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Drivers of Bank Credit Evolution in Mexican Regions during the COVID-19 Pandemic*

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Abstract

This paper examines the impact of supply and demand shocks on the evolution of bank credit to firms across Mexican regions during the COVID-19 pandemic, using a Structural Bayesian Vector Autoregression (SBVAR) model with sign restrictions and data from January 2006 to May 2023. Our results indicate that bank credit to firms rose at the onset of the pandemic, likely due to precautionary motives, but subsequently contracted, particularly in the central region. The analysis shows that demand factors predominantly explained this contraction in the central region, whereas supply factors were more relevant in the northern and north-central regions. This regional divergence may reflect the weaker post-pandemic recovery in the central region and the manufacturing-related cost pressures and input shortages faced in the northern regions. Starting in 2022 and up to May 2023, regional demand shocks played a key role in supporting the recovery of bank credit, especially in the northern and central regions.

Keywords: Supply and Demand Shocks, Bank Credit, SBVAR
JEL codes: E31, F41, R11.

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1. Introduction

A textbook prediction posits that a mature and efficient financial system plays a pivotal role in directing funds toward the most productive uses, thereby fostering economic growth. Within this system, bank credit to businesses constitutes a key channel, given its importance both at the national and regional levels. Over the past two decades, bank credit to firms in Mexico gained increasing relevance as a driver of economic activity.

For example, the ratio of bank credit to non-financial private firms relative to GDP exhibited substantial growth between 2005 and 2023. Nationally, this ratio increased by 5.9 percentage points, rising from 4.2% to 10.1%. Regional variations were evident, with increases of 3.8, 5.6, 8.4, and 3.0 percentage points in the northern, north-central, central, and southern regions, respectively.[1] Despite starting from the lowest initial level, the southern region registered the smallest increase in absolute terms, which has resulted in it continuing to lag significantly behind the other regions in terms of credit provision to firms.[2]

The heterogeneous behavior of bank credit to firms across regions—particularly the pronounced contraction in the central region following the COVID-19 outbreak—highlighted a relevant research gap. Most existing studies focus on advanced economies, leaving limited evidence on the regional determinants of bank credit to firms during crisis episodes in emerging markets such as Mexico. This paper addresses this gap by examining a central question: *How did simultaneous supply and demand shocks contribute to the evolution of bank credit to non-financial private firms across Mexico's four major regions during the COVID-19 pandemic?*

To answer this question, we construct a dataset spanning January 2006 to May 2023 using information from the National Institute of Statistics and Geography (INEGI, by its Spanish acronym) and Banco de México. We adopt the methodology presented in Box 1, "Regional Evolution of Bank Credit to Businesses in the Context of the COVID-19 Pandemic," from the July–September 2021 *Report on Regional Economies*. Specifically, we estimate a Structural Bayesian Vector Autoregression (SBVAR) with sign restrictions that enables the identification of supply and demand shocks affecting bank credit dynamics. This approach provides a consistent and transparent framework to quantify the role of these shocks in shaping the heterogeneous evolution of bank credit across Mexican regions during the pandemic.

Our findings reveal a common initial increase in bank credit to firms at the onset of the pandemic, likely driven by precautionary motives. However, this surge was followed by a notable contraction, which was particularly pronounced in the central region. The analysis indicates that demand factors primarily accounted for this contraction in the central region, whereas supply factors played a more relevant role in the northern and north-central regions. This regional divergence appears consistent with the weaker post-pandemic recovery observed in the central region and the heightened cost pressures and input shortages affecting manufacturing activity in the northern regions. Starting in 2022 and until May 2023, regional demand shocks played an increasingly important role in supporting the recovery of bank credit, particularly in the northern and central regions.

Finally, as a validation exercise, a national version of the model was also estimated. The results from the

[1]The bank credit figures for non-financial firms used in this section exclude regulated multiple-purpose financial institutions (SOFOMES, by their Spanish acronym) that are subsidiaries of banking institutions and financial groups. Additionally, these figures are not adjusted for foreign exchange rate variations due to the lack of detailed regional information required for such adjustments.

[2]To maintain consistency with the economic analysis conducted by Banco de México, and considering that some of the variables used in our analysis are available based on the Banco de México regionalization, we adopt the regional classifications outlined in the *Reporte sobre las Economías Regionales*. The regions are defined as follows: Northern — Baja California, Chihuahua, Coahuila, Nuevo León, Sonora, and Tamaulipas. North-Central — Aguascalientes, Baja California Sur, Colima, Durango, Jalisco, Michoacán, Nayarit, San Luis Potosí, Sinaloa, and Zacatecas. Central — Ciudad de México, Estado de México, Guanajuato, Hidalgo, Morelos, Puebla, Querétaro, and Tlaxcala. Southern — Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, and Yucatán. The regionalization is depicted in Figure 1.

national specification closely resembled those obtained for the central region, likely reflecting the substantial concentration of bank credit to firms in that region and its correspondingly large weight in the national aggregate.

The structure of this paper is outlined as follows: Section 2 provides an overview of the literature concerning the identification of supply and demand shocks in both the credit market and the goods and services market. Section 3 delves into the regional evolution of bank credit to firms. Section 4 introduces the empirical framework and details the data we employ to discern the contribution of supply and demand shocks to bank credit for firms. Following this, Section 5 presents the results of the effects of supply and demand shocks on the evolution of bank credit to firms at the regional level. Finally, Section 6 offers concluding remarks and outlines potential avenues for future research.

2. Related Literature

Our study examines the key macroeconomic factors shaping credit dynamics across Mexico's regions, placing special emphasis on the pandemic and post-pandemic periods. The onset of the COVID-19 pandemic introduced a range of disruptions, leading to the emergence of multiple shocks that simultaneously impacted macroeconomic variables. The central challenge of our research is to unravel these diverse macroeconomic forces that specifically influenced bank credit to firms in Mexico during this period. To this end, we place a significant emphasis on the literature concerning macroeconomic shock identification, with a particular focus on the structural Vector Autoregression (VAR) models.

The paper delves into the complexities of distinguishing credit supply shocks from traditional demand or supply shocks, a task that is particularly challenging due to the multifaceted ways in which financial sector shocks transmit to the economy. These shocks can propagate through various supply- and demand-type channels, affecting macroeconomic variables differently depending on the predominant channel.

Empirical studies have proposed various strategies to estimate the impact of credit supply shocks within the framework of Structural VAR models. These strategies typically involve incorporating key variables or instruments into a VAR model and defining specific behaviors for these variables to effectively isolate credit supply shocks. The literature, as highlighted by authors like Abbate et al. (2023), reflects a lack of consensus on optimal identification methods for these shocks, underscoring the need for further exploration in this area.

A common approach, exemplified by studies like Gambetti and Musso (2017), involves expecting an inverse relationship between lending interest rates and lending volumes in response to a credit supply shock.

However, distinguishing a credit supply shock from a traditional supply shock requires additional considerations. A key part of the literature suggests that a credit supply shock should produce a joint response in loan volumes, inflation rates, and short-term interest rates, reflecting its primary transmission through demand-type channels. For example, easier credit conditions stimulate spending, which in turn generates upward pressure on prices, prompting central banks to raise interest rates.

Yet, some researchers argue against the conventional restrictions imposed on inflation rates, suggesting that credit supply shocks could indeed induce inflation, particularly due to their impact on the marginal costs of financially dependent businesses. This perspective has led to a new strand of literature that models financial shocks as cost-push shocks. Key contributions in this area, such as Gilchrist et al. (2017), Fiore and Tristani (2013), and Christiano et al. (2015), propose that financial shocks affect firms' pricing decisions either due to borrowing costs being part of firms' marginal costs or as a result of firms hedging against expensive external financing. Hence, an increase in the cost of external financing can lead to higher inflation, either through elevated marginal costs or increased markups.

Consequently, the net impact of financial shocks on inflation remains an empirical question, contingent on the dominant propagation channel in the economy. In their efforts to identify credit supply shocks, many studies have adopted a neutral stance regarding the response of prices, focusing instead on other variables to distinguish these shocks from others, such as aggregate supply or monetary policy shocks. This approach involves integrating additional, more specific indicators into the analysis to ensure accurate shock identification.

A notable example is the work of Fornari and Stracca (2012), who incorporates the relative share price of the financial sector compared to other sectors. The authors assume that only shocks originating from within the financial sector itself will elicit a parallel response in both the relative share price of this sector and credit availability. This method hinges on the premise that endogenous financial sector shocks have a unique footprint in the behavior of sector-specific share prices.

Another innovative approach involves using Central Bank loan officers' survey data as proxies for credit supply. Lown and Morgan (2006) utilized the net percentage tightening of credit standards from the U.S. senior loan officers' survey. Their findings indicate that shocks to this survey variable correlate with a decrease in both output and the quantity of lending. This implies that the survey data can serve as an effective proxy for shifts in credit supply, offering a tangible measure to capture the often elusive dynamics of credit market conditions.

Likewise, a significant portion of the empirical research on credit supply shocks focuses on deriving non-observable variables that can act as proxies for financial conditions and encapsulate credit market frictions. One common approach within this segment of the literature is the development of aggregate macroeconomic indices or financial stress indices, often constructed using state-space Dynamic Factor Models. For example, Carrillo and García (2021) estimates a financial conditions index for Mexico and examines the responses of real variables during periods of deteriorating financial conditions.

Finally, a substantial body of research emphasizes the role of asset price fluctuations and their correlation with the business cycle. Notably, studies employing corporate bond credit spreads —defined as the yield differential between private non-financial corporate debt instruments and comparable sovereign securities — have garnered significant attention. A pioneering work in this domain is that of Gilchrist and Zakrajšek (2012), who introduced a novel method for calculating the credit spread, known as the "GZ credit spread". They further dissected this spread into two primary components: the risk premium and the excess bond premium (EBP). Their findings reveal that the EBP component is predominantly responsible for the credit spread's influence on macroeconomic variables and is closely associated with credit supply in the economy. This makes the EBP an optimal indicator for analyzing credit supply shocks. They demonstrated that abrupt increases in the EBP, unrelated to the economy's current state, lead to substantial and statistically significant downturns in real economic variables.

Recent critiques, notably by Gauthier (2020), have questioned the reliance on financial variables for identifying financial shocks, pointing out their pro-cyclical and forward-looking nature. Gauthier (2020) also contends that credit rationing can occur without significant price volatility, rendering financial stress indexes or spreads potentially misleading. As an alternative, Gauthier (2020) advocates using firms' funding decisions as a proxy for identifying credit supply shocks. In an augmented New Keynesian framework, he discovers that financial shocks uniquely cause divergent movements in bond and loan financing at the onset, whereas other non-financial shocks lead to parallel movements in these financing types. The underlying premise is that firms restructure their financing in response to financial shocks, opting for the most efficient debt type. Consequently, a positive financial shock prompts firms to favor loans over bonds, stimulating positive reactions in output, investment, and consumption.

Hence, our paper introduces a novel perspective to the existing literature, particularly pertinent to contexts like Mexico, where the dynamics of bank credit to firms during the pandemic have not been extensively studied, especially from a regional standpoint. Most research in this area has focused on advanced economies, leaving a noticeable gap in understanding the determinants of bank credit to firms in emerging markets under pandemic conditions. Our study aims to bridge this gap, utilizing the insights from this comprehensive literature review to develop and substantiate our approach for identifying both supply and demand shocks. This methodology will be applied to both the goods and services market and the credit market, with a specific focus on the trends in bank credit to firms at the regional level in Mexico.

3. Regional Evolution of Bank Credit to Firms

In Mexico, access to credit for non-financial private firms exhibits substantial heterogeneity. As illustrated in Figure 2, the 2021 data reveal a stark contrast: while some northern states registered a ratio of bank credit to non-financial private firms relative to state GDP exceeding ten percent, several southeastern states barely reached 3 percent. It is worth noting that this ratio improved over time. For instance, Figure 3 shows that the national ratio of bank credit to non-financial private firms relative to GDP increased significantly between 2005 and 2019, rising by 6.4 percentage points (pp), from 4.2% to 10.6%. Regionally, the increases were 3.9 pp in the north, 5.9 pp in the north-central, 9.5 pp in the central, and 3.1 pp in the south. Although the southern region experienced the smallest absolute gain—and from the lowest starting point—it continued to lag markedly behind the other regions in terms of bank credit provision to firms. With the onset of the pandemic, the national credit-to-GDP ratio declined by 0.5 pp between 2019 and 2021, driven primarily by a 1.1 pp contraction in the central region, while remaining relatively stable elsewhere.

Figure 4 indicates that bank credit to firms was trending upward across all regions prior to the health crisis, despite a slowdown in 2019. A notable initial increase in bank credit occurred in the early months of the pandemic, but this trend reversed starting in April 2020. By the fourth quarter of 2021, bank credit levels in all regions had fallen below their February 2020 levels, with the central region showing both the steepest and the most sustained decline. As of May 2023, the northern and north-central regions had recovered to pre-pandemic levels, whereas the central and southern regions remained below them.

In terms of real annual growth, Figure 5 shows that, nationally, current bank credit to firms expanded at an average rate of 7.2% from January 2018 to February 2020. During this period, the north-central (19.9%) and southern (15.7%) regions recorded the highest average growth rates. The north and central regions grew at averages of 7.6% and 3.7%, respectively. Considering each region's share of national credit, the north-central and central regions contributed 2.6 pp and 2.2 pp, respectively, to the national expansion; the north and south contributed 1.6 pp and 0.8 pp.

Between March and June 2020, bank credit expanded significantly at the national level, driven partly by increased liquidity needs and the impact of exchange rate depreciation on foreign currency–denominated portfolios. All regions contributed positively to this expansion. The central and northern regions accounted for the bulk of the 9.8% average annual variation in bank credit, contributing 5.1 pp and 2.7 pp (79.6% combined), while the north-central and southern regions each contributed 1.0 pp. However, from July 2020 to April 2022, national bank credit contracted consistently, averaging -7.8%. This decline reflected reduced financing needs, tighter lending conditions, and the effects of currency appreciation on foreign currency portfolios. Regionally, the central region contributed most to this contraction due to its higher credit penetration and the magnitude of its decline, followed by the north. From May 2022 to May 2023, bank credit to firms showed signs of recovery, led by the northern and north-central regions.

Figure 6 presents the sectoral contributions to bank credit across regions. Prior to the pandemic (Q1 2018–Q1 2020), the secondary sector was the main driver of credit dynamics in the northern and central regions, whereas the tertiary sector dominated in the north-central and southern regions. During the initial months of the pandemic (Q2 2020), firms in the tertiary sector significantly boosted credit demand in the central region, while in the northern and southern regions the expansion originated mainly in the secondary sector. After this period, all regions experienced negative annual variations in bank credit, though at different times. In the northern, central, and southern regions, the declines were driven primarily by the tertiary sector; in contrast, in the north-central region the downturn was chiefly associated with the secondary sector. As of 2023, bank credit recovery in the northern, north-central, and central regions was mostly supported by the tertiary sector, while in the south the tertiary sector continued to drive negative annual variations.

We also examined the evolution of credit access conditions across regions and compared them with national trends. To do so, we used data from the Survey on General Conditions and Standards in the Banking Credit Market (EnBan) and identified three distinct periods: (i) relative stability in credit conditions during 2018–2019; (ii) a marked tightening in 2020 due to the pandemic; and (iii) a gradual reversal of this tightening from 2021 to 2023.

Additionally, we used data from the Conjunctural Evaluation Survey of the Credit Market and examined regional diffusion indices capturing perceptions of bank credit access.[3] These indices include offered amounts, terms, collateral requirements, credit resolution times, refinancing conditions, and other lending criteria. Figure 7 shows that regional perception indices mirrored national patterns: declining sharply in 2020 and rising thereafter as credit conditions eased. Regional diffusion indices for offered amounts and terms closely tracked their national counterparts, suggesting that credit supply conditions did not differ substantially across regions.

The analysis in this section highlights the heterogeneous evolution of bank credit to firms during the COVID-19 pandemic, both across and within regions. The sectoral dimension further underscores the complexity of these dynamics. Together, these findings justify the importance of adopting a regional perspective when analyzing the evolution of bank credit to firms during this unprecedented period.

4. Empirical Framework and Data

The methodology used in this section to identify the contribution of supply and demand drivers on the evolution of bank credit to non-financial firms follows the proposal of the Banco de México (2021a), and Banco de México (2021b), with an application to the regions of the country[4].

Using data spanning January 2006 to May 2023, we estimate a SBVAR model for each region.[5] The reduced-form representation of each SBVAR model is described below:

$$y_t = C + B_1 y_{t-1} + ... + B_p y_{t-p} + u_t \quad (1)$$

where y_t is an $N \times 1$ vector of N endogenous variables, C is an $N \times 1$ vector of constants, B is an $N \times N$ matrix of coefficients for lagged variables, p is the number of lags, u_t is a vector of residuals for each equation with $u_t \sim N(0, \Sigma)$, where Σ is the $N \times N$ variance-covariance matrix of residuals.[6] Given the large number

[3]The diffusion index is defined as the percentage of firms reporting more accessible conditions plus half of the percentage reporting unchanged conditions. Values above (below) 50 indicate that a larger share of firms perceived more (less) accessible conditions relative to the previous quarter.

[4]Banco de México (2021a) corresponds to Banco de México, Quarterly Report, January-March 2021, Box 4: Determinants of Supply and Demand in the Recent Evolution of Bank Credit to Firms. Downloadable at https://www.banxico.org.mx/publications-and-press/quarterly-reports/quarterly-reports-prices-banc.html. Banco de México (2021b) corresponds to Banco de México, Regional Economic Report, July-September 2021, Box 1: Regional Evolution of Bank Credit to Firms in the Context of the COVID-19 Pandemic. Downloadable at https://www.banxico.org.mx/publicaciones-y-prensa/reportes-sobre-las-economias-regionales/reportes-economias-regionales.html.

[5]The period chosen for the analysis was determined by data availability.

[6]The Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ) both selected p = 1 for most of the

of parameters to be estimated, we use Bayesian methods to deal with the dimensionality issue and assume a Gaussian-Wishart prior distribution to derive the posterior distribution of the VAR coefficients.[7] To map the structural supply and demand shocks in which we are interested from the reduced-form estimated shocks, we need to impose some restrictions on the estimated variance–covariance matrix. As a result, the error term u_t can be written as a linear combination of structural shocks:

$$u_t = A\epsilon_t \tag{2}$$

with $\epsilon_t \sim N(0, I)$, where I is an $N \times N$ identity matrix and where A is a nonsingular parameter matrix. The variance-covariance matrix has the following structure: $\Sigma = AA'$.[8] Therefore, in order to identify A we impose some sign restrictions. Our identification scheme relies on the restrictions imposed on impact and with a lag on the sign of the endogenous variable's response to each structural shock by Banco de México (2021a) and Banco de México (2021b).

In Equation 1, y_t refers to the following set of endogenous variables: i) annual variation of the outstanding balance of bank credit to firms at a regional level in real terms; ii) annual variation of formal regional employment from IMSS; iii) annual growth rate of regional core CPI; iv) average bank funding interest rate; v) national business climate index (BCI) for the next 6 months; vi) annual real variation of the balance of debt in the domestic market of issuing firms, and vii) annual variation of the exchange rate in pesos per US dollar to meet obligations denominated in foreign currency.[9,10] The VAR model identification involves four shocks, and Table 1 provides a summary of the aforementioned identification.

- **Regional supply shock:** We assume that a positive innovation in regional supply could occur due to a reduction in production costs, which in turn would lead to a decrease in consumer prices. Regional production and employment would respond positively as firms adjust their utilized capacity. To this end, firms would seek to contract a larger amount of bank credit.

- **Regional demand shock:** A positive shock on regional demand (consumption and/or investment) would lead to an increase in regional production, without necessarily implying that firms have to adjust their productive capacity immediately. Thus, the positive innovation on regional demand would

VAR models. For more direct comparability, we maintained the same number of lags for the VAR specifications. As a robustness check, results remain qualitatively similar when increasing the number of lags.

[7]We choose the set of hyperparameters to compute the mean and variance of the prior distribution for the VAR coefficients based on the combination that optimizes the marginal likelihood function. In particular, we allow for the auto-regressive coefficient to vary between 0 and 1, the overall tightness hyperparameter (λ_1) to vary between 0.05 and 0.2 and the lag decay hyperparameter (λ_3) to vary in a range between 1 and 2. These values are standard in the literature, see for instance, Dieppe et al. (2016). The total number of iterations is 20,000, and the number of burn-in iterations is 19,000. We examined whether altering the number of burn-in and total iterations in the estimation process would impact the estimates. Nevertheless, the response indicates that, for total iterations exceeding 20,000, there was no significant change in the estimates. Consequently, we opted to retain this iteration count, indicating that the estimation process remained stable and converged effectively.

[8]To understand how each identified shock affects the deviation of annual variations in the corresponding variable from its long-term mean, please refer to Appendix A for technical details on historical shock decompositions.

[9]The Business Climate Index is constructed using information from the Survey on Expectations of Specialists in the Private Sector Economy conducted by Banco de México. Specifically, it is an index that ranges from 0 to 100, where these values represent the percentage of responses from specialists who believe that the business climate for the private sector will improve in the next 6 months compared to the past six months.

[10]We have access to monthly data; however, a monthly measure of economic activity for Mexican states is unavailable. Consequently, we utilize formal employment data from the Mexican Social Security Institute (IMSS in Spanish) as a proxy for regional economic activity. This choice is substantiated, in part, by the robust correlation between the two variables (refer to De Lucio and Izquierdo, 2002, and Potts and Yerger, 2010). Furthermore, we conduct an analysis of the impacts of supply and demand shocks on the deviation of the real growth rate of bank credit to firms at the national level from its long-term mean, utilizing monthly data on formal employment and the global economic activity indicator (IGAE in Spanish). The results demonstrate qualitative similarity and detailed findings are presented in Section 5.

generate an increase in core inflation. The increase in regional production would, in turn, lead to an improvement in the business climate and thereby a greater need for financing by firms.

❖ **Bank credit demand shock due to liquidity reasons:** In the face of multiple negative economic shocks, it's possible to observe that as the business climate deteriorates due to an unexpected decline in economic activity or its outlook, firms may seek additional credit. This action is often taken in anticipation of a sudden disruption in their cash flow or constraints in other financing sources. Such a scenario would lead to an increase in the outstanding balance of bank credit to businesses.

❖ **Bank credit supply shock:** Following Gauthier (2020), it is considered that a positive innovation in the supply of bank credit eases credit conditions, encouraging firms to apply for more bank loans. This, in turn, leads to the substitution of other financing sources, such as debt issuance.[11] Increased bank credit fosters the initiation of investment projects, thereby boosting production and regional employment. Furthermore, it is assumed that changes in banking lending conditions do not have an immediate effect on the exchange rate. This additional constraint controls for the impact that exchange rate variations have on the value of a portfolio denominated in foreign currency. Hence, changes in the balance of bank credit resulting from exchange rate fluctuations will not be interpreted as adjustments in the supply of bank credit to businesses.

The identification strategy does not allow for differentiation between traditional credit demand shocks (distinct from liquidity-related shocks, which are identified in the model) and shocks to regional demand. This is due to the challenge of separating these two factors, as both lead to increases in credit, economic activity (investment), and improvements in the business climate.[12]

A common concern when estimating a vector autoregressive model for each region is the assumption that each region operates as if it were an isolated entity. Such estimations might overlook interregional demand effects resulting from shocks in other regions. To assess the significance of interregional effects from shocks in other regions on a specific region, we refer to the Multi-State Input-Output Matrix published by INEGI in 2022. From this matrix, the Leontief inverse matrix is derived, allowing the calculation of the effects of exogenous shocks on aggregate demand, initially on gross production and subsequently on the gross value added of federal entities and regions.[13] In this context, we simulate an exogenous shock equivalent to a 1% increase in final demand for all industries across all regions.[14]

Within this analytical framework, the change in the value added (VA) of an economic sector i for a federal entity j is calculated using the following expression:

$$\Delta VAB_{i,j} = (DL)\Delta X_{i,j} \tag{3}$$

where:

- $\Delta VAB_{i,j}$: Represents a 1024×1 vector detailing changes in the VA of sector i in the federal entity j, associated with a shock in the final demand of sector i of the federal entity j.

[11] Given the lack of information on the balance of debt issuances at the regional level, it is assumed that the behavior of the annual real variation of this variable at the regional level mirrors that at the national level.

[12] Refer to Banco de México (2021a) for more insights into the difficulties of distinguishing between regional demand shocks and bank credit demand shocks.

[13] For the derivation of the Leontief inverse matrix and a more comprehensive interpretation thereof, refer to Miller, R. and P. Blair (2009). "Input-Output Analysis: Foundations and Extensions". Cambridge University Press.

[14] We recognize that the shocks' nature may vary among industries and regions, implying that the growth rate in the final demand for regional industries could differ. Nevertheless, for simplicity and illustrative purposes, we assume a uniform shock across all industries in the four regions.

- D: A 1024×1024 diagonal matrix showing the VA proportions of each sector relative to its gross production, derived from the Multi-State Input-Output Matrix.
- L: The 1024×1024 Leontief inverse matrix.
- $\Delta X_{i,j} = X_{i,j} \times 0.01$: A 1024×1 vector of final demand shocks for sector i of the federal entity j. Here, $X_{i,j}$ is the 1024×1 vector of final demand for sector i and federal entity j, scaled by a 1% increase in final demand (0.01 in decimal form).

Equation 3 is used to estimate both intraregional and interregional effects arising from an increase in final demand. Intraregional effects refer to the changes in the VA of all economic sectors within a region h (ΔVAB_{hh}), in response to changes in the final demand for that region h, as a proportion of the gross value added (GVA) of the same region (VAB_h), i.e., $\Delta VAB_{hh}/VAB_h$. Interregional effects, on the other hand, capture the changes in the GVA of a different region k (ΔVAB_{hk}), attributable to changes in the VA of the region h receiving the shock, as a proportion of the VA of region k (VAB_k), i.e., $\Delta VAB_{hk}/VAB_k$.

The outcomes of this exercise are presented in Figure 8, indicating that, in response to a shock in the final demand of each region, the intraregional impact on value added is the most relevant. This observation is logical, as it encapsulates the value-added effects on the industries where the shocks originated. The findings suggest that the trade of intermediate goods holds greater significance within regions, notwithstanding the existence of trade relations between states. Notably, these relations exhibit greater strength among neighboring states, which collectively constitute each region.

Moreover, Figure 8 illustrates that, in the scenario of a shock to the final demand in each region, there are consequential effects on the value added in other regions. Although the cumulative impact of these effects is modest, particularly in the northern region, which contributes significantly to interregional effects. Nonetheless, the simultaneous occurrence of shocks across all industries in all regions, affecting a specific region, appears somewhat implausible. As a result, we are confident that our individual estimates derived from autoregressive vector models by region remain unbiased, unaffected by the omission of shocks from other regions. Any potential bias, if present, is deemed negligible.

5. Effects of Supply and Demand Shocks on the Evolution of Bank Credit to Firms at the Regional Level

In this section, we analyze the effects of supply and demand shocks on the evolution of bank credit to firms at the regional level. Figure 9 displays, for each region, the decomposition of the deviation in the annual variation of active bank credit from its long-term average according to the estimated model.[15] The bars represent the contribution of each identified structural shock to the deviation in the annual variation of bank credit.

During the initial period of the pandemic, regional demand shocks were the main factor negatively affecting the evolution of bank credit to businesses in all regions. The negative impact of this factor was particularly significant and persistent in the central region, seemingly reflecting a more pronounced decline in economic activity and a slower recovery relative to other regions.

Starting in 2022, however, regional demand shocks became the most important drivers of the upward trend in bank credit to businesses in the central region. Demand shocks also contributed positively to the evolution of bank credit in the northern and north-central regions, while in the south their impact remained negligible.

[15] We present the impulse response function of each variable following the corresponding identified structural shock in Appendix B. In the estimation of the SVAR models, we utilize the percentage of firms that anticipate the business climate index will worsen in the following six months.

During the health crisis period, the contribution of the regional supply factor to the annual variation of bank credit to businesses was negative across all regions. This factor was the most significant in explaining the contraction of bank credit in all areas, particularly in the north. This pattern is consistent with the pandemic-induced challenges—such as input shortages and disruptions to supply chains—that affected the manufacturing sector, especially the automotive industry, which plays a crucial role in the economic activity of these regions.

It is important to note that in nearly all regions, the negative contribution of supply shocks intensified at the beginning of 2022, following the onset of the conflict between Russia and Ukraine. However, later in 2022, the adverse impact of supply shocks began to ease.

It is also estimated that during the pandemic period, the only factor that consistently contributed positively, on average, to the variation in bank credit to businesses across all regions was the increased demand for credit for liquidity reasons, which occurred primarily at the onset of the health crisis. This factor reflects that firms, anticipating adverse scenarios and tightening credit market conditions, precautionarily increased their demand for bank credit. Notably, in the southern region, this factor contributed more significantly to the annual variation of bank credit than in other regions. This could indicate that this region was relatively more reliant on tourism-related services (such as temporary accommodation, food and beverage preparation, and transportation), whose demand was particularly negatively affected by the pandemic, especially at the beginning of the health crisis. In this context, the sharp decline in anticipated sales likely forced firms in these sectors to draw more heavily on existing credit lines to meet obligations that would have been difficult to satisfy otherwise. However, starting in 2021, the positive contribution of liquidity-driven credit demand shocks reversed, which is consistent with the recovery of economic activity following the reopening of productive sectors.

We also estimated that shocks to the supply of bank credit had a negative contribution in the north-central, central, and southern regions during 2020. In the case of the north-central and southern regions, the credit supply shocks estimated by the model showed marginally positive contributions during 2022. These results should not be interpreted as widespread. According to the Bank of Mexico's third-quarter 2023 report, although there was a moderate and initial easing of lending conditions by banks with significant participation in small and medium-sized non-financial enterprises in 2022, lending conditions remained tight for large firms.

Finally, given the underidentified nature of our SVAR model, other unspecified shocks also help explain the remaining portion of the surge in bank credit observed in March and April 2020. In the context of the substantial uncertainty prevailing at the onset of the pandemic, several additional factors may have encouraged large firms to draw more intensively on pre-existing credit lines. However, starting in 2021, the initially positive contribution of these other shocks reversed, turned negative, and subsequently diminished across nearly all regions.

Importantly, in identifying the regional credit supply shock, we relied on the issuance of debt by firms at the national level. However, an alternative approach could involve using information on interest rates for new bank loans, available in Report R04-C from the National Banking and Securities Commission (CNBV, by its Spanish acronym), albeit with access restricted to the last ten years of such data.[16] Incorporating these interest rates allows the identification of the bank credit supply shock to hinge on movements in asset prices, rather than on the substitution between available financing sources for issuing firms. In this specification, the volume of corporate bond issuance is replaced by the intermediation margin of bank credit to firms. Under this framework, the identification of the bank credit supply shock requires a counter-movement between the evolution of credit extended and the differential between the interest rate on new loans to firms and the bank funding rate.

[16] For more detailed information on this alternative identification strategy, please consult Banco de México (2021a).

In this scenario, a negative innovation in lending conditions would sharply increase the bank intermediation margin, leading to a contraction in credit provision. Consequently, this would reduce the funds available for working capital and investment, potentially resulting in a decline in economic activity. While Banco de México (2021a) reported that, at the national level, the results obtained using debt issuances or interest rates were qualitatively similar, the possibility of using future information on interest rates for new bank loans by region to identify regional credit supply shocks is not ruled out.

5.1. National Validation Exercise

To assess the consistency of the regional identification strategy and evaluate whether the structural shocks inferred from regional dynamics align with those obtained from an explicitly national specification, a national version of the SBVAR model was also estimated.

In this national model, three variables were constructed directly from their regional counterparts. The *annual variation of the outstanding balance of bank credit to firms at a regional level in real terms* was aggregated across regions to obtain national real bank credit growth. The *annual variation of formal regional employment from IMSS* was summed across regions to construct national formal employment growth. The *annual growth rate of regional core CPI* was computed using a weighted average of regional core inflation rates, where the weights correspond to each region's participation in the national CPI basket.

The remaining variables included in the regional specification already existed at the national level and were incorporated directly: the *average bank funding interest rate*, the *national business climate index for the next six months*, the *annual real variation of the balance of debt in the domestic market of issuing firms*, and the *annual variation of the exchange rate in pesos per US dollar*.

Additionally, as a robustness exercise, the national model was re-estimated by replacing formal employment with the *Índice Global de la Actividad Económica* (IGAE) as a broader measure of economic activity. The impulse responses obtained using IGAE remained qualitatively similar.

The results of the national validation exercise and the IGAE-based robustness check are presented in Panels (a) and (b) of Figure 10.

The national results indicate that aggregate demand shocks—which affect the traditional component of credit demand—imposed a significant negative contribution during 2020, consistent with the sharp decline in firms' financing needs for investment in physical capital. As the economic recovery progressed, the adverse contribution of these shocks gradually reversed, and starting in 2022 they began to exert a positive influence on bank credit growth, a pattern that persisted until mid-2023.

Aggregate supply shocks also contributed to the weak performance of bank credit since the onset of the pandemic, reflecting the exceptional contraction in economic activity experienced by the country. In addition, credit supply shocks exerted negative pressures on bank lending to firms from 2020 through 2022, consistent with a higher counterparty risk perceived by banks amid the intensity and simultaneity of the shocks affecting economic activity during this period.

The marked increase in bank credit observed in March and April 2020 corresponds primarily to liquidity-driven credit demand shocks, reflecting that firms—particularly large firms—made intensive use of pre-existing credit lines to confront sudden income shortfalls and secure operational liquidity. However, the contribution of these shocks reversed sharply during 2021 and 2022 as economic activity normalized and precautionary financing needs diminished.

As in the regional analysis, additional unidentified shocks account for the remaining portion of the rise in bank credit during March and April 2020. Given the high uncertainty surrounding the economic environment at the onset of the pandemic, various additional factors likely influenced firms' decisions to draw down pre-approved credit lines more aggressively. Subsequently, during 2022 and 2023, the contribution of these shocks turned negative, consistent with the normalization of financing conditions.

Importantly, the national results closely resemble the regional findings, particularly those of the central region, which concentrates the largest share of bank credit to firms nationwide. This alignment reinforces the consistency of the regional approach and its ability to capture the main drivers of bank credit dynamics in Mexico.

6. Concluding Remarks

Bank credit to firms plays a central role in supporting economic activity by financing productive investment and providing working capital for day-to-day operations. Its evolution in Mexico has been noteworthy: between 2005 and 2023, the ratio of bank credit to firms increased from 4.2% to nearly 10% of GDP. However, the regional distribution of this credit remains highly uneven, with a higher concentration in the central region and a markedly lower share in the south.

The evolution of bank credit during the pandemic reveals important differences in the effects of supply and demand shocks across regions and across credit and goods-and-services markets. During the early stages of the pandemic (April–May 2020), all regions exhibited a positive deviation in the annual real-adjusted rate of bank credit to firms, with the increase particularly pronounced in the south. This pattern is consistent with a liquidity-driven demand shock, reflecting firms' precautionary use of credit lines in anticipation of a deteriorating economic environment.

Starting in 2022, the evolution of bank credit has been primarily shaped by shocks to economic activity. Positive contributions from aggregate demand shocks emerged across all regions, with stronger and more persistent effects in the central region. Although demand shocks played a dominant role, regional supply shocks tempered the expansion of bank credit—especially in the northern and southern regions—consistent with lingering disruptions in production costs and supply chains. While these supply shocks have gradually eased, their interaction with demand conditions has remained an important driver of credit dynamics.

An additional contribution of this paper is the national robustness exercise, in which we construct national counterparts of the regional variables and estimate an aggregate SBVAR model. The resulting national historical decomposition of the bank credit growth rate closely resembles that of the central region, which is consistent with the fact that this region concentrates the largest share of bank credit to firms nationwide. This alignment reinforces the internal consistency of the regional identification strategy and provides external validation for the main findings.

Looking ahead, several avenues for future research could further enhance the understanding of regional credit dynamics. One promising direction involves identifying credit supply shocks using interest rates on new bank loans, based on information available in Report R-04C. Another is to expand the analysis to incorporate additional shocks—such as external or monetary shocks—to provide a more comprehensive characterization of the forces driving bank credit to firms in Mexico. Advancing along these lines would contribute to a deeper and more complete assessment of the mechanisms shaping credit behavior across regions.

Figure 1: **Mexican regions.**
Source: Banco de México.

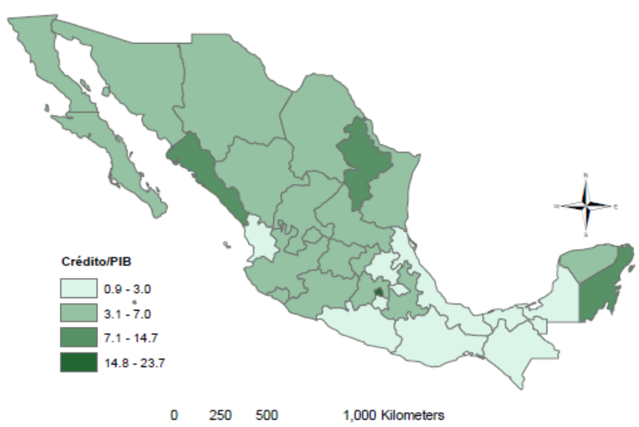


Figure 2: **Bank credit to non-financial private firms as a fraction of GDP, by state in 2021 (in percent).**
Notes: Bank credit to non-financial private firms excludes subsidiaries of regulated SOFOMES (Multiple-Purpose Financial Institutions) affiliated with banking institutions and financial groups. The figures are not adjusted for the effects of exchange rate variations because the necessary disaggregated information at the regional level is unavailable.
Source: Own calculations using data from INEGI and Banco de México (2021).

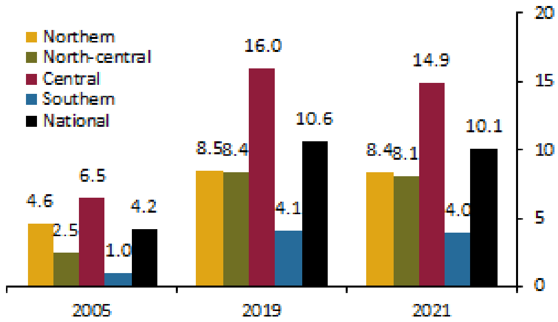


Figure 3: **Bank credit to non-financial private firms as a fraction of GDP, by state over time (in percent).**
Notes: Bank credit to non-financial private firms excludes subsidiaries of regulated SOFOMES (Multiple-Purpose Financial Institutions) affiliated with banking institutions and financial groups. The figures are not adjusted for the effects of exchange rate variations because the necessary disaggregated information at the regional level is unavailable.
Source: Own calculations using data from INEGI and Banco de México.

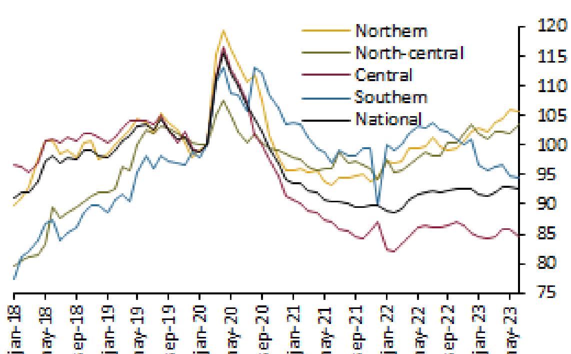


Figure 4: **Bank credit to non-financial private firms (Index Feb 2020 = 100).**
Notes: Bank credit to non-financial private firms excludes subsidiaries of regulated SOFOMES (Multiple-Purpose Financial Institutions) affiliated with banking institutions and financial groups.The figures are not adjusted for the effects of exchange rate variations because the necessary disaggregated information at the regional level is unavailable.
Source: Own calculations using data from Banco de México.

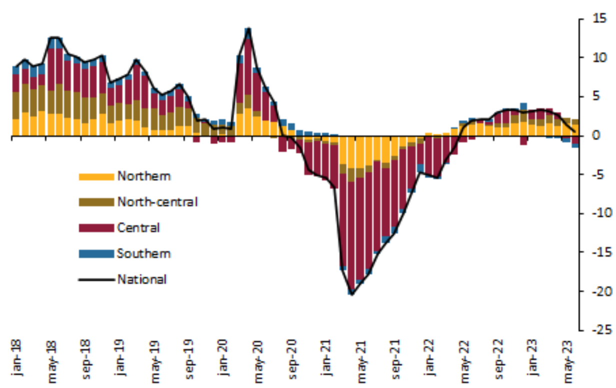
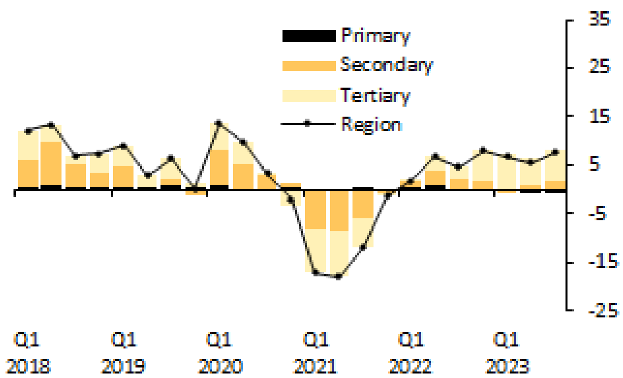


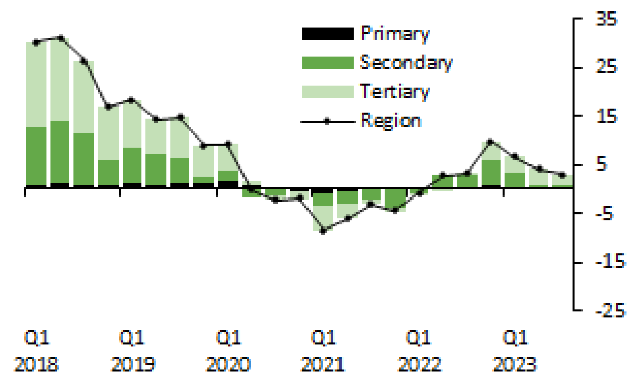
Figure 5: **Regional contribution to the real annual growth rate of regional bank credit to non-financial private firms (in percentage points).**

Notes: Bank credit to non-financial private firms excludes subsidiaries of regulated SOFOMES (Multiple-Purpose Financial Institutions) affiliated with banking institutions and financial groups. The figures are not adjusted for the effects of exchange rate variations because the necessary disaggregated information at the regional level is unavailable.

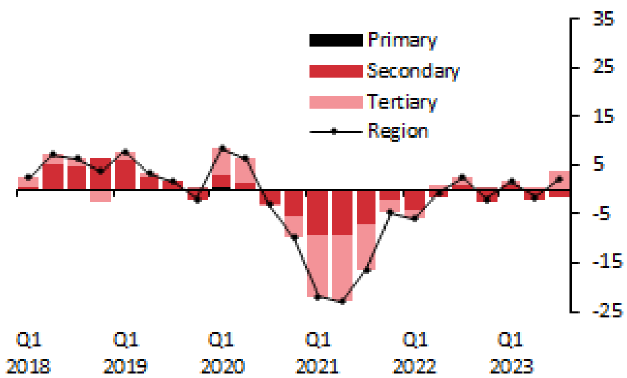
Source: Own calculations using data from Banco de México.



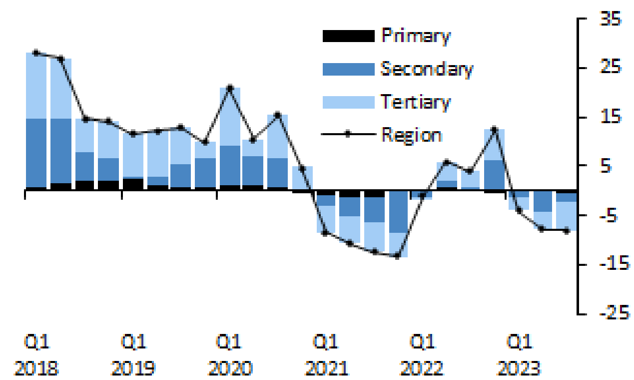
(a) Northern



(b) North-Central



(c) Central

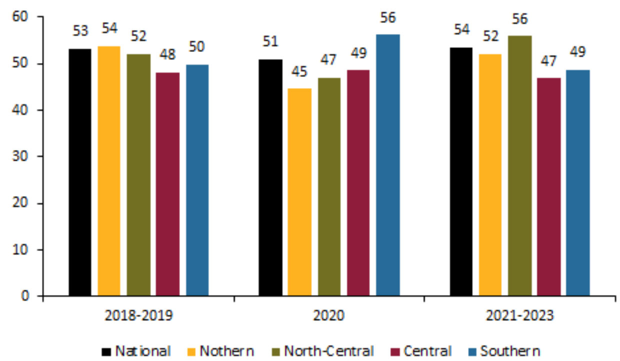


(d) Southern

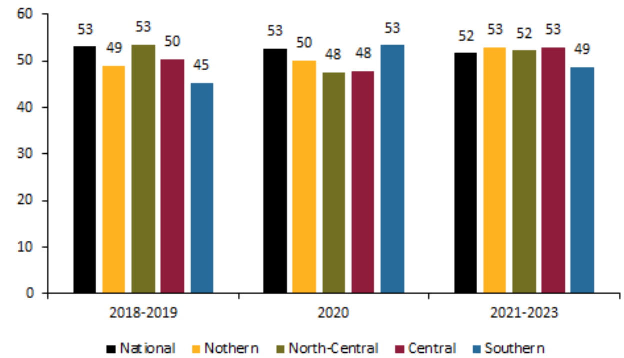
Figure 6: **Sectoral contribution to the real annual growth rate of regional bank credit to non-financial private firms (in percentage points).**

Notes: Bank credit to non-financial private firms excludes subsidiaries of regulated SOFOMES (Multiple-Purpose Financial Institutions) affiliated with banking institutions and financial groups. The figures are not adjusted for the effects of exchange rate variations because the necessary disaggregated information at the regional level is unavailable.

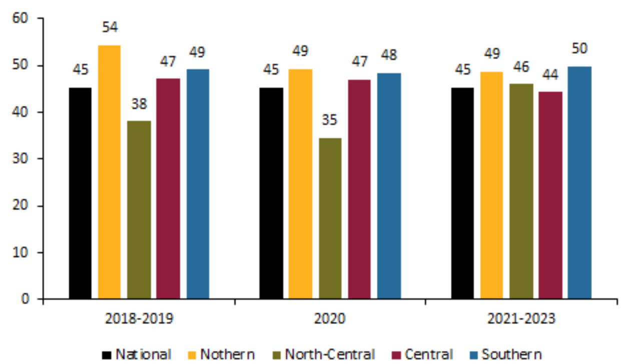
Source: Own calculations using data from Banco de México.



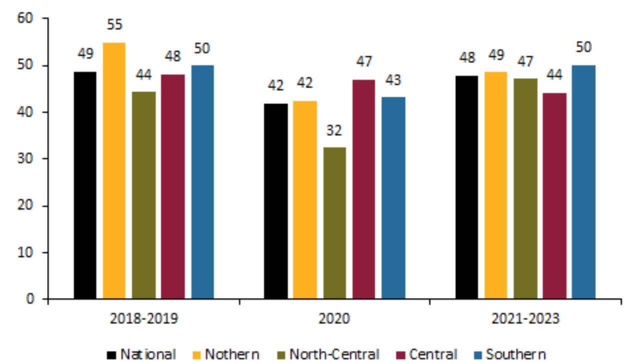
(a) Offered amounts



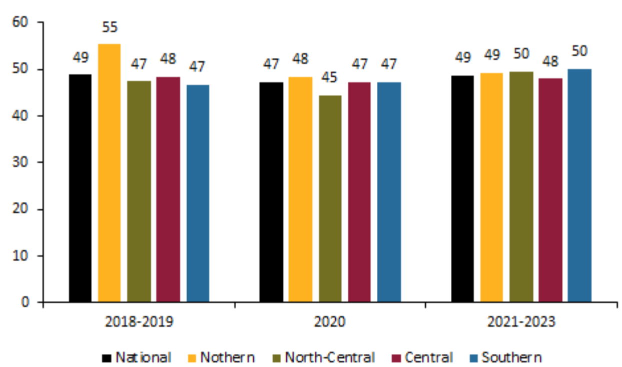
(b) Terms



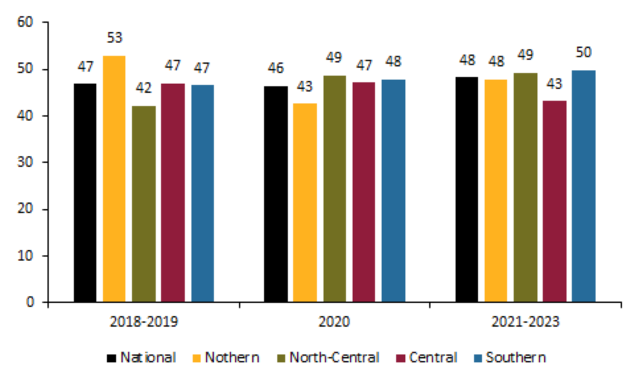
(c) Collateral requirements



(d) Credit resolution times



(e) Conditions for refinancing loans



(f) Other criteria imposed by banks

Figure 7: **Median of regional diffusion indices related to perceptions of conditions for accessing bank credit.**
Notes: The diffusion index is defined as the sum of the percentage of firms that mentioned more accessible conditions, plus half of the percentage of firms that indicated no changes in access conditions. Under this metric, when the diffusion index value is higher (lower) than 50, it means that a greater number of firms reported perceiving more accessible (less accessible) conditions in the relevant variable compared to the situation observed in the previous quarter.
Source: Own calculations using data from Banco de México.

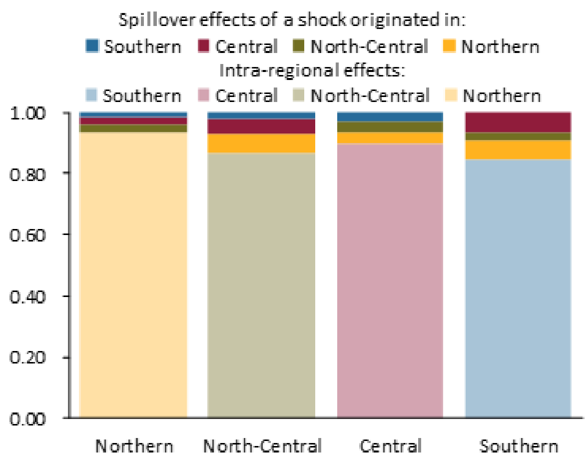


Figure 8: **Intra and inter-regional effects on regional value-added following a regional final demand shock (in percent).**
Source: Own estimates using data from INEGI.

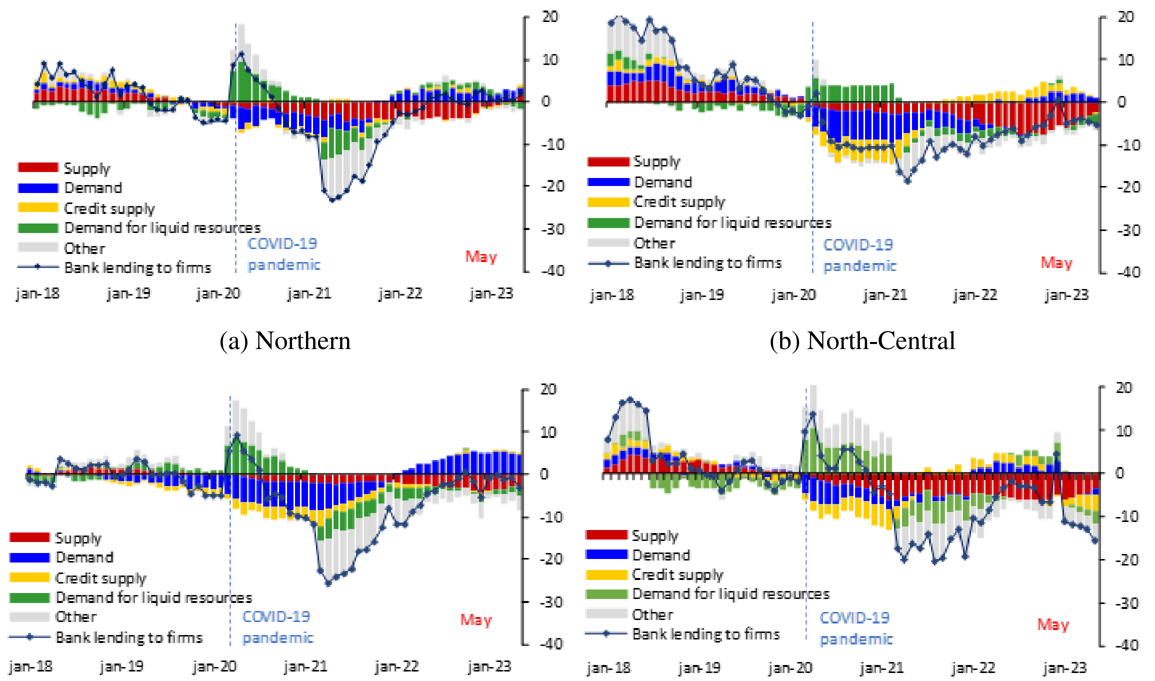
	Regional Supply		**Regional Demand**		**Credit Supply**		**Liquid Resources Demand**	
	Impact	Lagged	Impact	Lagged	Impact	Lagged	Impact	Lagged
Regional Economic Activity		+	+	+	+	+		-
Regional Core Inflation	-	-	+	+				
Funding Rate				+				
Business Climate			+				-	
Regional Bank Credit		+		+	+	+	+	+
Debt Balance of Issuing Firms		+		+	-	-		
Exchange Rate								

Table 1: **Identification strategy.**
Notes: A "+" signifies that the endogenous variables respond positively on impact following a positive structural shock, while a "-" indicates a negative impact response of the endogenous variable to that positive shock. A "0" indicates no contemporaneous response of the endogenous variable, and an empty cell indicates our agnosticism regarding the contemporaneous response of the variable, allowing the data to freely speak. The identification strategy posits that the delayed effect on each of the indicated variables manifests itself three months after the occurrence of the corresponding shock.

Figure 9: **Historical decomposition of the bank credit to firms.**

Notes: The black line denotes the deviation of the real annual growth rate of bank credit to firms from its long-term mean. The long-term mean corresponds to the period spanning January 2006 to May 2023. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition.

Source: Own estimates using data from INEGI, and Banco de México.



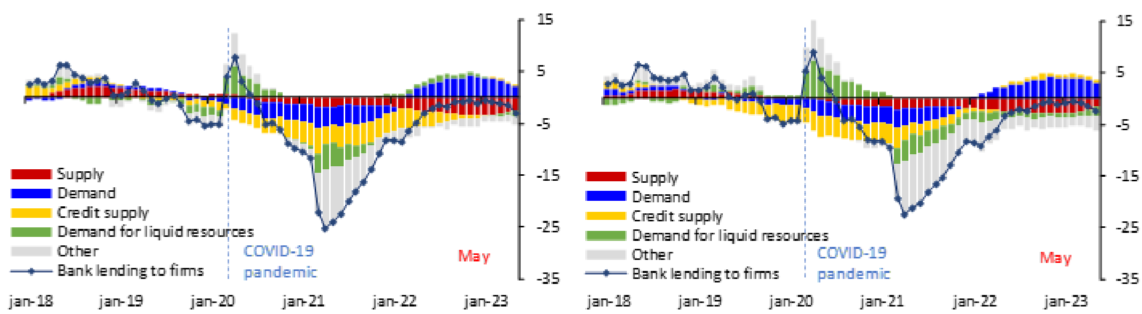
(a) Northern (b) North-Central

(c) Central (d) Southern

Figure 10: **Historical decomposition of the bank credit to firms.**

Notes: The black line denotes the deviation of the real annual growth rate of bank credit to firms from its long-term mean. The long-term mean corresponds to the period spanning January 2006 to May 2023. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition.

Source: Own estimates using data from INEGI, and Banco de México.



(a) National estimates using IGAE (b) National estimates using employment

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Appendix

A. Historical Suggestion Analysis

The historical decomposition analysis of the shocks and the deterministic part is performed using the following equations:

$$y_t = \mu_t + \sum_{i=1}^{p} B_i y_{t-i} + u_t, \tag{A.1}$$

where y_t is the $N \times 1$ vector of endogenous variables, μ_t is the $N \times 1$ vector of deterministic terms, B_i is the $N \times N$ matrix of lag coefficients for $i = 1, \ldots, p$, p is the number of lags, and u_t is the $N \times 1$ vector of residuals.

The structural shocks can be expressed as:

$$\epsilon_t = A^{-1} u_t, \tag{A.2}$$

where A^{-1} is the inverse of the parameter matrix A.

The contribution of each structural shock $\epsilon_{i,t}$ to the endogenous variable j at time t can be calculated as:

$$\Delta y_{j,t}^{i} = \sum_{k=0}^{p-i} (B_{i+k} - B_k) j, :\epsilon i, t, \tag{A.3}$$

where $(B_{i+k} - B_k) j, :$ is the j^{th} row of the matrix $(Bi + k - B_k)$.

The total contribution of all structural shocks to the endogenous variable j at time t can be calculated as:

$$\Delta y_{j,t}^{shocks} = \sum_{i=1}^{p} \Delta y_{j,t}^{i}. \tag{A.4}$$

The contribution of the deterministic terms to the endogenous variable j at time t can be calculated as:

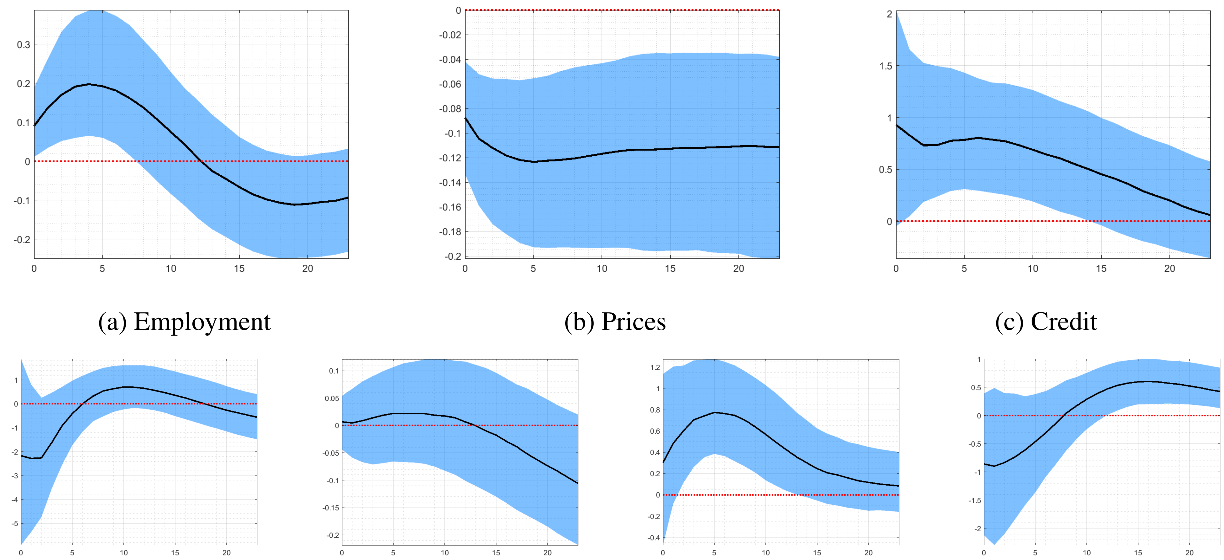
$$\Delta y_{j,t}^{deterministic} = \mu_{j,t} - \mu_{j,t-1}. \tag{A.5}$$

The total contribution of all shocks and the deterministic terms to the endogenous variable j at time t can be calculated as:

$$\Delta y_{j,t} = \Delta y_{j,t}^{shocks} + \Delta y_{j,t}^{deterministic}. \tag{A.6}$$

These equations provide the historical decomposition of shocks and the deterministic part, which allows us to analyze the contribution of each structural shock and deterministic term to the behavior of the endogenous variables over time.

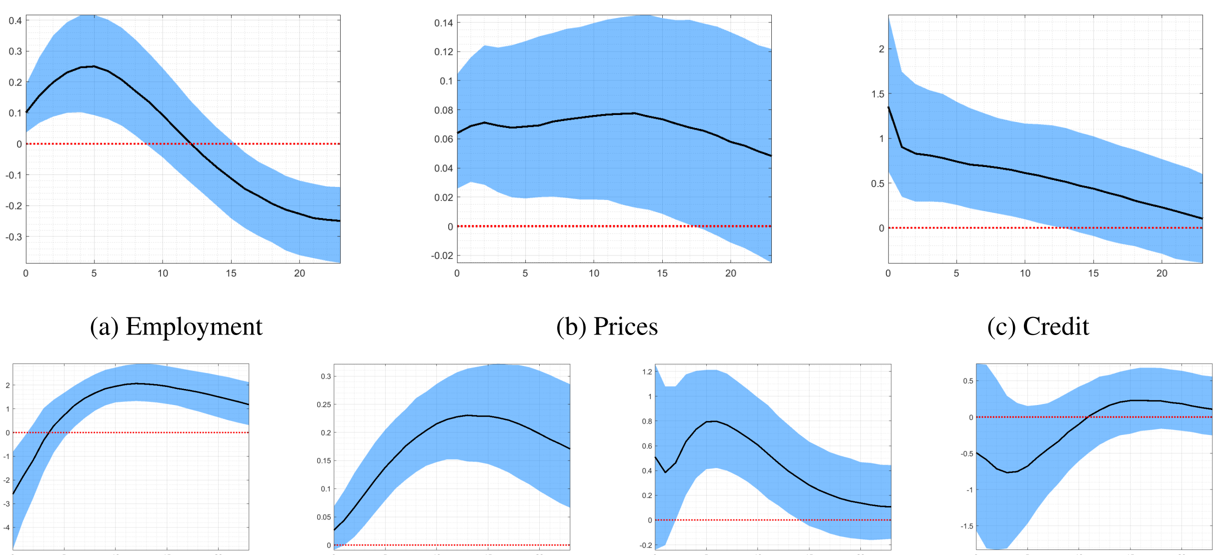
B. Impulse Response Functions



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

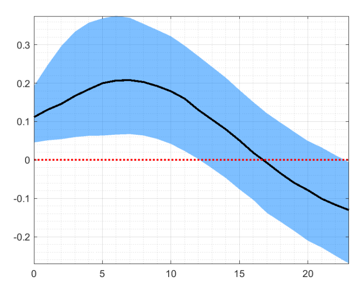
Figure B1: **(Northern Region). Impulse response functions of each variable following a regional supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
Notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



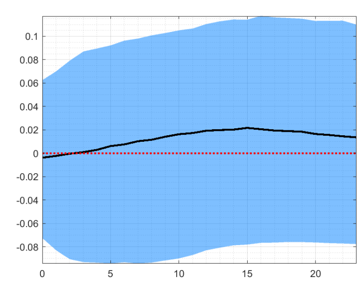
(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

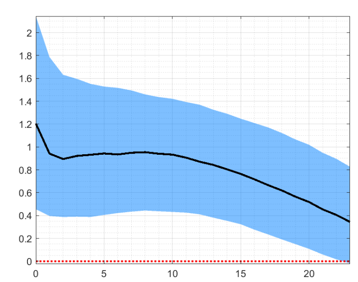
Figure B2: **(Northern Region). Impulse response functions of each variable following a regional demand shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



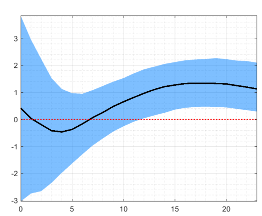
(a) Employment



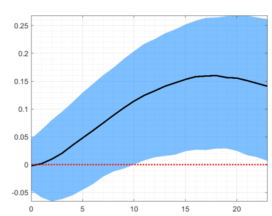
(b) Prices



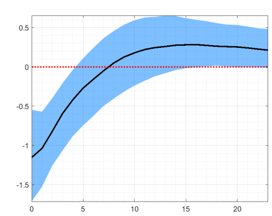
(c) Credit



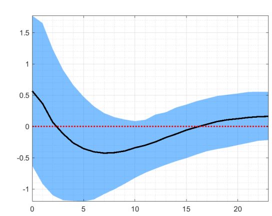
(d) BCI



(e) Interest rate

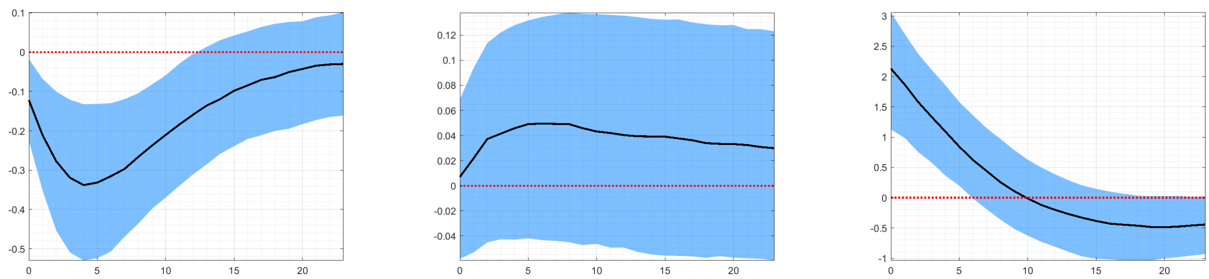


(f) Emissions

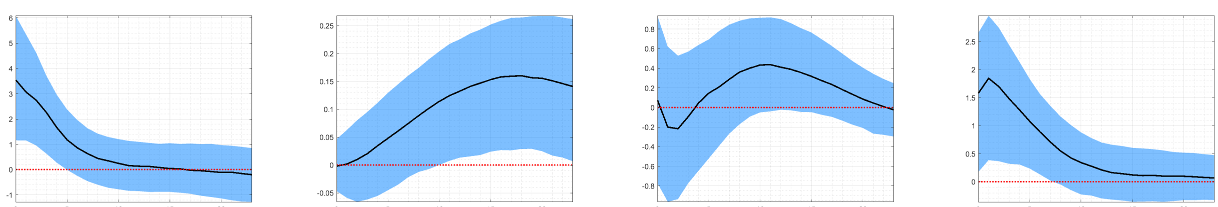


(g) Exchange rate

Figure B3: **(Northern Region). Impulse response functions of each variable following a credit supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

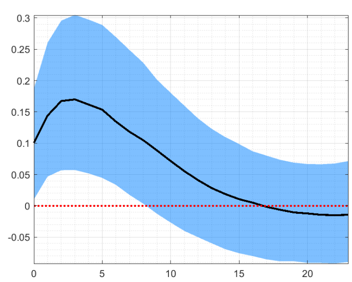


(a) Employment (b) Prices (c) Credit

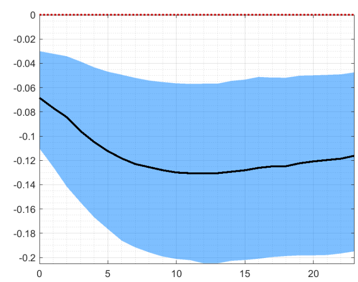


(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

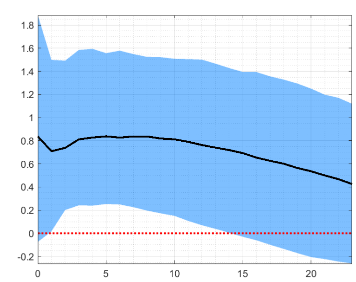
Figure B4: **(Northern Region). Impulse response functions of each variable following a bank credit demand shock due to liquidity reasons.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



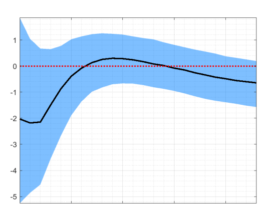
(a) Employment



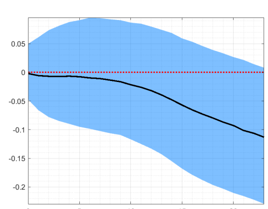
(b) Prices



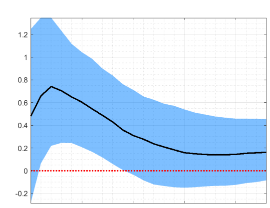
(c) Credit



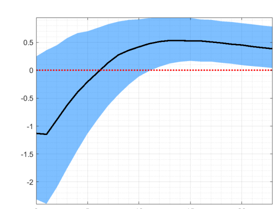
(d) BCI



(e) Interest rate

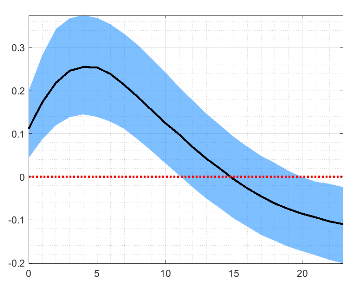


(f) Emissions

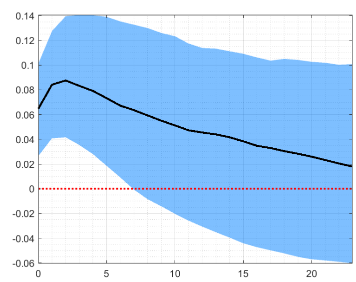


(g) Exchange rate

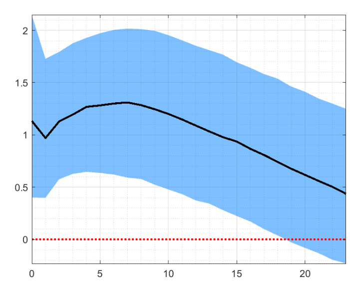
Figure B5: **(North-Central Region). Impulse response functions of each variable following a regional supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



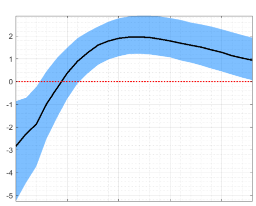
(a) Employment



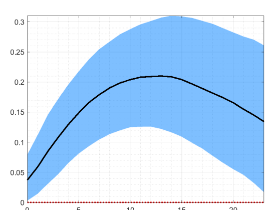
(b) Prices



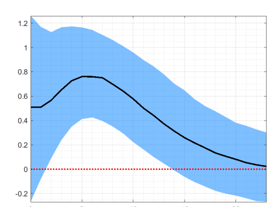
(c) Credit



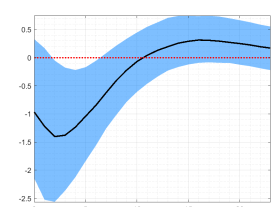
(d) BCI



(e) Interest rate

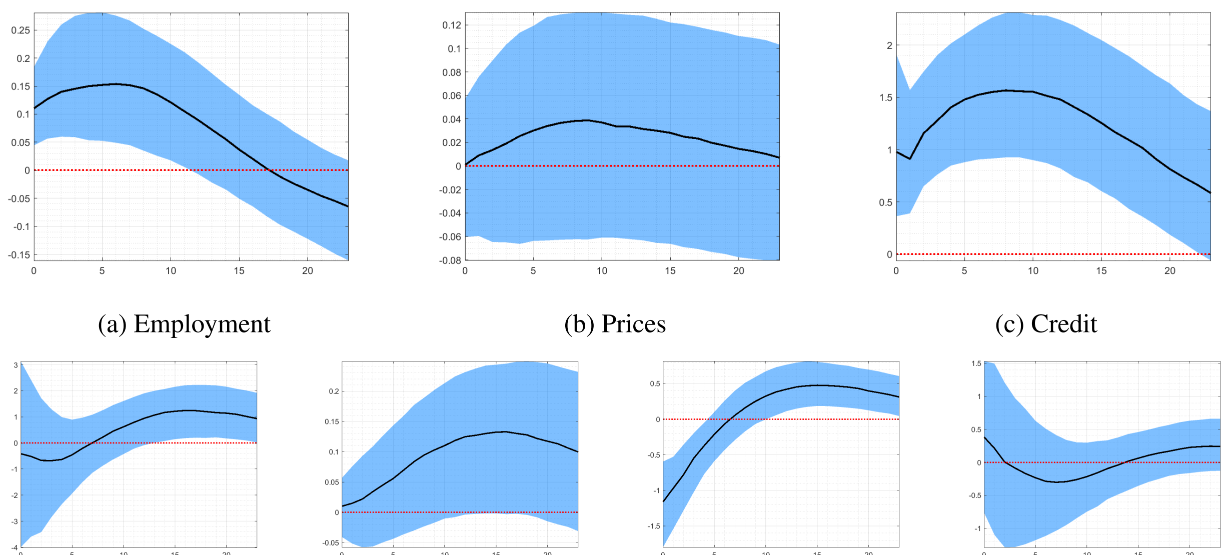


(f) Emissions



(g) Exchange rate

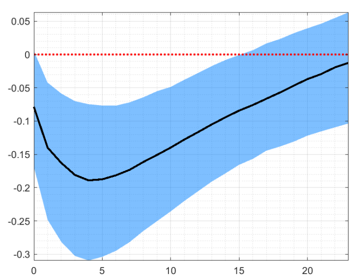
Figure B6: **(North-Central Region). Impulse response functions of each variable following a regional demand shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



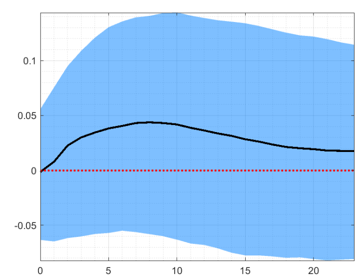
(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

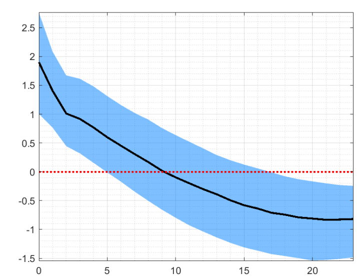
Figure B7: **(North-Central Region). Impulse response functions of each variable following a credit supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



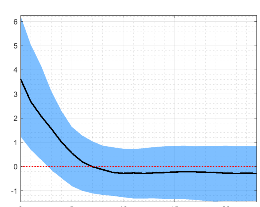
(a) Employment



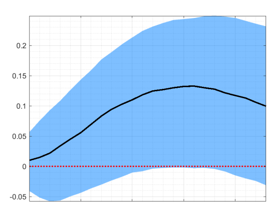
(b) Prices



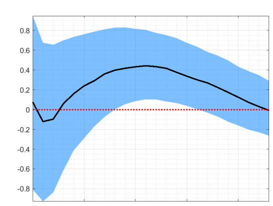
(c) Credit



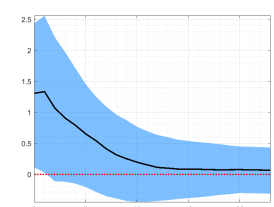
(d) BCI



(e) Interest rate

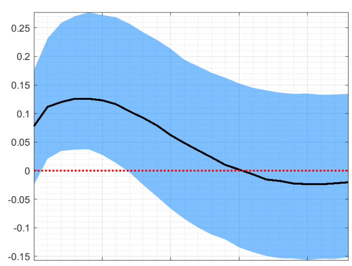


(f) Emissions

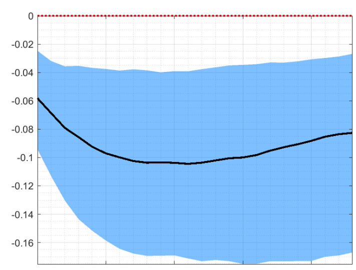


(g) Exchange rate

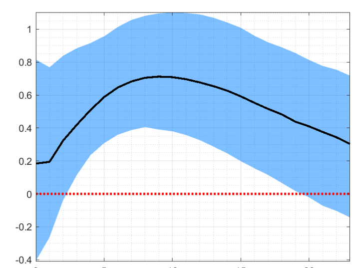
Figure B8: **(North-Central Region). Impulse response functions of each variable following a bank credit demand shock due to liquidity reasons.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



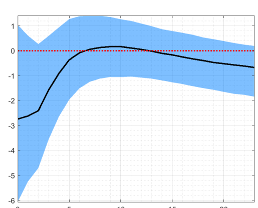
(a) Employment



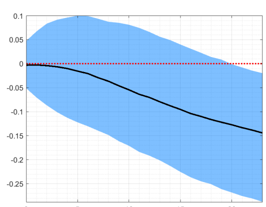
(b) Prices



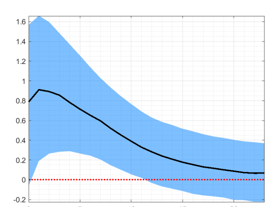
(c) Credit



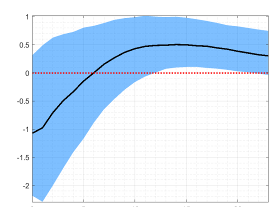
(d) BCI



(e) Interest rate

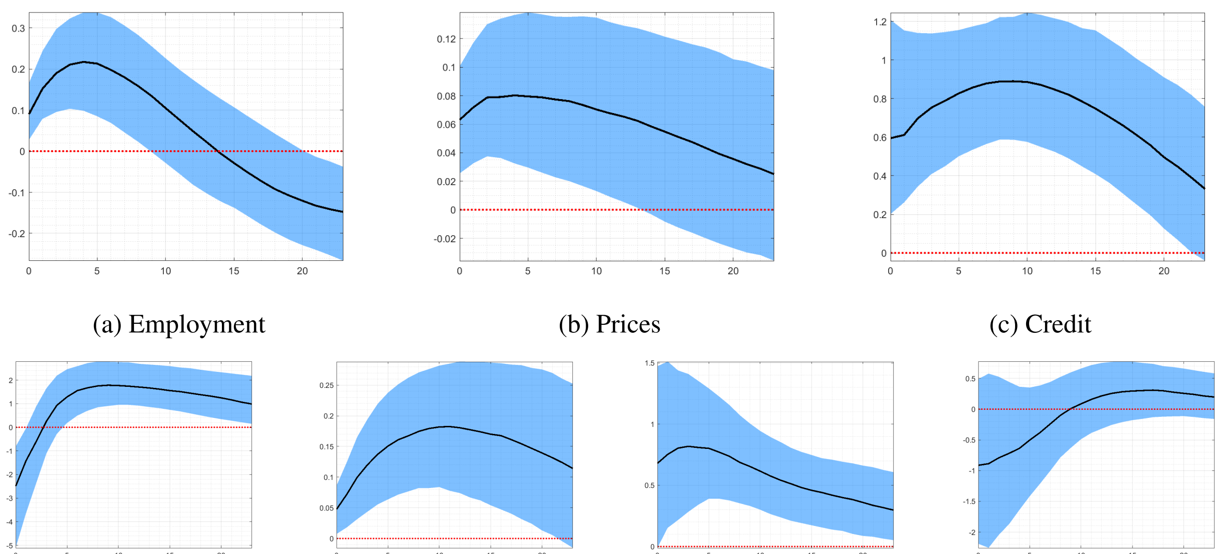


(f) Emissions



(g) Exchange rate

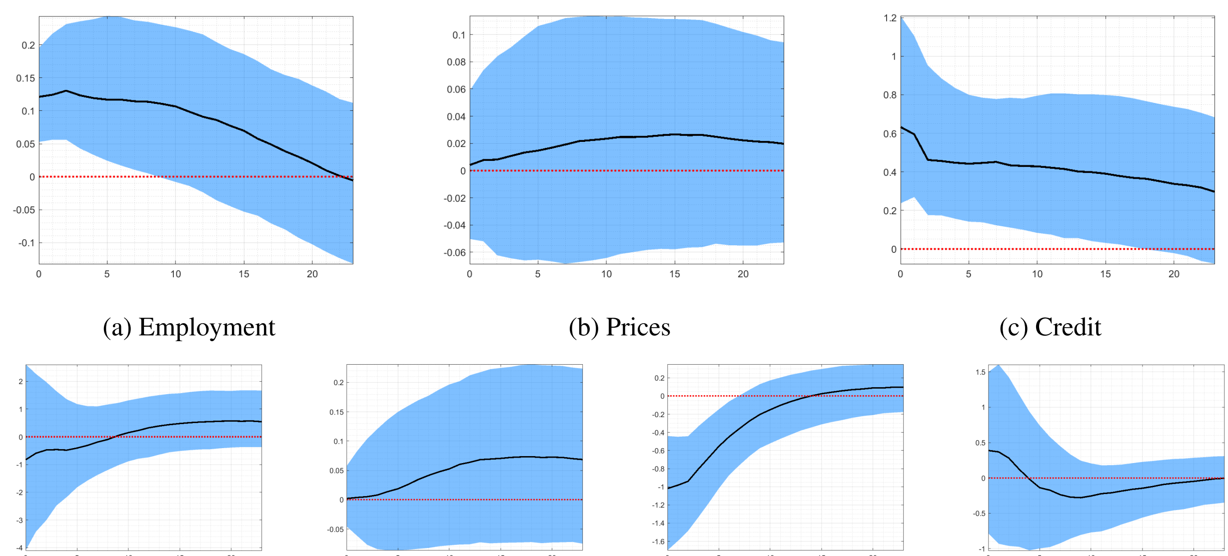
Figure B9: **(Central Region). Impulse response functions of each variable following a regional supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

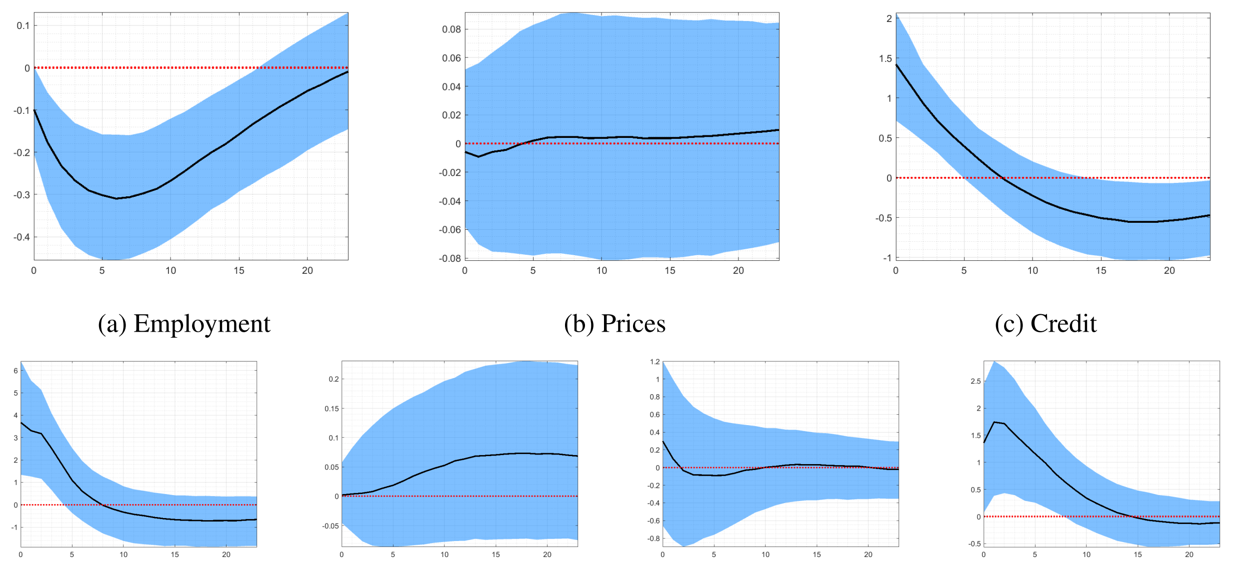
Figure B10: **(Central Region). Impulse response functions of each variable following a regional demand shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

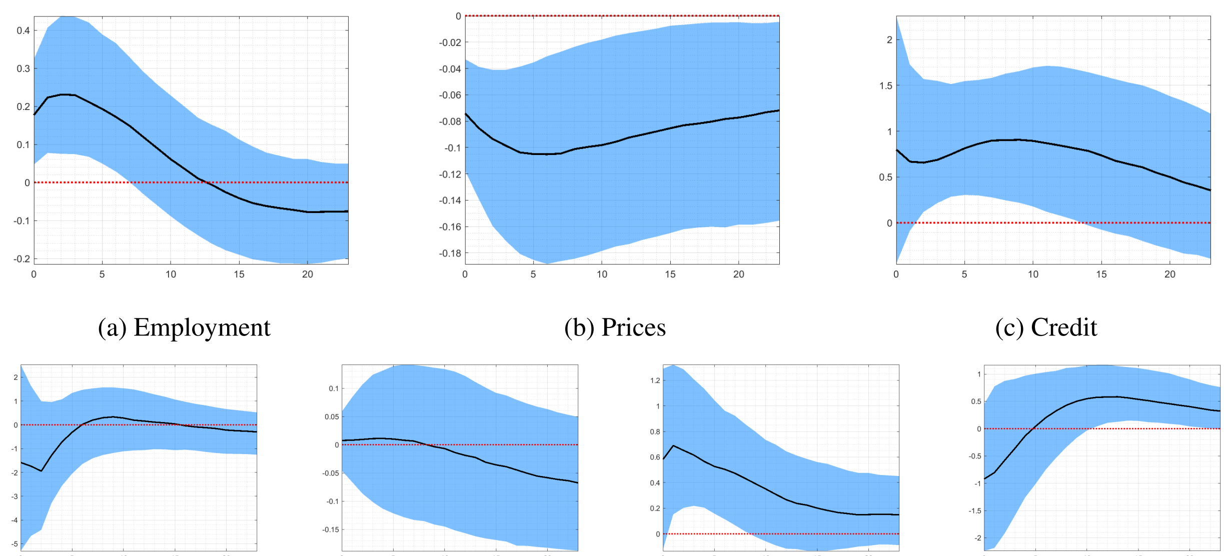
Figure B11: **(Central Region). Impulse response functions of each variable following a credit supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

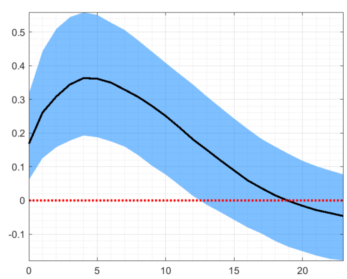
Figure B12: **(Central Region). Impulse response functions of each variable following a bank credit demand shock due to liquidity reasons.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



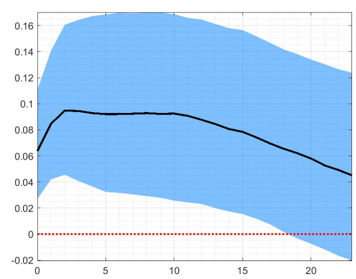
(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

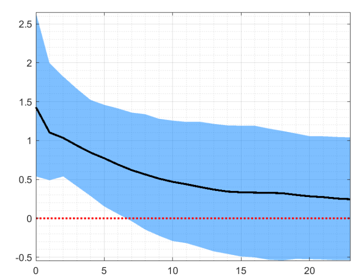
Figure B13: **(Southern Region). Impulse response functions of each variable following a regional supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



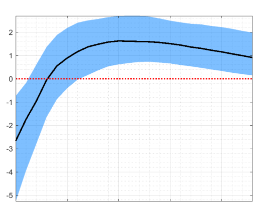
(a) Employment



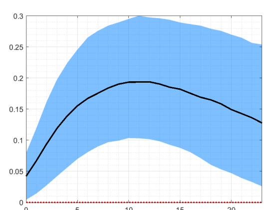
(b) Prices



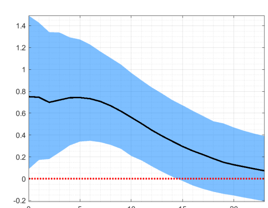
(c) Credit



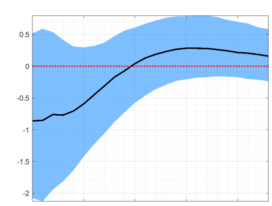
(d) BCI



(e) Interest rate

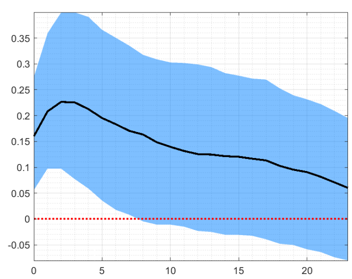


(f) Emissions

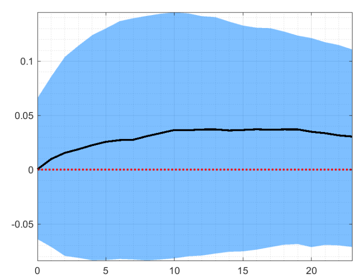


(g) Exchange rate

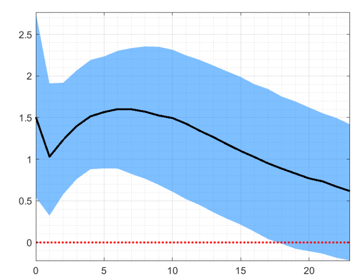
Figure B14: **(Southern Region). Impulse response functions of each variable following a regional demand shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



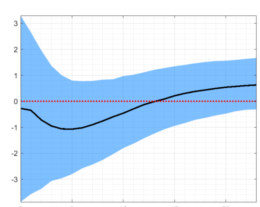
(a) Employment



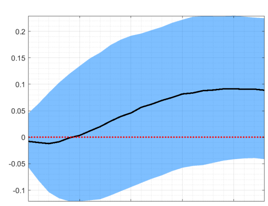
(b) Prices



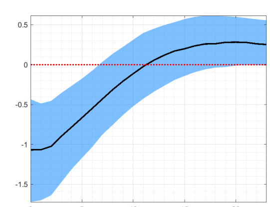
(c) Credit



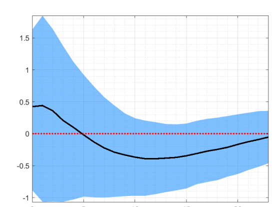
(d) BCI



(e) Interest rate

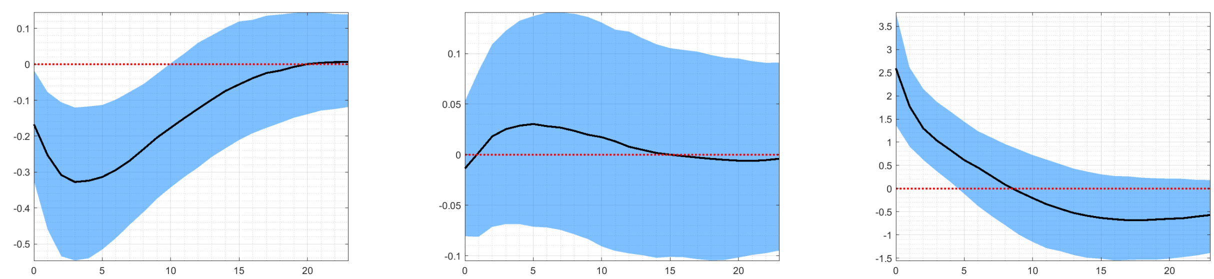


(f) Emissions

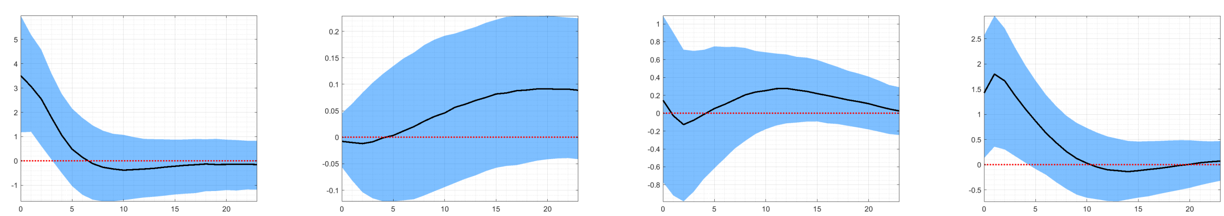


(g) Exchange rate

Figure B15: **(Southern Region). Impulse response functions of each variable following a credit supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

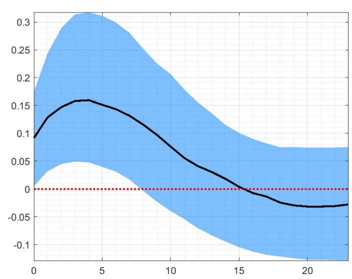


(a) Employment (b) Prices (c) Credit

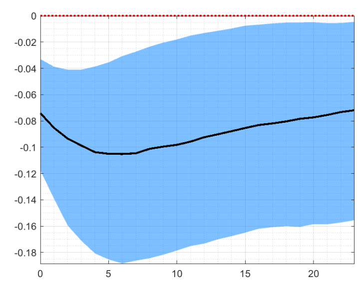


(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

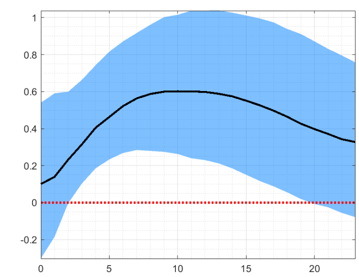
Figure B16: **(Southern Region). Impulse response functions of each variable following a bank credit demand shock due to liquidity reasons.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.



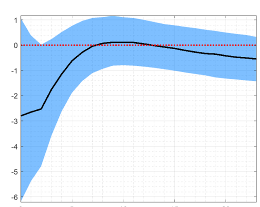
(a) Employment



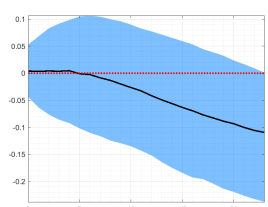
(b) Prices



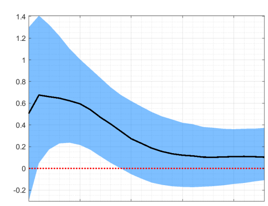
(c) Credit



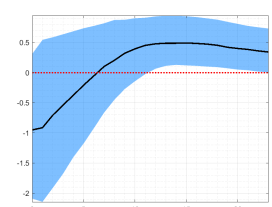
(d) BCI



(e) Interest rate

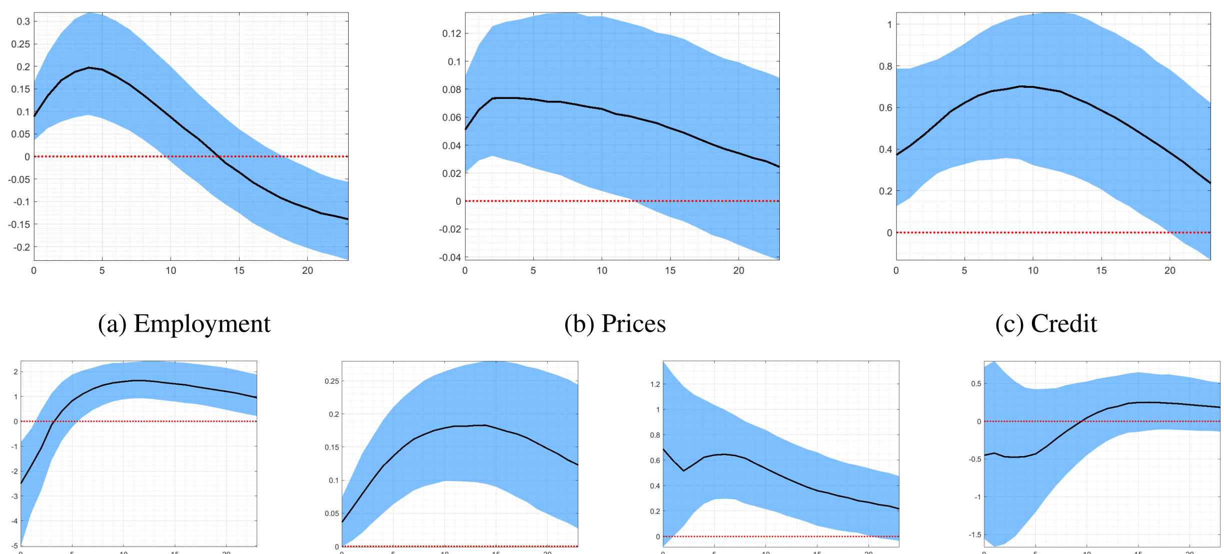


(f) Emissions



(g) Exchange rate

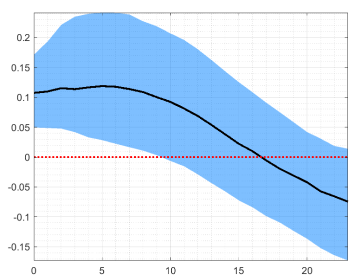
Figure B17: **(National Level). Impulse response functions of each variable following a aggregate supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation formal employment is used as economic activity.



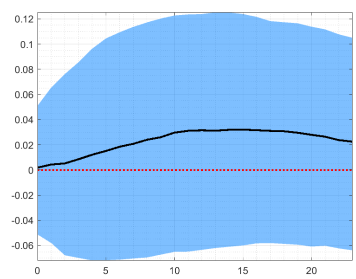
(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

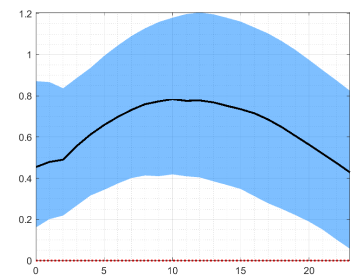
Figure B18: **(National Level). Impulse response functions of each variable following an aggregate demand shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation formal employment is used as economic activity.



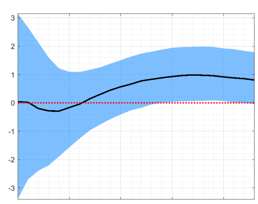
(a) Employment



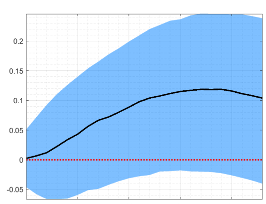
(b) Prices



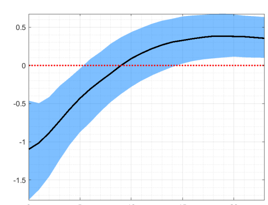
(c) Credit



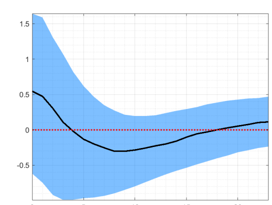
(d) BCI



(e) Interest rate

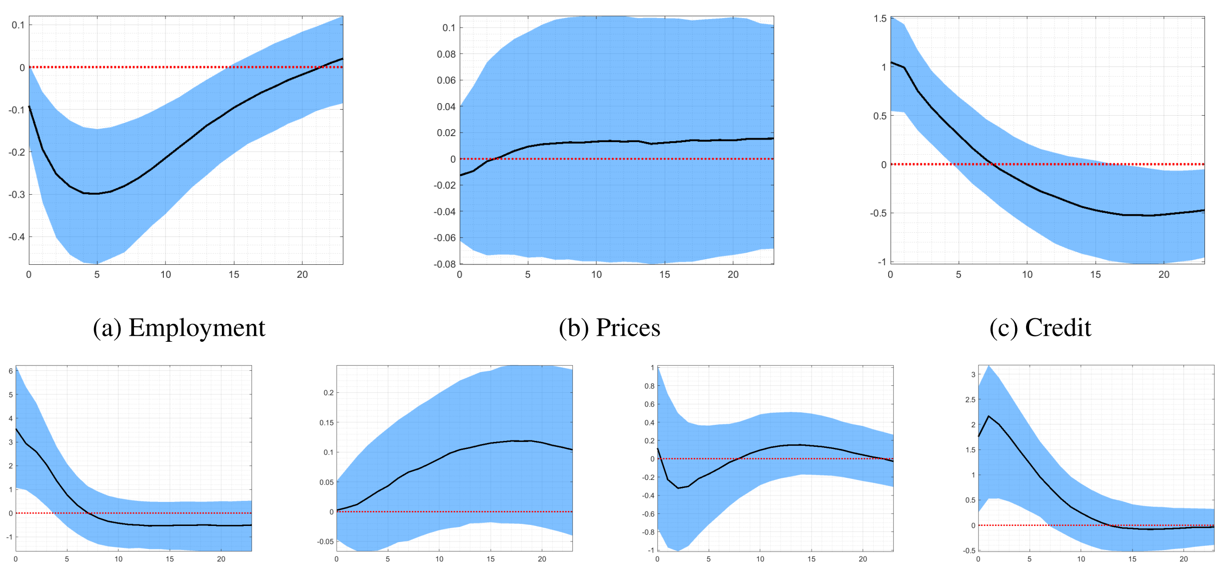


(f) Emissions



(g) Exchange rate

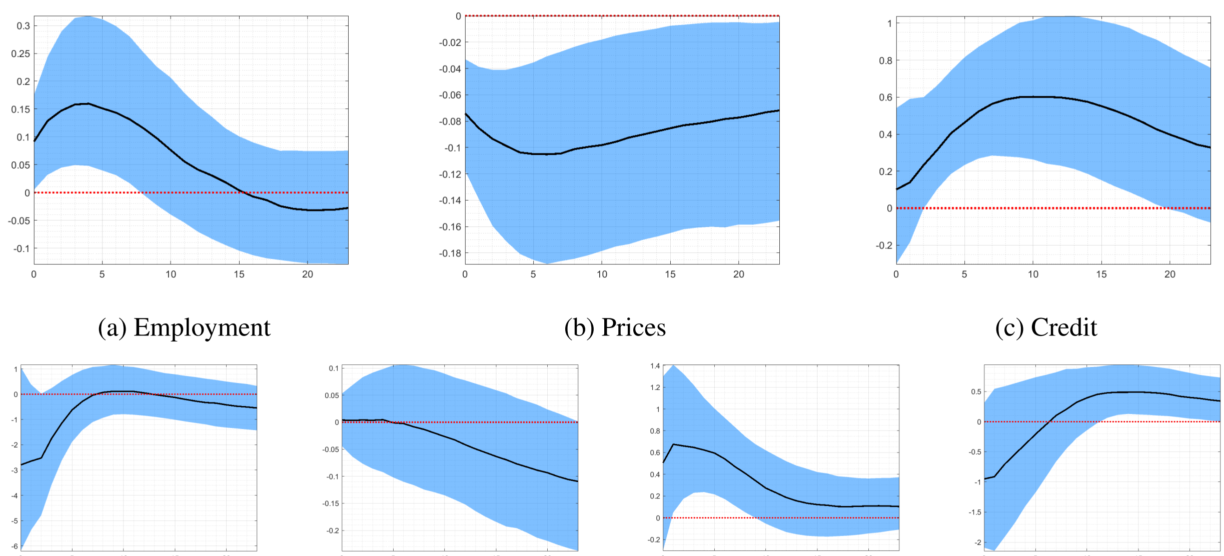
Figure B19: **(National Level). Impulse response functions of each variable following a credit supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation formal employment is used as economic activity.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

Figure B20: **(National Level). Impulse response functions of each variable following a bank credit demand shock due to liquidity reasons.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation formal employment is used as economic activity.



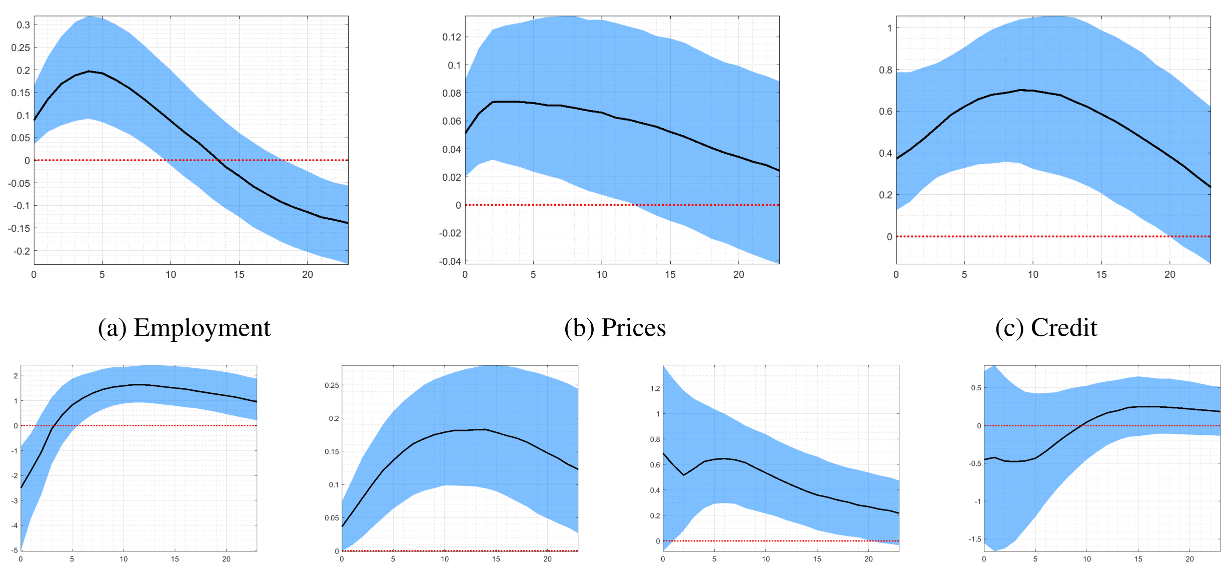
(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

Figure B21: **(National Level). Impulse response functions of each variable following an aggregate supply shock.**

Source: Own estimates based on data from INEGI, and Banco de México.

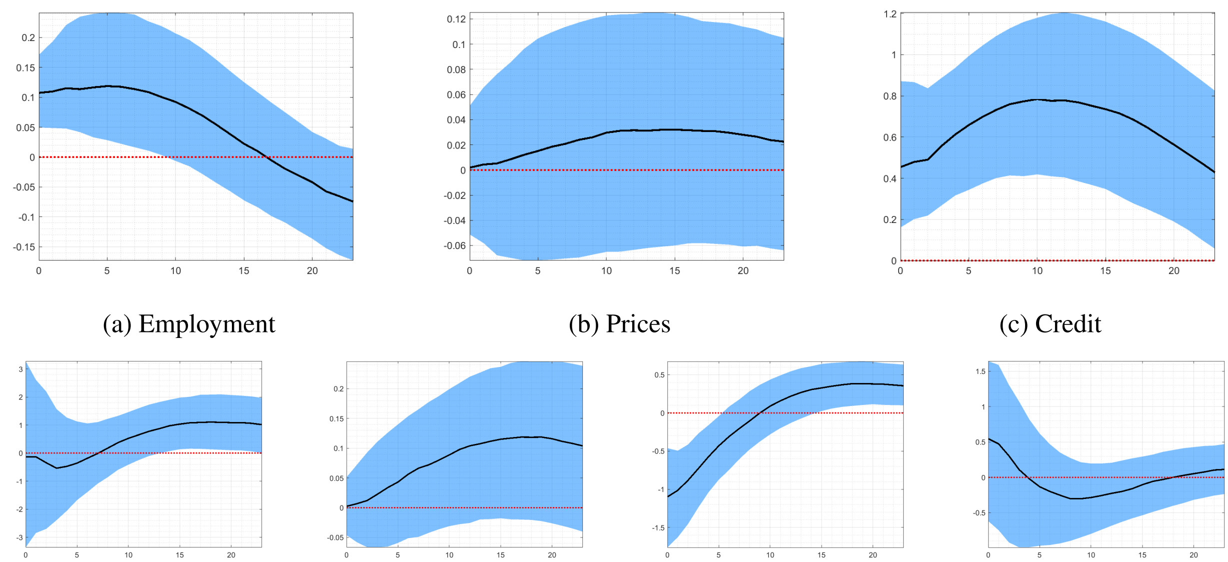
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation, IGAE is used as economic activity.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

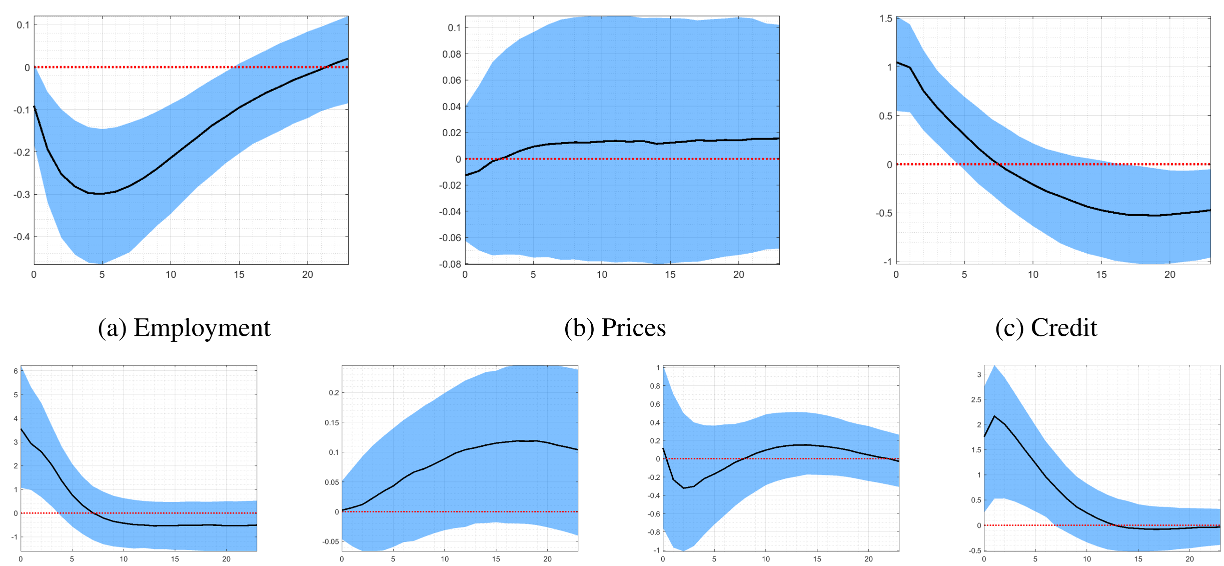
Figure B22: **(National Level). Impulse response functions of each variable following an aggregate demand shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation, IGAE is used as economic activity.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

Figure B23: **(National Level). Impulse response functions of each variable following a credit supply shock.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation, IGAE is used as economic activity.



(a) Employment (b) Prices (c) Credit

(d) BCI (e) Interest rate (f) Emissions (g) Exchange rate

Figure B24: **(National Level). Impulse response functions of each variable following a bank credit demand shock due to liquidity reasons.**
Source: Own estimates based on data from INEGI, and Banco de México.
notes: Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals. Under this estimation, IGAE is used as economic activity.