Monetary policy transmission in a small open economy before and after the pandemic: the case of Mexico*

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Abstract

This paper analyzes the effects of monetary policy on macroeconomic variables in Mexico, an emerging market economy with a high degree of trade openness. We find three main results. First, output and inflation respond to monetary policy in a way comparable to other emerging markets. These results are robust across various models and identification strategies. Second, once controlling for the excess volatility in real variables caused by the pandemic shocks, the transmission mechanism shows no statistically significant differences compared to the pre-pandemic period. Omitting pandemic controls produces inconsistent results. Third, economic sectors that are more sensitive to exchange rate variations, such as manufactured goods, display stronger price and real activity responses to monetary policy adjustments than more domestically driven sectors, such as services. This result highlights the importance of the exchange rate as a key transmission channel of monetary policy in small open economies with significant trade exposure.

Keywords: Monetary policy transmission, small open economy, SVAR models, local projections.
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1 Introduction

Monetary policy transmits to the economy through different channels, affecting output and inflation with a lag. This process is known as the monetary policy transmission mechanism (MPTM).[1] As such, central banks aiming to promote an environment of price stability must make decisions while considering the time horizon in which monetary policy operates, as well as the nature of shocks affecting inflation and its determinants.

In this context, the unprecedented shocks caused by the COVID-19 pandemic and the war in Ukraine, with their deep, broad-based, and persistent effects on the global economy, have raised concerns about whether the MPTM has changed. In particular, given the most severe surge in inflation in decades, questions have emerged about whether monetary policy can bring inflation back to target as efficiently as in previous inflationary episodes, or whether, after the pandemic, the MPTM has become slower and less effective. Thus, measuring the transmission mechanism in the current juncture —where the effects of the shocks that triggered the price surge have nearly faded, yet inflation remains above target— is crucial for reassessing the conduct of monetary policy after the pandemic.

This paper tackles these questions by estimating the MPTM before and after the pandemic in Mexico, an emerging market economy with a high degree of trade openness. Specifically, we ask whether the Mexican MPTM has changed or remained the same. We do so by analyzing the responses of output, inflation, and the exchange rate to an unexpected adjustment in the monetary policy interest rate, i.e., the so-called monetary policy shocks.[2] In addition, we explore the MPTM further by examining the responses of different economic sectors to monetary policy adjustments.

As is standard in the literature, we use structural vector autoregression (SVAR) models to identify monetary policy shocks and estimate the economy's responses to these shocks. The sample period span from January 2002 to December 2023, but we do differentiate between two sub-samples: one for the pre-pandemic period (up to December 2019), and the other for the period including the pandemic and beyond (up to Decemebr 2023). We adopt a robust approach by estimating multiple SVAR models that encompass a diverse set of identification strategies, as well as local projections. This approach helps minimize potential biases

[1] It is widely acknowledged that the transmission of monetary policy operates with long and variable lags (Friedman, 1972; Goodhart, 2001).

[2] In the literature, it is standard to measure the transmission of monetary policy through its unexpected component, commonly referred to as the "monetary policy shock." This shock is defined as a change in monetary policy that is not anticipated by markets. Identifying monetary policy adjustments in this way is both common and necessary to properly assess its transmission mechanism. This is because monetary policy typically responds to multiple shocks affecting the economy, in particular those influencing inflation. Consequently, the effects of policy rate adjustments could be confounded with those of the shocks to which monetary policy is reacting.

related to the choice of a single-model strategy. We focus on standard policy shocks, that is, unexpected changes in the policy rate.[3] To identify these shocks, we estimate a total of 11 SVAR models featuring either Cholesky restrictions (Christiano et al., 2005), sign restrictions (Uhlig, 2005), narrative information (Antolín-Díaz and Rubio-Ramírez, 2018), or external instruments based on high-frequency financial data around monetary policy announcements (Gertler and Karadi, 2015). To obtain unbiased estimates during the pandemic period, we control for the effects of the extreme and unique shocks observed during this episode. We adopt various approaches to do so, either by including pandemic dummies (as in Holston et al., 2023; Maroz et al., 2021; Ng, 2021), cleaning the data of outliers (as in Arriola et al., 2022; Carriero et al., 2021), or by adopting pandemic priors (as in Cascaldi-Garcia, 2022).

Our paper yields three main findings. First, output and inflation respond to monetary policy adjustments in a manner consistent with international evidence, both in terms of timing and magnitude. Specifically, after an unexpected increase in the policy rate, which we normalize to 100 basis points (bps), the output gap declines by 30 to 65 bps after 1 to 1.5 years, while core inflation decreases by 15 to 22 bps after 1 to 2 years. These intervals correspond to a plausible range derived from the 11 SVAR models estimated for the pre-pandemic period. Meanwhile, the Mexican peso appreciates immediately after the shock, though this effect is short-lived. The results for output and inflation are broadly in line with the evidence presented by Deb et al. (2023) for both advanced and emerging economies. Their findings indicate that monetary policy exerts its maximum effect on output and inflation within a two-year timeframe, regardless of a country's income level. In terms of magnitude, they estimate that following a 100-bps monetary policy shock, inflation declines by an average of 40 bps in advanced economies and 20 bps in emerging economies, while the output gap narrows within a range of 20 to 40 bps.

Second, we do not find sufficient evidence suggesting that the monetary policy transmission mechanism in Mexico has undergone significant changes in recent years, particularly when comparing the pre- and post-pandemic periods. To assess whether the pandemic led to changes in monetary policy transmission, we estimated the SVAR models up to December 2023. It is worth noting that conducting this exercise is not straightforward, as the extreme shocks of the pandemic introduce inconsistencies in typical SVAR models. This is because the unprecedented decline in the output gap during the early lockdown period (particularly in 2020-Q2) cannot be explained by the standard macroeconomic shocks identified in these models. Indeed, the unique nature of the pandemic-related shocks requires methodological

[3]To extract the effects of these shocks, some methodologies require disentangling them from the effects of central bank information shocks—i.e., the impact triggered by new information released by the monetary authority in its communications (Jarociński and Karadi, 2020). Although we separate the effects of these two shocks, we do not analyze the economy's responses to new information released by the central bank in this paper.

adjustments to ensure unbiased and statistically valid estimates. In this version of the article, we report the results from incorporating pandemic dummies and outlier controls that were primarily active during the lockdown period. Thus, once controlling for the extreme fluctuations observed in the output gap during the pandemic outbreak, any substantial change in the responses of macroeconomic variables to monetary policy could suggest a shift in the transmission mechanism. However, in our analysis for Mexico, we do not find such changes.

Finally, we find that the effects of monetary policy adjustments differ significantly across economic sectors. To illustrate this, we re-estimate the models incorporating sectoral indicators of output and prices. The results show that real activity in the manufacturing sector responds more strongly to a monetary policy shock than in the services sector. Similarly, inflation in manufactured goods exhibits a larger and faster response than services inflation, which displays a moderate and delayed effect, becoming statistically significant only after two years. In addition, housing prices, which is an element of services inflation, do not seem to respond to the monetary policy shock. These findings suggest that economic sectors more sensitive to exchange rate fluctuations, such as manufactured goods, exhibit stronger price and real activity responses to monetary policy adjustments compared to more domestically driven sectors, such as services. The results also highlight the relatively high importance of the exchange rate as a key transmission channel in Mexico's MPTM. By contrast, the impact of monetary policy on household and business consumption and savings decisions, which directly affect aggregate demand and thus domestic activity, appears to be relatively low. This lower relevance of the savings and expenditure channels is, in turn, consistent with Mexico's low levels of financial inclusion and credit penetration, as households and businesses have limited resources to smooth consumption and spending.

Related literature. Reassessing the MPTM after the pandemic will be a topic of interest for central banks for years to come. If there is indeed a structural, low-frequency change in the mechanism, it might take more time for the SVAR models to fully capture it. In this context, this paper contributes to the literature by measuring the MPTM in a small open and emerging economy, both before and after the pandemic. Since the wake of the health crisis, several contributions emerged to address the challenges of estimating the SVAR models after 2020, as the extreme and atypical volatility of this episode caused conventional methodologies to breakdown, becoming less effective. A strand of the literature has proposed *adapted models* that employ more flexible structures to model error variances, isolating pandemic-related shocks (e.g., Bobeica and Hartwig, 2023; Carriero et al., 2024; Holston et al., 2023; Lenza and Primiceri, 2022; Primiceri and Tambalotti, 2020). Other studies introduced pandemic priors and/or dummy variables for specific periods to capture

the pandemic-specific shocks (e.g., Cascaldi-Garcia, 2022; Maroz et al., 2021; Ng, 2021). Additionally, some other methods have identified periods of atypical movements in real variables and implemented strategies to exclude these values to estimate the typical error variance estimation, using them instead to either estimate extraordinary volatility processes, or cleaning real variables (e.g., Carriero et al., 2021; Schorfheide and Song, 2021). In this paper, we build on this body of work by accounting for pandemic effects through the use of both cleaned variables and dummy variables in our estimates. To test for potential changes in the MPTPM, we consider two estimating samples: a pre-pandemic period from 2002 to 2019, and an extended period from 2002 to 2023, which includes the pandemic and post-pandemic years. This enables a comparison of the MPTM before and after the widespread and persistent disruptions triggered by the pandemic. It also allows us to document the inconsistent and erratic results that pop up when no pandemic controls are introduced.

Some other recent studies have focused on measuring potential changes in the MPTM following the pandemic. However, these works are often limited to advanced economies (e.g., Barrett and Platzer, 2024; Evgenidis and Fasianos, 2023; Rathnayaka et al., 2024). For emerging economies, the evidence is more scarce. Prabheesh et al. (2021) analyze 14 emerging economies and find that monetary policy transmission to inflation and output seems to have weakened, which they attribute due to the heightened uncertainty that accompanied the pandemic. Nonetheless, their evidence is not conclusive. We build on this literature by providing further analysis of possible post-pandemic changes to the MPMT in small open and emerging economies, with a particular focus on Mexico.

Our work also relates to the large body of literature on the monetary transmission mechanism. Contributions for advanced economies have extensively documented its contractionary effects on inflation and output, though with varying lags and magnitudes.[4] For emerging market economies (EMEs), the evidence is less extensive but reveals similar contractionary effects, although the timing and magnitude vary across countries. Specifically for Latin American countries, studies such as Ormaechea and Fernandez (2011), Céspedes et al. (2008), and Minella (2003) provide evidence of the heterogeneous impact of monetary policy shocks on output and inflation across different countries and periods, with output contracting and reaching its peak within a year, while the inflation response persists within two years. In this vein, Otero (2015) estimates a SVAR model to assess the impact of monetary policy

[4]In the United States, Bernanke et al. (2005) find that an unexpected increase in the federal funds rate leads to persistent declines in industrial production and employment, with inflation responding more gradually. Other studies on Canada have found negative effects on output and inflation following a restrictive monetary policy shock using wither SVAR models (e.g., Bhuiyan, 2008; Ha and So, 2023; Soosalu, 2024) or local projections (Champagne and Sekkel (2018). Similarly, studies in the Euro Area (e.g., Anzuini and Levy, 2007; Boivin et al., 2008; Bredin and O'Reilly, 2004; Jarociński, 2010; Wrobel and Pawlowska, 2002) and the United Kingdom (e.g., Cloyne and Hürtgen, 2016; Mountford, 2005) report significant declines in output following a monetary tightening, with inflation responding over longer horizons of two to three years.

shocks in five Latin American countries that have long operated under an inflation-targeting regime (Chile, Brazil, Colombia, Peru, and Mexico). Their findings indicate that Mexico and Peru feature larger responses to monetary policy shocks compared to the other countries included in their analysis. In their findings, they highlight that the exchange rate channel is particularly significant in Mexico, while credit-related channels seem more relevant in Peru. Other studies, such as Catão and Pagan (2010), focus on Brazil and Chile, finding that a 100 basis point monetary policy shock leads to a peak reduction of 30 basis points in the output gap in Chile and 20 basis points in Brazil. Similarly, Tahir (2012) examines the impact on industrial activity in both countries, showing that Brazil's industrial production exhibits a weak response, whereas in Chile, the effects take approximately two years to fully materialize. Additionally, for other EMEs, Mallick and Sousa (2012) find that monetary tightening in Brazil, Russia, India, China, and South Africa (BRICS) reduces GDP by 0.2% within four quarters, with inflation declining quickly but briefly.

More recent studies have relied on panel analysis to compare the transmission mechanism of monetary policy shocks across EMEs and advanced economies, highlight the amplifying role of the exchange rate in EMEs, with monetary policy shocks exhibiting larger and more prolonged effects compared to advanced economies. For instance, Checo et al. (2024) analyze the transmission of monetary policy shocks in emerging markets using a novel dataset constructed from analysts' forecast errors of policy rate decisions. They report that while industrial production and inflation respond to monetary tightening in both groups, EMEs tend to exhibit larger and more prolonged responses, particularly through the exchange rate channel. Similarly, Brandao-Marques et al. (2020) examine monetary policy transmission in emerging markets and developing economies using local projection methods across 39 countries. They find that in EMEs, the exchange rate amplifies the effects of monetary shocks, with peak responses occurring within seven months. Deb et al. (2023) examine the heterogeneity of monetary policy transmission across 33 advanced and emerging economies using a novel dataset of monetary policy shocks spanning three decades. They show that a 100 basis point rate hike leads to a 0.3% decline in GDP in both advanced and emerging economies, but inflation responses are more muted in EMEs, reflecting structural differences in their financial systems and policy environments.

The remainder of the paper is organized as follows: Section 2 outlines the modeling approach for a small open economy and describes the data used in the estimation. Section 3 presents and discusses the estimation results and Section 4 concludes.

2 Methodology

To analyze the monetary transmission mechanism in Mexico, we rely on traditional methods widely used in the literature, such as structural vector autoregressions (SVARs) introduced by Sims (1980) and Local Projections (Jordà (2005)), to examine the dynamics of economic variables in response to shocks. These models provide a foundational framework for understanding how monetary policy shocks influence the evolution of macroeconomic variables, such as output and inflation, particularly in response to unanticipated changes in the monetary policy rate. They also account for endogeneity within the system by allowing the simultaneous determination of variables, ensuring that the dynamic interdependencies among macroeconomic variables are properly captured in the estimation process. We employ a Bayesian approach to estimating these models, which offers significant methodological advantages for handling high-dimensional data and models with a large number of parameters. By incorporating prior distributions, these methods address overparameterization concerns, reduce the width of error bands, and improve the precision of inference (Litterman (1986); Bańbura et al. (2010)).

A small open economy (SOE) framework is adopted in this modeling strategy, recognizing that Mexico, as a small open economy, is significantly influenced by external factors. We follow the block exogeneity restriction proposed by Cushman and Zha (1997), a widely used approach for modeling SOEs within the SVAR framework. This restriction rests on the premise that the economy under analysis is *small* relative to the global economy, thereby treating international economic conditions as exogenous. Accordingly, the model is structured into two components: a *foreign block* and a *domestic block*. The foreign block is assumed to evolve independently of the domestic economy, while the domestic block responds endogenously to both foreign and domestic shocks. This approach allows the model to capture the dynamic relationships between external influences and domestic economic conditions.

Consider the following general representation for a structural vector autoregression model (SVAR):

$$X_{t+h} = \begin{bmatrix} Z_{t+h} \\ Y_{t+h} \end{bmatrix} = C_h + \sum_{\ell=1}^{p} B_{h,\ell} X_{t-\ell} + A u_{t+h}, \tag{1}$$

where h is the time horizon; Y_t and Z_t are vectors containing endogenous and exogenous variables, respectively; u_t is a vector of structural shocks with mean zero and not autocorrelated, which includes the monetary policy shock; A is an invertible structural matrix denoting the impact effect of shocks u_t on variables Y_t and Z_t; and finally, C_h and $B_{h,\ell}$ are matrices of

parameters, in which the latter are consistent with the assumption of block exogeneity[5], such that:

$$B_{h,\ell} = \begin{bmatrix} B_{zz,h,\ell} & 0 \\ B_{yz,h,\ell} & B_{yy,h,\ell} \end{bmatrix} \tag{2}$$

In the literature, the MPTM is analyzed through the identification of a monetary policy shock, defined as an unanticipated change in the policy rate, not foreseen by market participants. This approach is crucial for isolating the effects of monetary policy adjustments, as policy actions often respond to a range of underlying economic shocks, making it difficult to disentangle the effects of policy rate adjustments from the impacts of the shocks to which monetary policy is reacting. A standard method for estimating these effects involves employing VAR models combined with an appropriate identification strategy. More recently, other strategies have emerged based on high-frequency data collected around monetary policy announcements. As such, we employ a *robust estimation approach* for the MPTM, incorporating a range of modeling strategies to mitigate potential biases associated with reliance on a single framework. This ensures more reliable and comprehensive conclusions regarding the mechanism and its potential changes in the aftermath of the pandemic. Specifically, we estimate the transmission mechanism using bayesian local projections and bayesian SVARs under various identification strategies for monetary surprises, including recursive ordering (Christiano et al. (2005)), sign restrictions (Uhlig (2005)), narrative information (Antolín-Díaz and Rubio-Ramírez (2018)), and external instruments using high-frequency data (Gertler and Karadi (2015)).

To implement this approach, matrix A in equation 1 is identified using these identification strategies. In turn, matrices $B_{h,\ell}$ are estimated using Bayesian techniques on either the canonical SVAR model (so that $B_{h,\ell} = (B_{h,\ell})^h$), or local projections (so that each $B_{h,\ell}$ is estimated independently and does not depend on $B_{h,\ell-1}$). The five identification approaches are detailed below:

1. **Cholesky restrictions.** To identify the monetary policy shock, it is assumed that variables placed before the short-run nominal interest rate do not respond in the impact period to an unexpected change in this variable. The order of variables used in this strategy is depicted in column (i) of Table 3.[6]

[5]The vector of variables included in Z_t in equation 1 represents exogenous factors that influence the dynamics of the variables contained in Y_t, which corresponds to the vector of endogenous Mexican variables. However, the reverse does not hold, as the dynamics of Z_t are assumed to remain unaffected by the variables in Y_t. This specification ensures the exogeneity assumption.

[6]A Minnesota prior is used in the estimations, reflecting the prior assumption that the variables within the model follow a random walk. The values of the hyperparameters are set according to the standards established in the literature (Canova (2011)): $\lambda_1 = 0.2$, $\lambda_2 = 0.5$, $\lambda_3 = 1$, $\lambda_4 = 10^5$.

2. **Sign and zero restrictions.** Four structural shocks for the Mexican economy are identified to reduce the uncertainty bands around the responses of endogenous variables to a monetary policy shock. The other three structural disturbances are a central bank information shock, an aggregate supply shock, and an aggregate demand shock. Table 1 summarizes the sign and zero restrictions used to identify these shocks. Within this approach, distinguishing between a conventional monetary policy shock and a central bank information shock is necessary to disentangle the effects of new information provided by the central bank about the state of the economy and changes in the reference rate at the time of a monetary policy decision (Jarociński and Karadi (2020)). In this case, it is assumed that after a restrictive monetary policy shock, the slope of the yield curve decreases, while after a pessimistic central bank information shock, this slope rises. For the former, the restriction implies that the 10-year yield remains steady as the 2-year yield increases. Conversely, after a pessimistic central bank information shock, the 10-year yield rises more than the 2-year yield, driven by a surge in the term premium from the risk compensation demanded by investors (see Carrillo et al. (2020)).[7]

3. **Local projections with Cholesky restrictions.** The impact response ($h = 0$) of endogenous variables to a monetary policy shock is given by the corresponding column of matrix A in Eq. 1. This matrix is obtained by applying Cholesky restrictions on a canonical SVAR model, following the order of variables presented in column (iii) of Table 3. To compute the response of each variable for time periods after the shock ($h > 0$), equation 1 is estimated as a linear regression using Bayesian techniques for each horizon of interest (for instance, $h = 1, 2, \ldots, H$). To estimate matrices B_h, Minnesota-type priors are employed to ensure that the responses of more distant periods gradually converge to zero (see Jordà (2005) and Ferreira et al. (2023))

4. **Narrative sign restrictions.** This approach uses the same variables and sign and zero restrictions as in column (ii) of Tables 3 and 1. The difference is that the identification includes narrative information, external to the VAR model, regarding the presence of monetary policy shocks. As such, the narrative approach requires some key events with conclusive information about the sign of the monetary policy shock. Adding this information into the model may significantly reduce uncertainty in the impulse-response functions (see Antolín-Díaz and Rubio-Ramírez (2018)). The nar-

[7]The baseline model adopts priors consistent with standard practice in the literature; however, the value of λ_1 is increased to provide greater flexibility for the data to inform the results. The priors are thus set as $\lambda_1 = 0.7$, $\lambda_2 = 0.4$, and $\lambda_3 = 1$.

rative information for Mexico exploits the difference between the observed monetary policy rate and a forecast of this rate from a Bloomberg survey. For the narrative information, the signs of the largest surprises are considered. As such, the sign of the March 2009 surprise is used, as well as those of the surprises from March and April 2020 for the sample including the pandemic.

5. **External instruments using high-frequency data.** In this approach, monetary policy surprises around Banco de México announcements are incorporated as an external instrument within the SVAR model. In particular, the monetary policy shock is identified using changes in the 3-month swap interest rate within a half-hour window around Banco de México's monetary policy decisions (see Solís (2023)). Large changes in the 3-month swaps are interpreted as reflecting surprises in market expectations regarding the monetary policy rate. The advantage of using these surprises is that the likelihood of other structural shocks influencing the swap rate within the specific time window is minimal. To estimate the impulse-responses of endogenous variables to the monetary policy shock, a two-stage linear regression is performed. In the first stage, a regression of the residuals corresponding to the monetary policy indicator equation is estimated on the external instrument, and adjusted residuals are obtained. In the second stage, these adjusted residuals are used to estimate the effects of the monetary policy shock on the variables analyzed.

Overall, the results from five methodologies are analyzed, with two considered baseline models: the SVAR under recursive identification (Estimation 1, last column of Table 2) and the SVAR under sign and zero restrictions (Estimation 5, last column of Table 2). These two models are regarded as benchmark or reference models due to the widespread recognition and frequent use of their identification strategies in the economic literature. To improve robustness, variations of these baseline specifications are also included.[8] In total, the analysis incorporates the results from 11 models, as summarized in Table 2. The estimations are conducted using monthly data for two distinct periods. The first covers a pre-pandemic sample from January 2002 to December 2019, providing a long time series for robust anal-

[8] Among the baseline models for Cholesky and Sign restrictions, three alternatives are presented. The first alternative, corresponding to $M2$ in both Sign and Cholesky approaches, considers 2 lags. The $M3$ models include alternative values for the hyperparameters. For the Cholesky approach, the alternative parameters are: $\lambda_1 = 0.1$, $\lambda_2 = 0.99$, $\lambda_3 = 1$, $\lambda = \infty$. For the Sign restrictions approach, the hyperparameter altered is λ_3, which controls the decay rate and is set to 2 instead of 1 for the baseline specification. Finally, the $M4$ variant of the baseline model incorporates an alternative measure of economic activity for both identification strategies, corresponding to the official output gap of the IGAE, as calculated by the Bank of Mexico.

ysis, as evidence suggests that inflation became a stationary process since 2001 (Chiquiar et al. (2010)). The second extends the analysis to include the pandemic and post-pandemic period, encompassing data up to December 2023.

Table 1: Sign and Zero Restrictions on Endogenous Variable Responses to Structural Shocks

	Structural shock to:			
Response on impact ($h = 0$)	**Monetary policy**	**Central bank information**	**Aggregate supply**	**Aggregate demand**
Output gap	0	0		+
Core inflation	0	0	+	
Short-run nominal interest rate	+	+		
Yield curve slope	−	+		
Nominal exchange rate	−			
Response six months after the shock ($h = 6$)				
Output gap	−	−	−	+
Core inflation	−	−	+	+
Short-run nominal interest rate				
Yield curve slope				
Nominal exchange rate				

Note: Restrictions are based on Carrillo et al. (2020). In the present analysis, since the interest is on measuring the monetary policy transmission mechanism in Mexico, the restrictions are imposed on Mexican variables, instead of U.S. variables.

Table 2: Total number of estimated models

Approach (type of SVAR model)	**Variation number**	**Estimation number**
i. Cholesky restrictions	1, baseline model	1
	2, with more lags	2
	3, with alternative hyperparameters	3
	4, with alternative output gap	4
ii. Sign and zero restrictions	1, baseline model	5
	2, with more lags	6
	3, with alternative hyperparameters	7
	4, with alternative output gap	8
iii. Local projections with Cholesky restrictions	1	9
iv. Narrative sign restrictions	1	10
v. External instruments using high frequency data	1	11

Estimation with the sample including the pandemic. Applying conventional methodologies to estimate the transmission mechanism of monetary policy during the pandemic has been complicated given the presence of extreme shocks affecting real activity. If not handled, these shocks may bias the estimation results, as their presence violates the assumptions underlying these models (e.g., well-behaved error terms). As such, the biased estimations may suggest false or erratic changes in the transmission mechanism. Addressing the challenges posed by pandemic shocks has therefore required exploring alternative approaches to adapt the methodologies. These efforts can be classified into three categories: First, adapted

models involve incorporating more flexible structures to model error variance, allowing pandemic shocks to be captured and isolated effectively (See Primiceri and Tambalotti (2020), Bobeica and Hartwig (2023), Lenza and Primiceri (2022),Carriero et al. (2024),Holston et al. (2023)). Second, pandemic dummy variables introduced to isolate the effects of pandemic shocks during specific periods, have also been widely employed (Maroz et al. (2021), Ng (2021), Cascaldi-Garcia (2022)), ensuring that these disruptions do not distort the estimation of underlying relationships. Third, cleaning of outliers entails identifying periods of atypical movements in real variables and applying targeted adjustments. These adjustments may include excluding extreme values from the estimation of error variance, using them to estimate extraordinary volatility and uncertainty, or cleaning real variables from atypical movements using confinement indicators, such as the Google Mobility Index (See Schorfheide and Song (2021), Carriero et al. (2021)).

For our analysis, we rely on the second and third strategies to address the challenges posed by pandemic-related shocks. Specifically, to isolate the effects of the pandemic, pandemic dummies were applied in the SVAR under the Cholesky recursive identification, while the pandemic priors strategy, as outlined in Cascaldi-Garcia (2022), was utilized for the narrative sign restrictions. Additionally, for the SVAR under sign and zero restrictions, as well as for local projections, outlier cleaning was employed to mitigate the impact of extreme values on estimation results. Specifically, to clean variables for the effects of the pandemic, the Google Mobility Index (GMI) and dummies for April to December 2020 were used.[9] Additionally, to adjust for the inflation shock, dummies based on the Global Supply Chain Pressure Index (GSPI) from March 2021 to December 2023 and the Commodity Price Index (CMO) from February 2022 to December 2023 were incorporated.[10] Lastly, the external instrument approach, which relies on high-frequency data around monetary policy announcements, has not yet been applied to the pandemic-included sample in our analysis. By employing these strategies, the analysis addresses the distortions introduced by pandemic-induced shocks, ensuring robust and reliable estimation of the transmission mechanism. The lack of consensus in the literature on which strategy to employ for handling pandemic-related shocks leaves this choice, in our paper, to the authors' discretion to best align with the preferred methodological framework.

[9]The GMI index tracks mobility trends over time across various categories, such as retail, workplaces, and transit stations, to measure the impact of COVID-19 lockdowns.

[10]The GSPI, provided by the Federal Reserve Bank of New York, measures global supply chain disruptions using variables such as delivery times and freight costs. The CMO is sourced from the World Bank's commodity markets data.

2.1 Data Description

In this subsection, we describe the variables included in the model specification in equation 1. Details on the sources and variable transformations used in the analysis are provided in Table B.1 in Appendix B. The models incorporate a block of endogenous variables (Y_t) , and a block of exogenous variables (Z_t),designed to capture both domestic and external factors in mexican economic dynamics.

The endogenous block includes several key variables for Mexico. The short-term nominal interest rate corresponds to the overnight interbank funding rate prior to January 2008 and the policy rate from that date onward. The inflation indicator used in the models corresponds to the core inflation component, as it more effectively captures medium-term trends by excluding volatile elements, providing a clearer measure of the inflation dynamics most influenced by monetary policy (see Mishkin (2007)). The output gap is defined as the difference between actual and potential economic activity, measured by GDP. Monthly GDP is estimated following the methodology outlined by Elizondo (2019), which employs the IGAE and the Kalman filter to derive an approximation of GDP. The calculation of the output gap is subsequently based on the potential GDP estimated by Banxico. Inflation expectations (12 months ahead) are included to reflect forward-looking inflationary pressures. The Producer Price Index (PPI) is commonly used in the literature as an indicator of supply-side inflationary dynamics (Hanson (2004)). The nominal exchange rate is included to account for currency fluctuations, which are particularly important in small open economies with high trade exposure as it's the case of Mexico. Additionally, the Emerging Markets Bond Index (EMBI) is included to account for sovereign risk perceptions, and the 10-year minus 2-year interest rate spread is used to represent the term structure of domestic interest rates.

The exogenous block includes international variables that are expected to influence Mexico's economy. The WTI crude oil price is included to account for external shocks in global energy markets. The U.S. output gap reflects global demand pressures, while U.S. core inflation measures underlying price trends in the United States. The shadow federal funds rate represents the stance of U.S. monetary policy, especially under unconventional monetary settings. The U.S. 10-year minus 2-year interest rate spread is included to capture the term structure of U.S. interest rates. Finally, the VIX index is used as a proxy for global risk sentiment and financial market volatility. Although the set of variables in each model varies slightly, the vector of endogenous variables Y_t generally includes similar variables. A summary of the variables used in the estimation of each of the previously discussed models, is presented in Table 3, with further details on the implementation of these estimations provided below.

Disentangling the MPTM on subcomponents of output and inflation. To analyze the strength of the monetary policy transmission mechanism (MPTM) across different sectors of the economy, additional variables are incorporated into the models. These variables capture economic activity in the manufacturing and services sectors, as well as the prices of goods and services. Each variable is added to each model in isolation, i.e., one at a time. For this analysis, we include series from the subcomponents of the Mexico's economic activity indicator (IGAE) and for core inflation. The IGAE is categorized into primary, secondary (the monthly indicator of industrial activity), and tertiary activities. Furthermore, the subcomponents of core inflation are disaggregated into goods and services, with the services category further refined to isolate the housing subcomponent.

Table 3: Variables included in the estimation

Approach (type of SVAR model)	**(i)** Cholesky	**(ii)** Signs and zeros	**(iii)** Local Projections	**(iv)** Narrative signs	**(v)** External instruments
Exogenous variables					
For the U.S. economy:					
Price of oil (WTI), output gap, CPI core inflation, Wu-Xia shadow federal funds rate, yield curve slope (10y-2y), VIX index	✓	✓	✓ (except VIX)	✓	✓
For the Mexican economy:					
Monetary policy surprise (narrative info.)				✓	
Monetary policy surprise (high frequency data)					✓
Endogenous variables for the Mexican economy					
12-month ahead headline inflation expectations	✓	✓	✓	✓	✓
Output gap	✓	✓	✓	✓	✓
Producer price inflation			✓		✓
Core inflation	✓	✓	✓	✓	✓
Short-run nominal interest rate	✓	✓	✓	✓	✓
Nominal exchange rate	✓	✓	✓	✓	✓
EMBI+ index	✓	✓	✓	✓	✓
Yield curve slope (10y-2y)	✓	✓			
Total number of variables included	13	12	12	13	12

Note: Inflation indicators refer to the annualized quarterly variation at a monthly frequency. The exchange rate is included as a monthly variation. For Mexico, the short-run nominal interest rate refers to the overnight banking funding rate before August 2008, and to the monetary policy reference rate after this date. For the external instrument approach, output, price indexes, and exchange rate are included in log-levels. Also, only for this approach, the short-run nominal interest rate corresponds to the 1-year rate. *Source*: Data retrieved from ST. Louis Fed, Bloomberg, INEGI, and Banxico.

3 Results

To assess the MPTM in Mexico and examine potential changes following the pandemic, we begin our analysis with a benchmark period preceding the pandemic. Specifically, models are initially estimated using data from January 2002 to December 2019, followed by a comparison with the period encompassing the pandemic and the post-pandemic period up to 2023. To facilitate comparisons across models and with international evidence, we normalize the policy shock to a 100 basis point (bp) increase in the policy rate.

Figure 1 illustrates the responses of key macroeconomic variables to a 100 basis point rate hike. These variables include the output gap, core inflation and the nominal exchange rate, estimated using various models. Each panel presents the dynamics over a 50-month horizon for the models estimated prior to the pandemic. Different solid lines represent different strategies: the Cholesky baseline (green), sign restrictions baseline (blue), narrative-based approaches (purple), local projections (mint green), and external instruments (light blue). Additionally, three alternative specifications for each baseline identification strategy are included, as detailed in Section 2. The black dashed line represents the median response obtained from the joint distribution of the 11 estimated models, while the shaded area corresponds to the 68% error bands, reflecting the 16th and 84th percentiles of the joint distribution of the 11 models. The joint distribution is derived from 1,000 draws per model, resulting in a total of 11,000 draws across all models. This approach is particularly advantageous as it integrates the distributions from all models to compute a global median and the corresponding uncertainty bands, rather than relying on simple averages.[11] This way, we improve confidence in our results, as individual models may exhibit heterogeneous distributions, which could otherwise result in wide confidence intervals and non-significant estimates for the variables under analysis. However, this issue does not arise in our case, thereby reinforcing the reliability of our findings. By considering the median of the joint distribution, the effects appear to be centered across models, as the error bands allow for the identification of significant effects in key variables of interest. This approach ensures more robust and reliable inference by addressing potential errors associated with failing to account for the full range of underlying distributions.

For the output gap, all models indicate an initial negative response to a monetary policy tightening, with variations in both the timing and magnitude of the effect. For instance, the narrative approach shows the lowest response, while the external instrument estimation shows a larger output contraction. Over time, all responses gradually converge toward zero. Core inflation also shows a negative response to a monetary tightning, with its peak impact occurring later than that of the output gap. This highlights the lag in the transmission of monetary policy to prices, which takes longer to materialize as monetary policy propagates through the economy before ultimately affecting inflation. Regarding the exchange rate, it exhibits an initial appreciation (indicated by the negative response) following a monetary policy rate hike, with most models indicating a rapid return to zero shortly thereafter.

Overall, our results reveal that, following an increase in the short-term nominal interest rate, output decelerates and inflation declines after several months. Specifically, after a 100

[11]It is important to note that there is no formal proof that the average of the medians of the 11 models should equal the median of the joint distribution derived from all 11 models.

bp monetary policy shock, the output gap decreases by 30 to 65 bp within 1 to 1.5 years, and inflation falls by 15 to 22 bp within 1 to 2 years. These ranges are derived from the responses of 11 different models in Figure 1, where the minimum and maximum values for each variable response at each time horizon are excluded as shown in the last rows (in red) of Table 4. Additionally, the table provides a detailed comparison of the time (in months) and magnitude (in basis points) of the peak responses for both the output gap and core inflation for all models following a 100 bp monetary policy shock.

Notably, these plausible ranges remain consistent even by excluding the minimum and maximum values. Specifically, the average peak response of the output gap to a 100 bp increase in the policy rate occurs within approximately one year, with a magnitude of 47 basis points, compared to 46 basis points when the extreme values are excluded. Similarly, the average peak response of core inflation occurs within 1.5 years, with a magnitude of 19 basis points, compared to 18 basis points without extreme values. While excluding these values narrows the plausible ranges to [30, 65] basis points for the output gap and [15, 22] basis points for core inflation, the average peak responses show minimal variation across specifications.

Table 4: Summary table of times and magnitudes for different identification methods.

Identification Method	**Output Gap**		**Core Inflation**	
	Time (months)	**Magnitude (bp)**	**Time (months)**	**Magnitude (bp)**
Cholesky baseline	13	56	19	20
m2	11	65	17	22
m3	12	54	18	21
m4	11	43	18	20
Baseline signs	17	43	21	16
m2	11	34	14	12
m3	16	42	21	15
m4	16	50	19	16
Narrative signs	10	15	15	14
Local projections	10	30	19	22
External instruments	10	82	25	32
Average	**13**	**47**	**19**	**19**
Range	[10, 17]	[15, 82]	[14, 25]	[12, 32]
Plausible average (without max-min)		**46**		**18**
Plausible range (without max-min)		**[30, 65]**		**[15, 22]**

Note: Model 2 includes 2 lags, model 3 uses different hyperparameters in the estimation process, and model 4 considers an alternative output gap measure.

These findings for Mexico are consistent with international evidence. Recent estimates by Deb et al. (2023) for both advanced and emerging markets indicate that the effects of monetary policy transmission are similar across income levels. They report that the responses of output and inflation typically peak within 2 years in both advanced and emerging market

economies. Specifically, their estimates show that a 100 bp policy rate increase results in a 40 bp decline in inflation in advanced economies and a 20 bp decline in emerging market economies. The impact on output is similarly comparable, with declines ranging from 20 bp to 40 bp following a 100 bp policy rate increase.

Building on this evidence, we now concentrate on the two baseline specifications for the remainder of the analysis. Figure 2 presents the impulse response functions to a monetary policy shock for the median of 11 baseline models (solid red line), alongside the two baseline models: the Cholesky identification strategy (blue dashed line) and the sign restriction identification strategy (green dashed line).[12] The shaded area denotes the 68% confidence interval derived from the joint distribution of the 11 models.

We observe that the output gap shows a pronounced initial negative response, peaking between 12 and 15 months across both models. The Cholesky baseline model indicates a slightly larger and quicker peak compared to the sign restriction model. For core inflation, the response is more gradual, with the peak impact occurring between 18 and 24 months, before recovering. The short-run nominal interest rate displays an immediate increase by construction, followed by a gradual decline as the shock dissipates. The exchange rate effect appears to be short-lived, with an initial appreciation, indicated by the negative response, followed by a rapid reversion toward zero. The close alignment between the median estimates across the three modeling approaches demonstrates robustness in the estimation, with all responses remaining within the confidence intervals.

3.1 Estimation with the sample including the pandemic

To assess whether the period including the pandemic caused changes in the monetary policy transmission mechanism, the results of the estimations up to 2019 are first presented and then compared with the period covering the pandemic up to 2023. Figure 3 illustrates the joint distribution for the two baseline models' estimations before (red) and after the pandemic (blue). As observed, once accounting for the pandemic's effects, the estimations suggest no significant differences in the responses of the output gap and inflation between the two periods. This indicates that the monetary policy transmission mechanism appears to have remained largely unchanged in recent years.

These results are far from trivial. As explained in Section 2, estimating the monetary policy transmission mechanism during the pandemic was complicated by the presence of extreme

[12] Figure B.1 in the Appendix presents a comparison of the MPTM in the pre-pandemic period for the Cholesky baseline (blue) and sign restrictions baseline (red), including their respective 68% error bands.

volatility shocks, which posed significant challenges for conventional methodologies. To address these issues, alternative strategies were implemented to adapt these methodologies, particularly due to the substantial impact of these shocks on certain real variables. Specifically, for the baseline specifications, dummy variables and pandemic priors (Cascaldi-Garcia (2022)) were used within the recursive identification strategy, while an outlier-cleaning approach (Schorfheide and Song (2021); Carriero et al. (2021)) was implemented for estimations utilizing sign and zero restrictions. We further examine these dynamics by incrementally extending the sample period, adding one year of data at a time from 2019 to 2023, to analyze its effects on output and inflation. This analysis is performed using the two baseline models: Cholesky (Figure 4) and sign restriction identification (Figure 5). The dotted circle in the figures represents the peak effect for baseline estimations up to 2019, while the arrows illustrate how the dynamics evolve as an additional year is progressively added. Subsequently, estimations up to 2023 are presented while controlling for the pandemic effect.[13]

Our results in Figures 4 and 5 indicate that from 2018 to 2019, there are no observable changes in the monetary policy transmission mechanism. However, starting in 2020 and continuing through 2023, the transmission mechanism undergoes significant changes when the pandemic effect is not accounted for. In contrast, when controlling for the pandemic, no statistically significant changes are observed in the monetary policy transmission mechanism compared to the estimations made for the pre-pandemic period. Furthermore, these findings are robust across various sample periods and identification methods, confirming the consistency and reliability of the results. Additional estimations, incorporating an additional year of data for the sample period from 2019 to 2023 after controlling for the pandemic, are presented in Figures B.3 and B.4 for the two baseline models.[14]

3.2 Disentangling the MPTM on output and inflation

As a small open economy with a high degree of trade openness, Mexico's exchange rate plays an important role in the transmission of monetary policy.[15] To deepen the analysis of the MPTM, particularly the importance of the exchange rate channel, we examine how a monetary policy shock influences the *components of core inflation* such as goods inflation, services inflation, and housing inflation, as well as the components of *Mexico's economic*

[13]The results for the non-baseline models are provided in Appendix B: narrative sign restrictions (Figure B.5) and local projections (Figure B.6).

[14]Estimations including the pandemic period across all models, are provided in Appendix B Figure B.7.

[15]Mexico's degree of trade openness is three times that of the U.S. Indeed, exports plus imports as a proportion of GDP in Mexico averages 76% in the last 10 years. Over the same period, in the U.S. this ratio has fluctuated between 20 to 30% .

activity indicator (IGAE), including secondary and tertiary activities. To achieve this, the models are re-estimated, incorporating an additional variable representing each of these core inflation components and IGAE activities as discussed in Section 2.1. Specifically, for this exercise, the vector Y incorporates production indicators for secondary sectors, such as manufacturing, and for tertiary sectors, representing the services industry. With respect to prices, the model includes goods inflation and services inflation. The SVARs are estimated using data through 2019 for the pre-pandemic sample.

Our results suggest that economic sectors that are more sensitive to exchange rate variations, exhibit stronger responses in *prices* and *real activity* to monetary policy adjustments compared to domestically-driven sectors like services. This is observed in Figure 6 for the *components of inflation*. As illustrated in the figure, goods inflation within core inflation responds negatively to a contractionary monetary policy shock and exhibits a statistically faster and significant reaction. In contrast, services and housing inflation do not show any statistically significant response to such a shock. This hints at the exchange rate channel playing a relevant role in influencing the behavior of goods inflation. Furthermore, the effect of the exchange rate on the price-setting process may have a relatively greater impact on the transmission of monetary policy in Mexico than its effect on households' and firms' consumption and savings decisions, which directly influence aggregate demand. The relatively lower importance of the savings and spending channels aligns with the low levels of financial inclusion in Mexico, as households and firms often lack sufficient resources to smooth consumption over time.

With regard to real activity, the components of the IGAE presented in Figure 7 reveal that the effect of a monetary policy shock on secondary activities like manufacturing industry, is both larger in magnitude and faster compared to tertiary activities like services. This result is consistent with the observation that monetary policy impacts the exchange rate rapidly, thereby accelerating its effect on tradable goods.Importantly, these patterns in our results are consistent across different model specifications, highlighting the robustness of our findings.

Overall, our findings suggest that the transmission mechanism has a stronger impact on the prices of tradable goods (such as goods and secondary activities) compared to non-tradable goods (such as services and tertiary activities). These findings highlight the critical role of the exchange rate channel in the transmission mechanism of monetary policy in Mexico.

4 Concluding remarks

In this paper, we analyze Mexico's monetary policy transmission mechanism (MPTM), focusing on the responses of key macroeconomic variables to an unanticipated policy rate change. These variables include the output gap, core inflation, and the exchange rate, as well as real activity and price indicators in the manufacturing and services sectors. Our findings suggest that the MPTM remained resilient despite the unprecedented economic shocks of the pandemic. Once controlling for the pandemic-related shocks, we find no statistically significant differences in the MPTM before and after the pandemic. However, failing to account for these shocks leads to inconsistent estimations during the pandemic period. This result highlights the importance of adopting a robust modeling approach in times of exceptional volatility. We do so by implementing a comprehensive methodology, integrating multiple strategies to identify the monetary policy shock and estimating impulse-response functions through vector autoregression models and local projections. Our results are thus robust across different model specifications.

Additionally, we find that monetary policy transmission is stronger in the manufacturing sector than in services. Manufacturing output and prices exhibit larger and faster responses to policy rate adjustments, while housing prices—a subcomponent of services—do not show statistically significant responses at any point. A key difference between the two sectors is that manufactured goods are tradable, making them highly sensitive to exchange rate fluctuations, whereas services are primarily driven by domestic demand. This highlights the exchange rate's crucial role as a transmission channel in Mexico's MPTM. Moreover, our findings suggest that savings and spending decisions by firms and households might be relatively insensitive to policy rate changes, which aligns with Mexico's low financial inclusion and credit penetration. Further research is needed to measure the elasticity of households' consumption and firms' spending to changes in the policy rate. Other emerging economies with high trade openness and financial constraints may exhibit a similar MPTM than Mexico, which calls for further research to explore broader implications for the MPTM in these economies.

While our study enhances understanding of monetary transmission in Mexico through a rigorous framework, it has certain limitations. We focus on the effects of monetary policy shocks on key macroeconomic variables but do not quantify the relative importance of different transmission channels.[16] Future research could examine these channels more closely to provide deeper insights for policymakers and researchers. Despite these limitations, our findings indicate that Mexico's monetary policy remains effective in maintaining price stability

[16] See Appendix A for an overview of transmission channels in Mexico, though this is beyond the paper's primary scope.

in the post-pandemic period. Extending our methodology to other small open and emerging economies could help assess potential changes in their transmission mechanisms after the pandemic. In any case, given the evolving structure of the economy, regular assessments of the MPTM remain essential to guide effective monetary policy decisions.

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Appendix A: Overview on the Channels of Transmission

As a small open economy with a high degree of trade openness, Mexico's exchange rate plays an important role in the transmission of monetary policy. In recent years, the exchange rate has been notably influenced by the interest rate spread between Mexico and the U.S., particularly during periods of low financial volatility. In this vein, a high interest rate spread, adjusted for volatility, tends to appreciate the Mexican peso, as this currency becomes more attractive to market participants. For example, in 2023, when the interest-rate spread remained elevated amid low financial volatility, the exchange rate appreciated by 13.2% over the year. This appreciation helped to reduce production costs of tradable good sectors, such as merchandises, contributing to a decline in the inflation rate of these goods. Specifically, merchandise inflation dropped from 11.09% in December 2022 to 4.89%in December 2023, and further to 2.39 % by November 2024, reckoning a lower level than before the pandemic. In the second half of 2024, the exchange rate experienced heightened volatility driven by both domestic and external factors, leading to a depreciation of the Mexican peso. In this context, the central bank has remained vigilant regarding the potential inflationary effects of this recent depreciation.

It is important to note that while the interest rate spread is partially influenced by Banco de México's decisions, the central bank conducts monetary policy solely to fulfill its primary mandate of price stability. Consequently, it does not target a specific level for the interest rate spread or the exchange rate. In fact, Mexico's flexible exchange rate regime is a cornerstone of the country's macroeconomic framework. This regime acts as a shock absorber, enabling the central bank to remain focused on its primary objective of maintaining price stability.

The inflation expectations channel is also one of the most effective monetary policy transmission channels in the country. This mechanism has been tested during various episodes, especially since Banco de México adopted the inflation-targeting regime in 2001. Despite the severity of certain episodes, such as the recent one related to the pandemic and geopolitical tensions, central bank actions have successfully contributed to maintain long-term inflation expectations stable and anchored close to the target. In this vein, recent evidence shows that long-term inflation expectations comply with different properties of anchoring.[17] As such, they are stable, as professional forecasters' revisions are infrequent and of low magnitude. Additionally, these expectations are unresponsive to inflationary surprises or changes in short- and medium-term inflation expectations.

The anchoring of long-term inflation expectations results from the credibility that the

[17]See the Box "Anchoring of long-term inflation expectations in Mexico" in Banco de México's Quarterly Report for April – June 2023.

central bank has built over the years through its commitment to fulfill its primary mandate of price stability. During the most recent inflationary episode, Banco de México's timely and decisive actions have further reinforced this commitment. This anchoring also serves as indirect evidence of the effectiveness of monetary policy, since only in a regime where there is confidence in the central bank's ability to maintain low and stable inflation can expectations remain firmly anchored. The interest-rate channel is another effective monetary policy transmission channel. Empirical analysis shows that changes in the policy rate have a statistically significant effect on government bond interest rates along the yield curve, for maturities from 1 month to 10 years.[18] As expected, the impact is more pronounced for shorter maturities.[19] These results document the strong influence that domestic monetary policy displays on the short end of the yield curve.

As of the bank credit and deposit channels, although they may be perceived as less powerful due to the country's low level of financial inclusion and credit penetration, changes in the policy rate drive, to a large extent, adjustments in the interest rates for bank loans and deposits. On the one hand, the pass-through of policy rate adjustments to interest rates of banking business loans is of nearly one-to-one. For consumer credit and mortgages the pass-through is lower, but still positive. On the other hand, bank deposit rates also mimic, to different degrees, changes in the policy rate, with the pass-through being substantially larger for term deposits of both firms and households than for check deposits.[20]

Other channels, as those related to asset and debt holdings (which include cash-flow and balance-sheet effects), are less relevant in Mexico. The main reason behind it is once more the country's low level of financial inclusion. Nevertheless, for those households and firms holding debt and financial assets, changes in the monetary policy rate influences their debt service, as well as the interest income of deposit and other financial investments. In particular, the service of firms' bank debt responds to changes in the monetary policy rate, since most of these loans are granted at variable interest rates. On the contrary, households' debt service is relatively less affected, as around 70% of household debt consists of mortgage loans, which have a fixed interest rate. Through the above channels, monetary policy effectively influences domestic financial conditions, impacting private sector's spending and saving decisions, and production costs of exchange-rate sensitive sectors. Overall, these actions have contributed to the anchoring of inflation expectations. The most recent inflationary episode is a clear

[18] See the Box "Pass through of Mexico's policy rate to interest rates across different maturities" in Banco de México's Quarterly Report for April - June 2022.

[19] The pass-through effect on medium- and long-term rates is lower, as these rates respond to additional factors such as future short-term rate expectations, inflation forecasts, and risk premiums.

[20] See the Box "Evidence on the pass through of the monetary policy rate to banking interest rates in Mexico" in Banco de México's Quarterly Report for April – June 2024.

example of how monetary policy has been transmitted through the economy, moderating the inflation surge, and contributing later to the disinflationary process. From June 2021 to March 2023, Banco de México raised the policy rate by 725 basis points to face an increase in inflation not seen in two decades. Along the way, government bond and bank interest rates rose, shifting some of aggregate spending towards savings and increasing the lending costs of firms. The exchange rate appreciated, especially when volatility was low, and this contributed to reduce production costs, notable for merchandises, lowering the inflation of these goods. And finally, inflation expectations remained well-behaved, with those for the short-term reflecting the effects of the shocks but also the anticipation that they were not permanent, while those for the long-term remained anchored.

Appendix B: Supporting Material

Table B.1 provides a description of the variables used in the model in Section 2.1, including details of each variable, with their respective transformations indicated in parentheses. The data is obtained from the National Institute of Statistics and Geography (INEGI), Banco de México (Banxico), Bloomberg, FRED Economic Data from St. Louis FED, and Velmer Data.

Pre-pandemic result for baseline models. Figure B.1 presents a comparison of the MPTM in the pre-pandemic period for the Cholesky baseline (blue) and sign restrictions baseline (red), including their respective 68% error bands. The figure shows the responses of output gap, core inflation, and the nominal exchange rate to a 100 bp unanticipated policy rate increase. Overall, the results are broadly consistent between the Cholesky and sign restriction methods, with no statistically significant differences observed between the two approaches within the first 24 months.

We can observe that the output gap shows a pronounced initial negative response, peaking between 12 and 15 months across both models. The Cholesky baseline model indicates a slightly larger and quicker peak compared to the sign restriction model. However, the median responses over the first 24 months remain within the respective error bands of the alternative identification strategy, suggesting no statistically significant differences between the two approaches. For core inflation, the response is more gradual, with the peak impact occurring between 18 and 24 months. The sign restriction approach exhibits a slightly less pronounced response than the Cholesky baseline but remains within the latter's error bands, which appear wider in this case. The short-run nominal interest rate displays an immediate increase by construction, followed by a gradual decline as the shock dissipates. For the

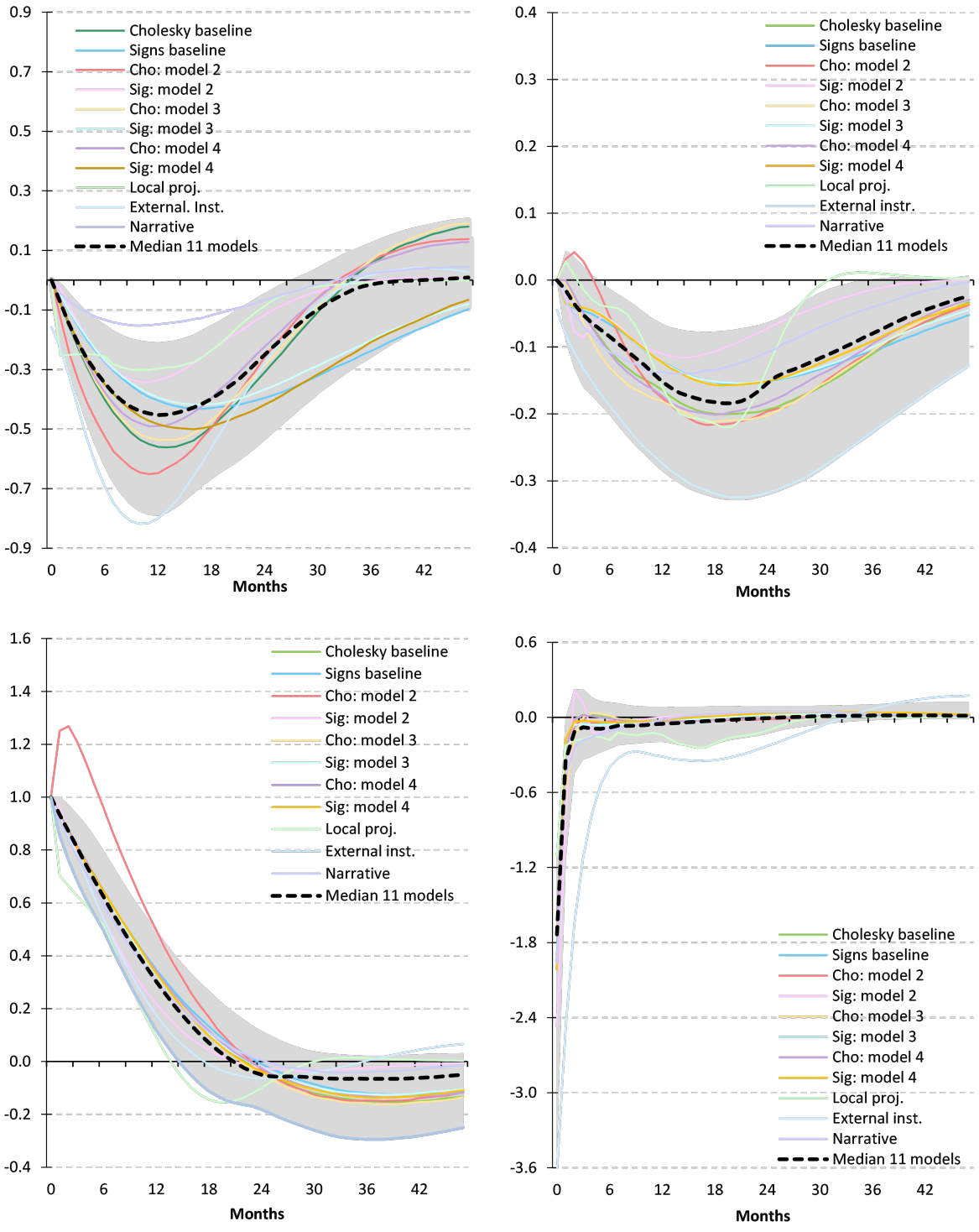
exchange rate, there is an initial appreciation, as indicated by the negative response. This effect appears short-lived, and uncertainty about the parameters remains comparable across the two models.

Pre-pandemic result for non-baseline models. Figure B.2 presents the results for the MPTM in the prepandemic period for non-baseline models. In the identification using external instruments in panel a, the results indicate a larger reduction in output and prices compared to other methodologies, alongside an exchange rate appreciation; however, this appreciation is not directly comparable to the outcomes of the other approaches. In panel b, the identification with local projections indicates a reduction in inflation similar to that observed in the Cholesky, sign, and narrative sign approaches, while the output gap and exchange rate display a slightly more muted response compared to other methodologies. Lastly, in panel c, the identification using external instruments again indicates a larger decline in both output and prices relative to alternative methodologies, along with an exchange rate appreciation, though this result remains methodologically incomparable.

Pandemic Estimates. Based on the results shown in Panel (b) of Figures 4 and 5, which indicate that the MPTM has not changed during the pandemic, additional estimates for other time periods are presented in Figures B.3 and B.4 for the two baseline models. These estimates are generated by incorporating an additional year of data for the sample period from 2019 to 2023, after controlling for the effects of the pandemic.

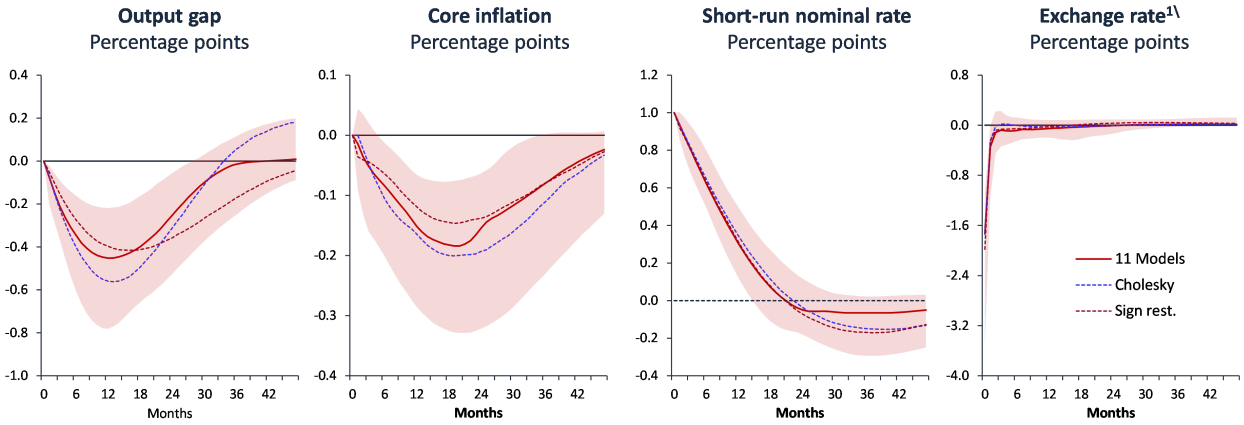
Similar to the way results for the two baseline models are presented in the main section of the paper (Figures 4 and 5), estimations for *non-baseline models*, including those using narrative sign restrictions (Figure B.5) and local projections (Figure B.6), are also provided. In Panel (a), we illustrate how the monetary policy transmission mechanism is distorted when the pandemic effect is not accounted for, with estimations conducted by progressively adding one additional year of data to the sample period, covering 2019 to 2023. Panel (b) compares these results with those for the full sample, up to 2023, where the pandemic effects are accounted for. Similarly to baseline models, no statistically significant changes in the transmission mechanism following the pandemic are observed under the narrative restrictions SVAR or local projections when the effects of the pandemic are accounted for.

Figure 1: Results of the MPTM in pre-pandemic: all models



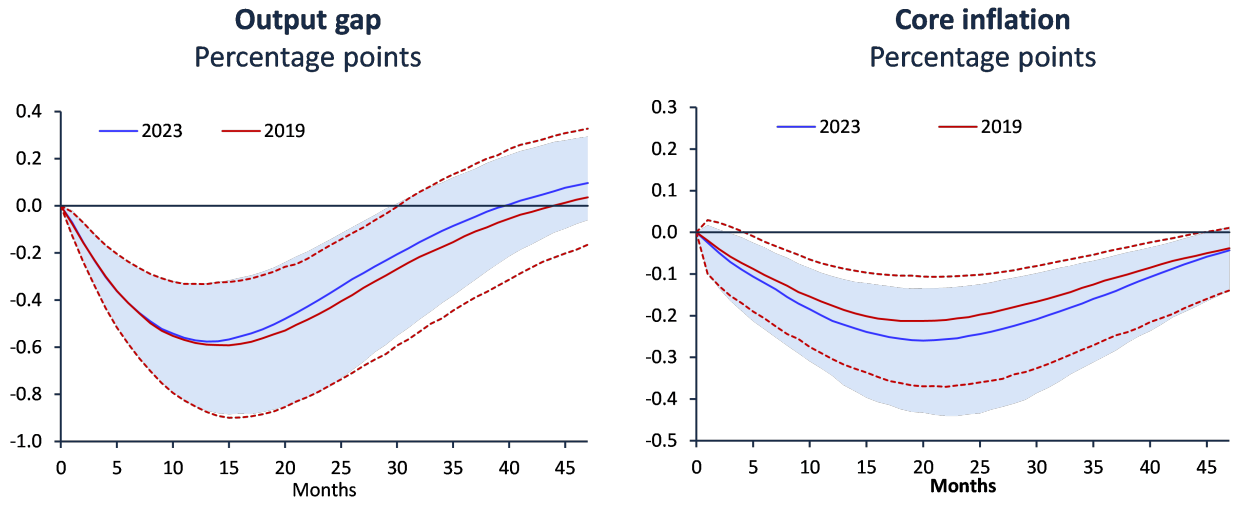
1/ The model 2 includes 2 lags, model 3 uses different hyperparameters in the estimation process, and model 4 considers an alternative output gap. The gray areas are obtained by removing the highest and lowest value of the all models in each month. *Source*: Own estimations using data from INEGI, Banco de México, Bloomberg, PiP, and Valmer

Figure 2: Results of the MPTM in pre-pandemic: Cholesky vs Signs



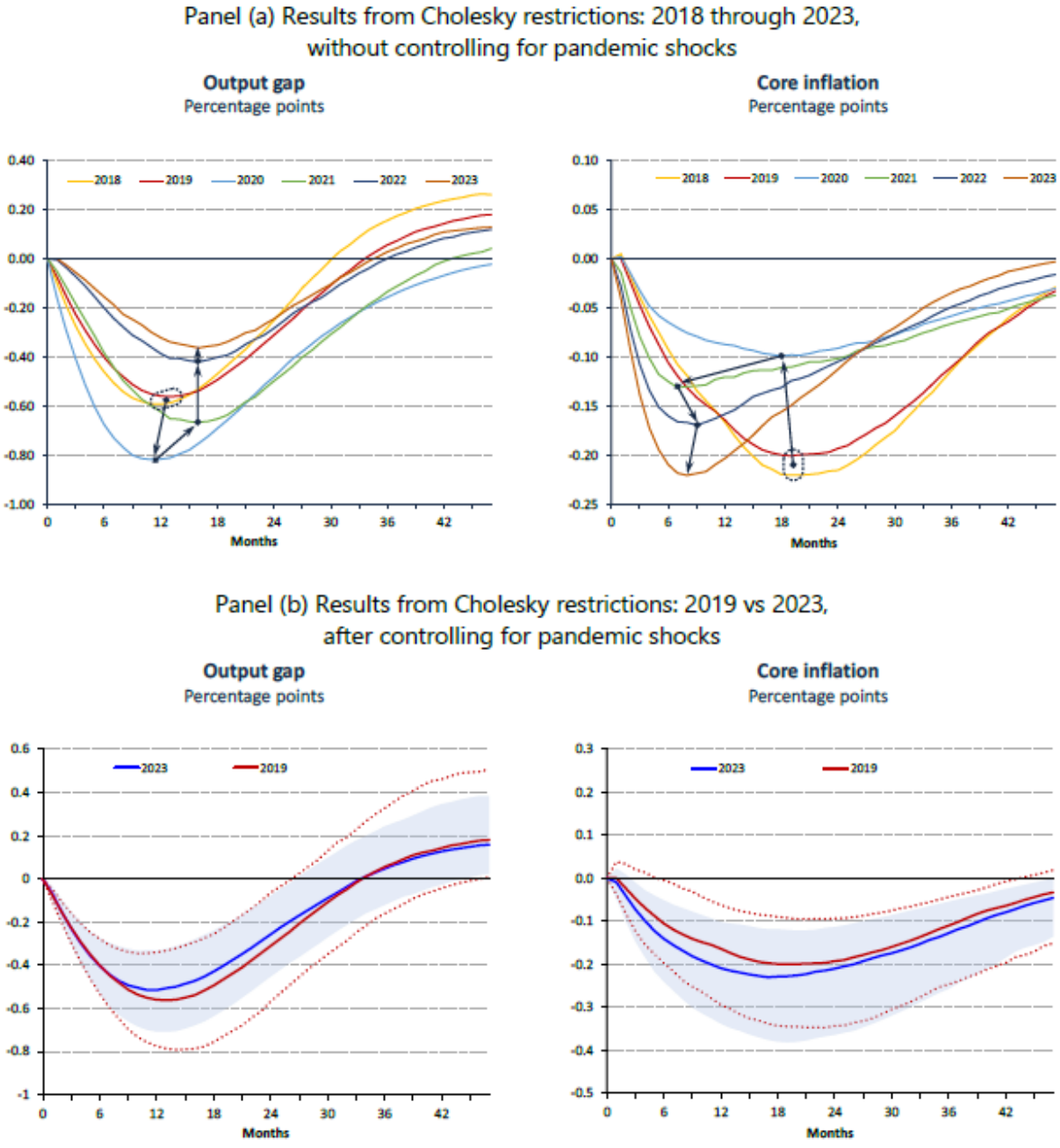
1/ Monthly percentage variation in the exchange rate between the Mexican peso and the U.S. dollar. *Note*: The solid red lines represent the median of the joint distribution of the 11 estimated SVAR models. The blue and green dashed lines correspond to the median of the distributions for the baseline models, Cholesky and sign restrictions, respectively. The shaded area represents the uncertainty band covering 68% of the joint distribution of the 11 estimated models. The estimates are conducted at a monthly frequency for the period before the pandemic, from Jan. 2002 to Dec. 2019. *Source*: Own estimations using data from INEGI, Banco de México, Bloomberg, PiP, and Valmer.

Figure 3: Baseline models: Estimation before and after the pandemic-joint distribution



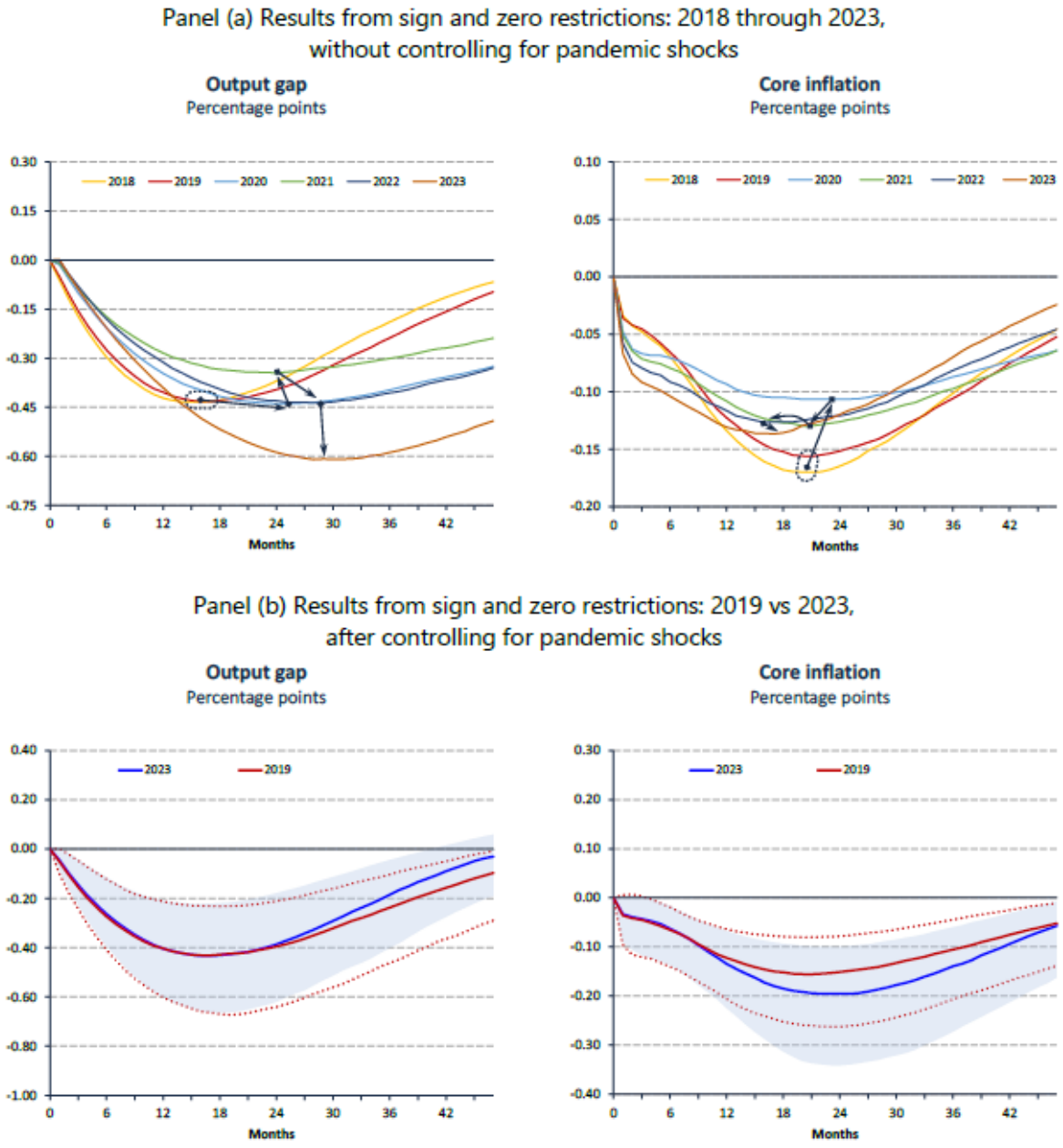
Note: The estimates are conducted at a monthly frequency for two samples: the pre-pandemic period (January 2002 to December 2019) and the period including the pandemic (up to December 2023). Solid lines represent the median of the joint distribution of the baseline models (Cholesky and sign restrictions). The shaded area and dashed lines indicate the 68% confidence interval of this distribution. *Source:* Own estimations using data from INEGI, Banco de México, Bloomberg, PiP, and Valmer.

Figure 4: Responses of real activity and prices to a monetary policy shock, before and after the pandemic, according to Cholesky restrictions



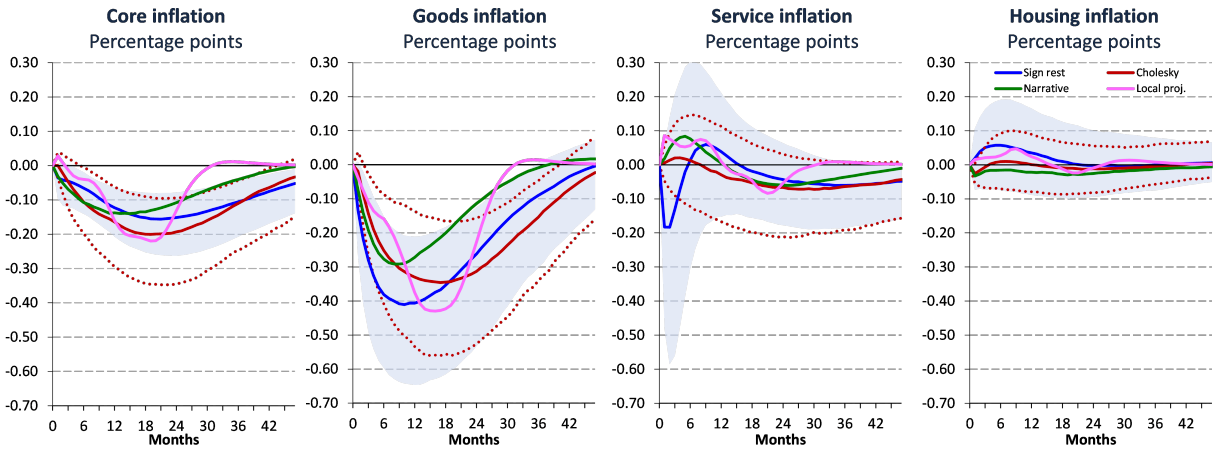
Note: The red dotted lines and the blue shaded area in Panel b represent the uncertainty bands covering 68% of the distribution in each model. *Source*: INEGI, Banxico, Bloomberg, PiP, Valmer.

Figure 5: Responses of real activty and prices to a monetary policy shock, before and after the pandemic, according to sign and zero restrictions



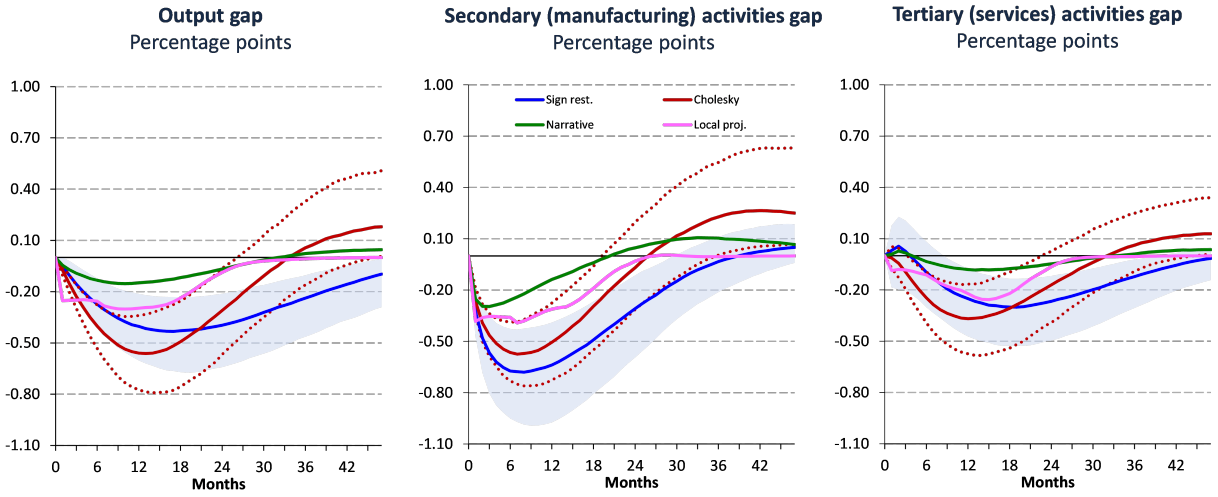
Note: The red dotted lines and the blue shaded area in Panel b represent the uncertainty bands covering 68% of the distribution in each model. *Source*: INEGI, Banxico, Bloomberg, PiP, Valmer.

Figure 6: Effect of MPTM on the components of core inflation



Note: The estimations are performed on a monthly frequency for a pre-pandemic sample from January 2002 to December 2019. The red dashed lines and the blue shaded area represent the uncertainty bands covering 68% of the distribution in the Cholesky and sign-restricted models, respectively. *Source*: INEGI, Banxico, Bloomberg, PiP, Valmer.

Figure 7: Effect of MPTM on the components of Mexico's economic activity indicator (IGAE)



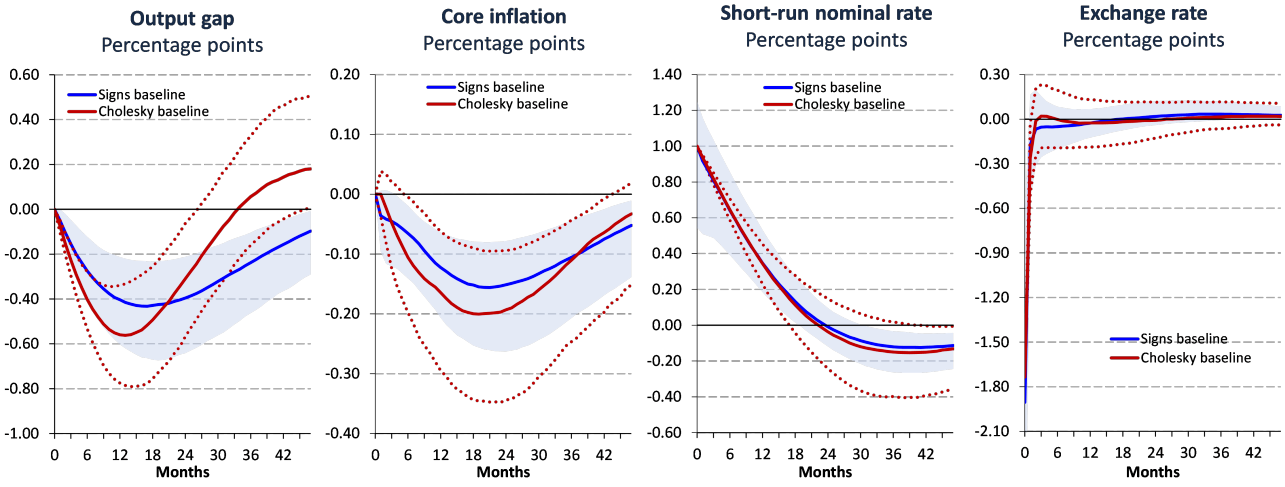
Note: The estimations are performed on a monthly frequency for a pre-pandemic sample from January 2002 to December 2019. The red dashed lines and the blue shaded area represent the uncertainty bands covering 68% of the distribution in the Cholesky and sign-restricted models, respectively. *Source*: INEGI, Banxico, Bloomberg, PiP, Valmer.

Table B.1: Sources and transformation of variables used in the model

Variable	Description (Transformation)	Source
Mexican Block		
Output gap	Official estimates, based on GDP, derived using the HP filter with tail corrections and interpolation.	Banco de México
GDP	Uses the IGAE and the Kalman filter to estimate GDP	Elizondo (2019)
IGAE subcomponents	Primary, secondary and tertiary activities (annualized quarterly variation)	INEGI
Infl. expectations	12 months ahead Core inflation expectations from Survey on the Expectations of Private Sector Economics Specialists	Banco de México
PPI	National Producer Price Index (annualized quarterly variation)	INEGI
Core inflation and sub-components[1]	Derived from Core CPI in Mexico (annualized quarterly variation)	INEGI
Nominal short rate	1-day interbank funding rate	Banco de México
EMBI	Emerging Markets Bond Index (annualized quarterly variation)	Bloomberg
Nominal exchange rate	Monthly average for FIX nominal exchange rate (monthly variation)	Banco de México
Mexican yield curve	10-year minus 2-year interest rate spread (Mexico)	Valmer data
Exogenous Block		
WTI price	WTI crude oil price (annualized quarterly variation)	ST. Louis Fed
U.S. output gap	U.S. output gap obtained as 100*(Real Gross Domestic Product - Real Potential Gross Domestic Product) / Real Potential Gross Domestic Product	ST. Louis Fed
U.S. core inflation	U.S. core inflation is derived from core CPI (annualized quarterly variation)	ST. Louis Fed
Shadow rate	Shadow federal funds rate to capture U.S. monetary policy in the presence of the zero lower bound	Krippner (2013); Wu and Xia (2016)
U.S. yield curve	10-year minus 2-year interest rate spread (U.S.)	Bloomberg
VIX	Volatility Index (annualized quarterly variation)	Bloomberg

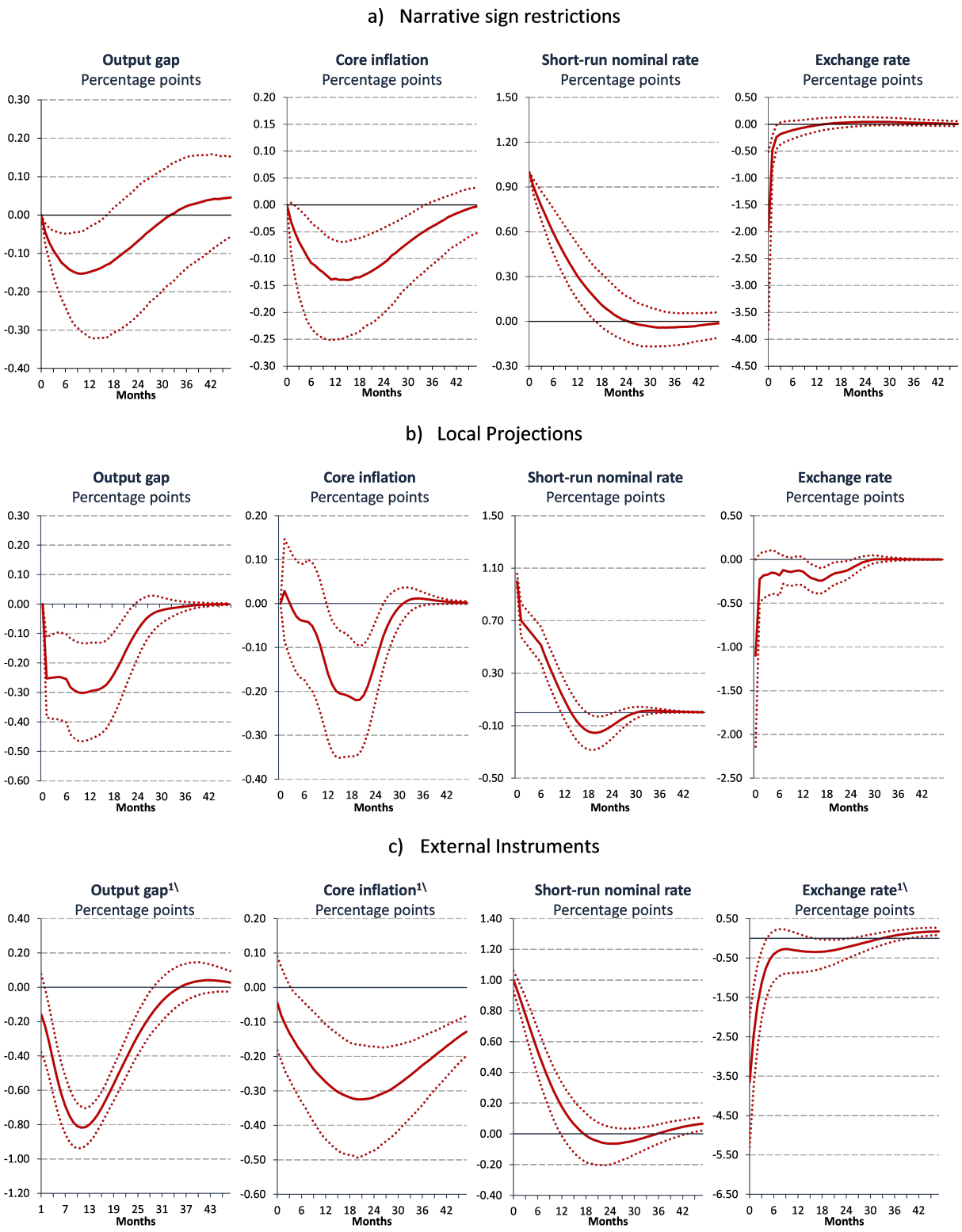
[1] Subcomponents of core inflation are disaggregated into goods and services, with the services category further refined to isolate the housing subcomponent.

Figure B.1: Results of the MPTM in pre-pandemic: Cholesky vs Signs



Note: The dotted red lines and the blue shaded area represent the uncertainty bands that cover 68% of the distribution in each model. *Source*: Own estimations using data from INEGI, Banco de México, Bloomberg, PiP, and Valmer.

Figure B.2: Results of the MPTM in pre-pandemic: non-baseline models



1/ The variables in the model are expressed in logarithms. *Note* The red dotted lines indicate the 68% uncertainty bands for the estimated distribution in each model. **Source**: INEGI, Banxico, Bloomberg, PiP, Valmer.

Figure B.3: Results of MPTM Controlling for the Pandemic (Cholesky, 2018–2023)

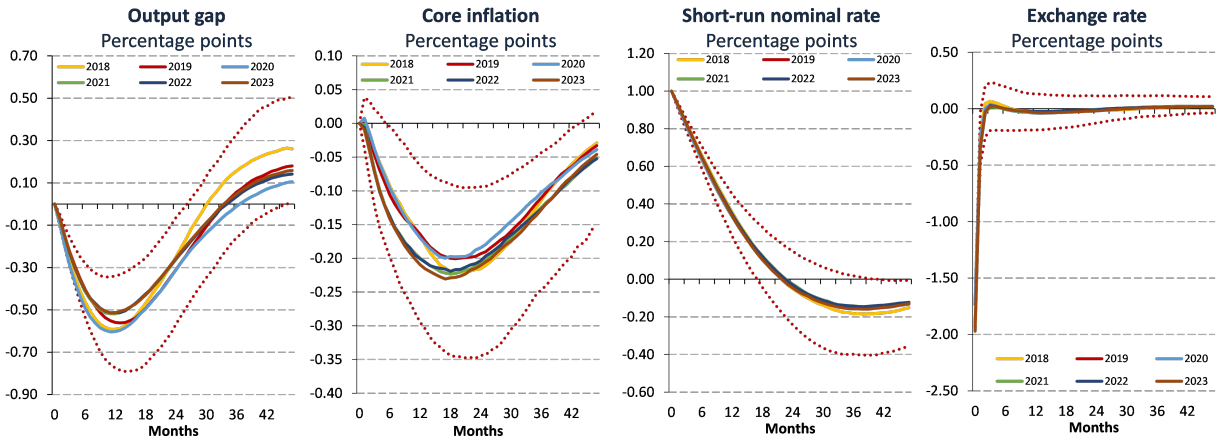
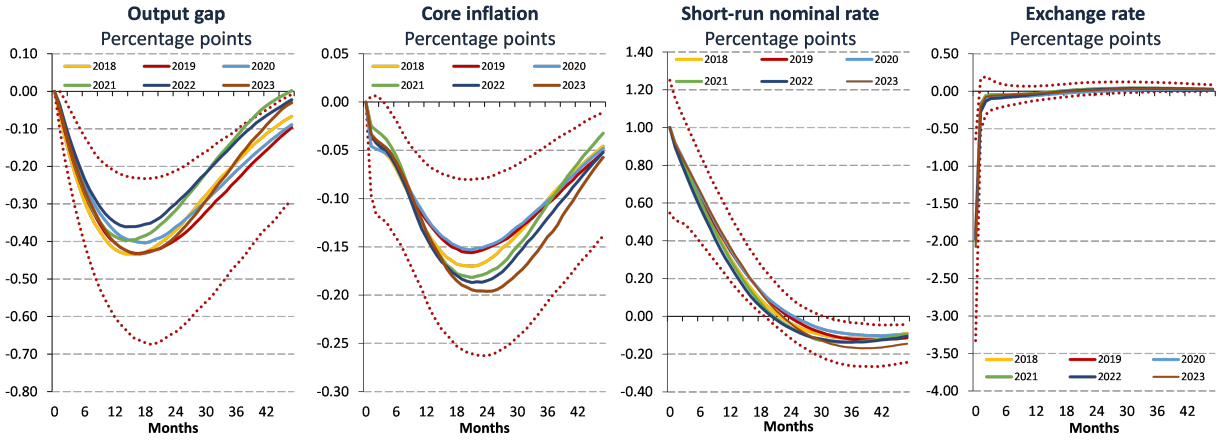
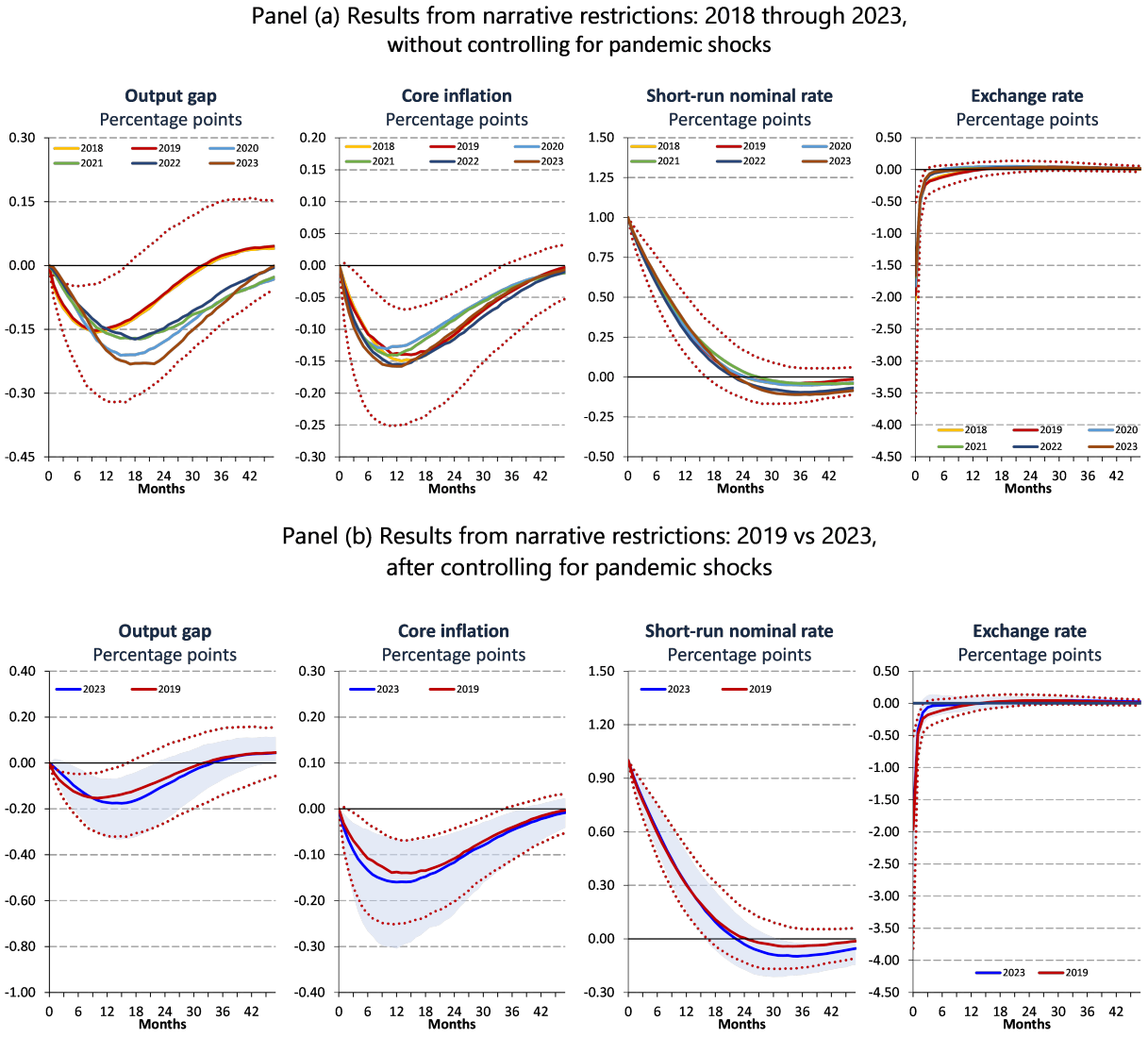


Figure B.4: Results of MPTM Controlling for the Pandemic (sign restrictions, 2018–2023)



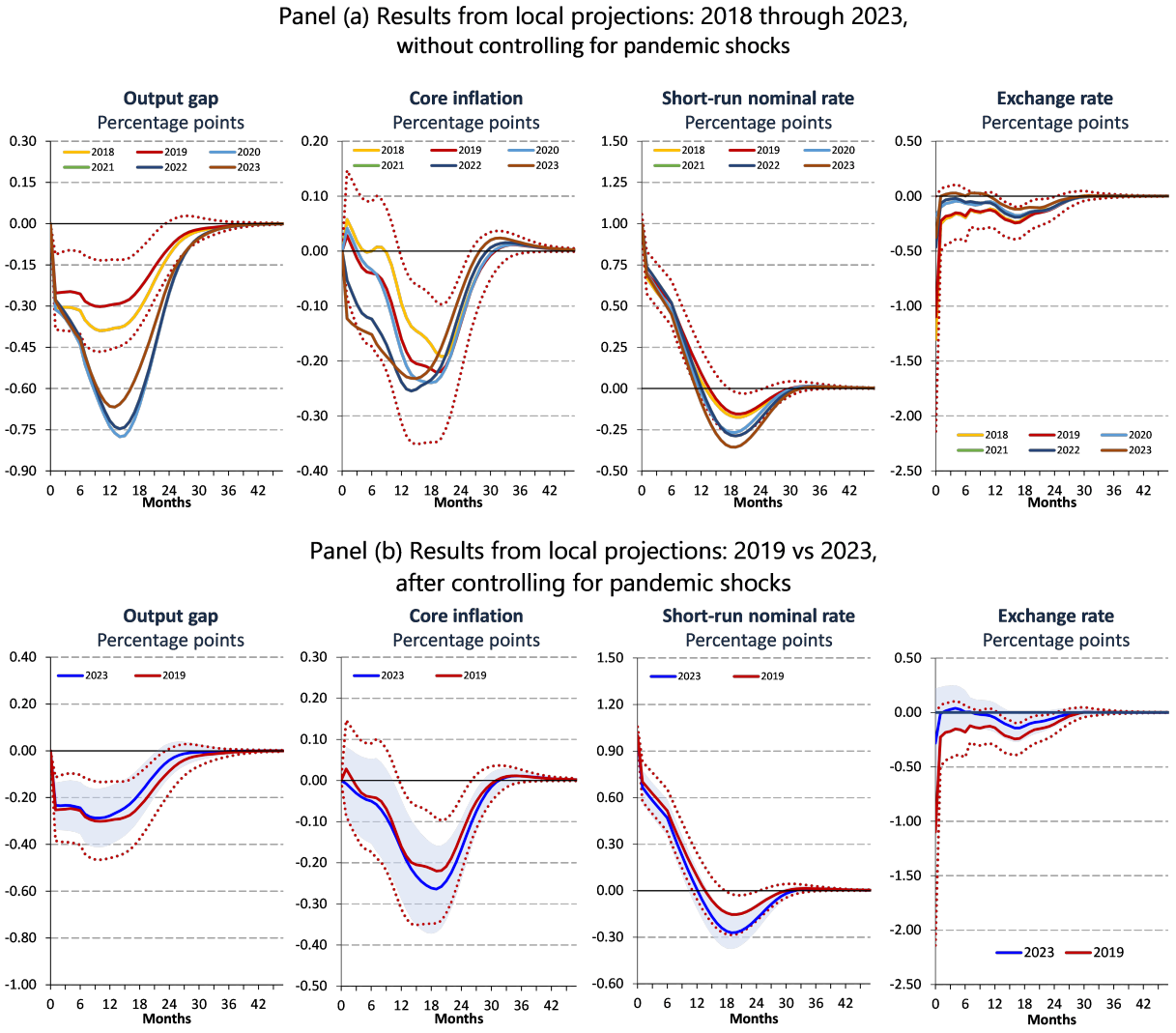
Note: The red dotted lines represent uncertainty band covering 68% of the distribution for the pre-pandemic (2019) model estimates. *Source*: INEGI, Banxico, Bloomberg, PiP, Valmer.

Figure B.5: Estimation under narrative restrictions



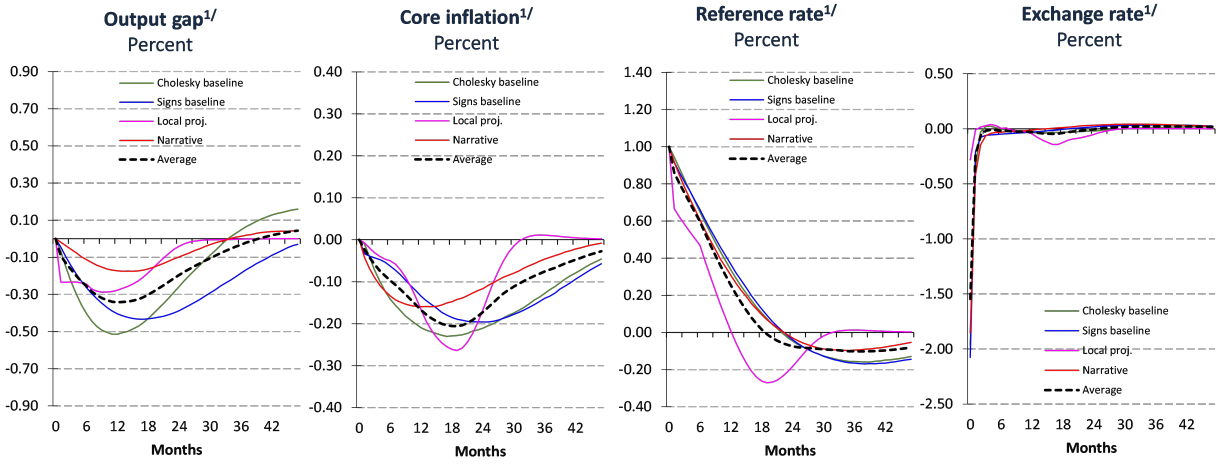
Note: Solid lines represent the median estimates for each sample cut. The red dotted lines in Panels (a) and (b) indicate 68% uncertainty bands for the pre-pandemic (2019) model estimates. The blue shaded area in Panel (b) display 68% uncertainty bands for the full-sample (2023) model. **Source**: INEGI, Banxico, Bloomberg, PiP, Valmer

Figure B.6: Estimation under local projections



Note: Solid lines represent the median estimates for each sample cut. The red dotted lines in Panels (a) and (b) indicate 68% uncertainty bands for the pre-pandemic (2019) model estimates. The blue shaded area in Panel (b) display 68% uncertainty bands for the full-sample (2023) model. **Source**: INEGI, Banxico, Bloomberg, PiP, Valmer

Figure B.7: Estimation in the pandemic period: all models 2023



Source: INEGI, Banxico, Bloomberg, PiP, Valmer