be rejected for the first two months and also from 7 to 10 months after the monetary policy shock (the intervals do not intersect). For the listed rental prices, the symmetry is rejected most of the time. We can see that for sales prices, expansionary (negative) surprises are much stronger than contractionary (positive) surprises, while the opposite is true for rental prices. On top of that, listed rental prices barely react to negative surprises.

4.3 Number of bedrooms

To exploit the diversity within the real estate market, we use our IV specification (Equation (5)) to estimate both listed sales and rental prices, taking into account the number of bedrooms. In other words, we can gain insight into how monetary surprises affect different types of accommodation.

Figure 6: LP-IV: 1 Bedroom

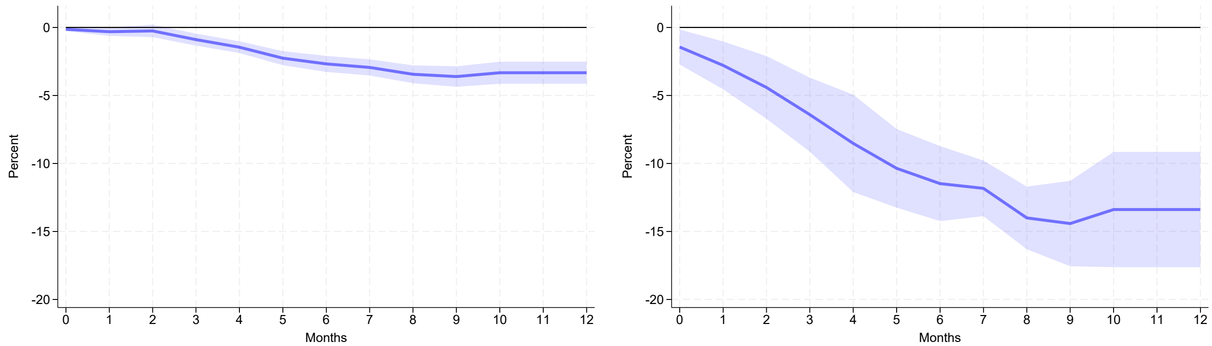


(a) Sales Prices **(b)** Rental Prices

Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. Responses are estimated using specification in Equation (5). Shaded areas represent the 90 percent confidence intervals based on Newey-West standard errors.

If we consider the number of rooms as an approximation for the size of the residence and also its price, we can also view this as a way to assess the surprise in the context of properties of varying sizes and prices. Figure 6 and Figure 7 illustrate the findings. We can see that the effect on sales prices is similar for 1 or 4+ bedrooms. In contrast, the impact on rental prices is greater for properties 4 + bedrooms, with a decrease approaching 15% after 9 months.

Figure 7: LP-IV: 4+ Bedrooms



(a) Sales Prices

(b) Rental Prices

Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. Responses are estimated using specification in Equation (5). Shaded areas represent the 90 percent confidence intervals based on Newey-West standard errors.

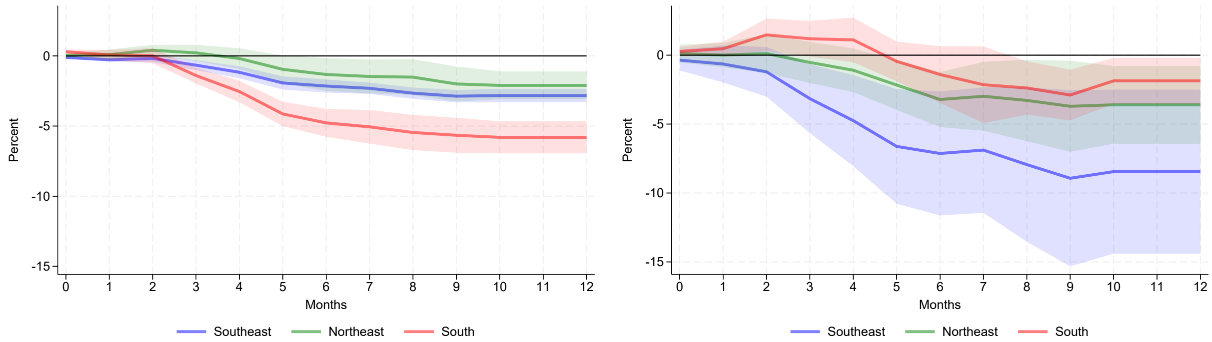
4.4 Regions

Brazil is a country of continental proportions, with a population of more than 213 million, where each region has its own peculiarities. To take into account these differences, we expanded our analysis to compare the results between regions. To put things into perspective, in 2021, according to data from *Instituto Brasileiro de Geografia e Estatística* (IBGE), the Southeast region represents approximately 52% of Brazil's GDP share and 42% of the population share. Meanwhile, the Northeast region represents 13.8% of the GDP share and 27% of the population share. Compared to other regions, the South region represents 17.3% of the GDP share and 14.25% of the population share.

These disparities in economic output and demographic distribution across regions show the importance of understanding how each region reacts to monetary surprises. In Figure 8 we can see the estimations of sales and rental prices for some of these different regions.

Our results show that the South region experiences the most significant impact of a monetary policy surprise on its sales prices. On the other hand, among the three regions, rental prices in the South region are the least affected by such policy shocks. The Southeast and Northeast regions show similar results.

Figure 8: LP-IV: Regions



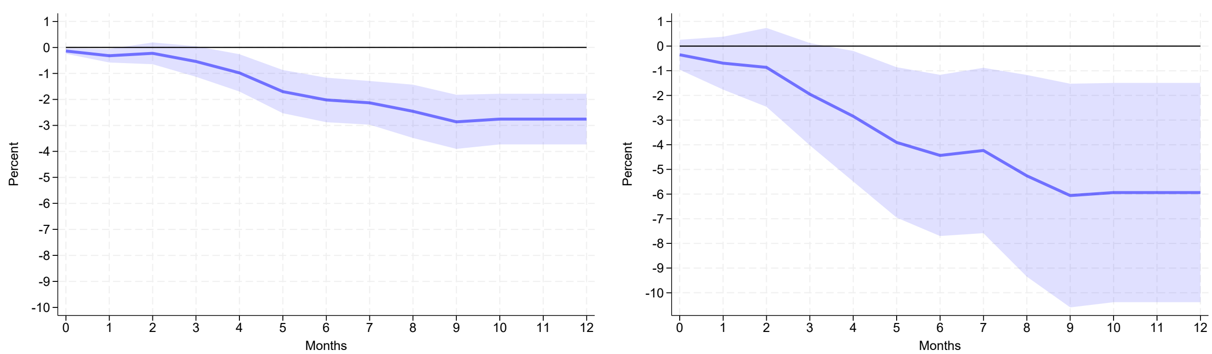
(a) Sales Prices **(b)** Rental Prices

Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. Responses are estimated using specification in Equation (5). Shaded areas represent the 90 percent confidence intervals based on Newey-West standard errors.

4.5 Largest cities

Lastly, we focused on the ten largest cities in Brazil: São Paulo, Rio de Janeiro, Brasília, Fortaleza, Salvador, Belo Horizonte, Manaus, Curitiba, Recife, and Goiânia. Once again, we employed the same model as before. It is worth noting that while we have sales price data available for all the ten cities listed above, but we don't have rental price data for Manaus. Figure 9 presents the results.

Figure 9: LP-IV: 10 Largest Cities



(a) Sales Prices **(b)** Rental Prices

Notes: Notes: The figure shows responses of the listed prices (sales and rents) index to a 25 basis points increase in our monetary policy surprise metric. Responses are estimated using specification in Equation (5). Shaded areas represent the 90 percent confidence intervals based on Newey-West standard errors.

In the context of analyzing the impact of monetary policies on urban real estate dynamics, we examined the responses to sales and rental prices in a restricted data set that contains only the 10 largest cities in the sample. Using the LP-IV methodology, Figure 9 depicts the reactions of prices over a 12-month time horizon following a standardized monetary shock of 25 bps.

In Figure 9, panel (a) illustrates the response of real estate sales prices. An initial slight negative response is observed after 3 months, followed by a downward trend, stabilizing around - 3% at the end of the analyzed period. In contrast, panel (b) displays the reaction of rental prices. The response shows a sharp decline, reaching approximately -1.0% in the initial months. After this initial drop, the response continues to decline, with prices accumulating a decrease of approximately 6% after 9 months from the initial shock. The width of the confidence interval in this graph is notably larger, especially after the fifth month. This phenomenon can be attributed to a relatively smaller sample size, which is likely common in rental price possibly due to the less frequent rental transaction traceability to sales, resulting in greater variability in the estimates.

Note that the effect on prices, both sales and rental, in the top 10 largest cities is similar to our baseline model. This could be related to the fact that the largest cities have the highest number of observations, so the effect in the baseline models may be driven by them.

5 Conclusion

In this study, we have examined the dynamic effects of monetary policy surprises on house prices in Brazil, utilizing a comprehensive dataset of listed sales and rental prices, as well as interest rate futures. Our analysis has employed local projection models, specifically the LP-OLS and LP-IV, to estimate the impact of monetary policy shocks on housing market dynamics. The findings reveal that following a contractionary monetary policy surprise, there is a discernible decline in both sales and rental prices, with the effects manifesting earlier than previously documented in the literature. Specifically, the decline in sales prices commences approximately three months after the shock, reaching its lowest point around nine months later, while rental prices exhibit a similar pattern, albeit with a slight temporal delay.

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