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## Effects of Supply, Demand, and Labor Market Shocks in the Mexican Manufacturing Sector

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# Effects of Supply, Demand, and Labor Market Shocks in the Mexican Manufacturing Sector\*

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**Abstract:** This paper analyzes the contribution of supply and demand shocks, and labor market shocks, to the evolution of regional production and inflation of manufactured goods in Mexico within the context of the pandemic. Under the identification of a Bayesian Structural Vector Autoregressive (SBVAR) model with sign restrictions, it is found that since 2021, external demand shocks increased their contribution relative to local shocks in explaining the growth of manufactured goods production in all regions except the South; meanwhile, external supply shocks increased their positive contribution in explaining inflationary pressures across all regions. On the other hand, from 2022 onwards, labor supply shocks have contributed to the behavior of the production and inflation of manufactured goods in the Northern and North-Central regions.

**Keywords:** External Shocks, Inflation, Manufacturing, SVAR

**JEL Classification:** E31, F41, R11

**Resumen:** Este documento analiza la contribución de choques de oferta y demanda, y del mercado laboral sobre la evolución de la producción regional y la inflación de bienes manufacturados en México en el contexto de la pandemia. Bajo la identificación de un modelo de vectores autorregresivos estructural bayesiano con restricciones de signo (SBVAR), se encuentra que, a partir de 2021, los choques de demanda externos incrementaron su contribución en relación con los choques locales para explicar el crecimiento de la producción de los bienes manufacturados en todas las regiones excepto la sur; en tanto que los choques de oferta externos incrementaron su contribución positiva para explicar las presiones inflacionarias en todas las regiones. Por otra parte, a partir de 2022, los choques de la oferta de trabajo han contribuido al comportamiento de la producción y la inflación de bienes manufacturados en las regiones norte y centro norte.

**Palabras Clave:** Choques Externos, Inflación, Manufacturas, SVAR

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## 1 Introduction

The COVID-19 pandemic has exposed the Mexican economy to a series of supply and demand shocks. As a result, the recovery of aggregate demand and the reopening of various activities impacted by the pandemic have been occurring amidst persistent bottlenecks in global supply chains. These factors have created imbalances between demand and supply, leading to upward pressure on inflation worldwide. Moreover, the military conflict between Russia and Ukraine has added to the inflationary pressures by causing disruptions in supply chains and driving up prices for certain raw materials. Against this complex backdrop, the Mexican economy experienced a favorable exogenous shock due to the fiscal incentives implemented in the United States during the most challenging phases of the pandemic in 2020 and 2021. This shock resulted in an upsurge in the demand for Mexican manufacturing goods, leading to increased production and higher price levels.<sup>1</sup> Also, output and prices were affected by internal supply shocks, such as the closure, at the beginning of the second quarter of 2020, of non-essential activities ordered by health authorities; and by internal demand shocks, such as households' measures of self-confinement, which reduced their consumption of specific goods and services. Additionally, within the context of the pandemic, especially from 2022 onwards, labor market shocks have gained some significance, including both labor supply and wage bargaining shocks. This situation arises in an environment where manufacturing firms have struggled to fill job vacancies while concurrently resulting in wage increases larger than before the pandemic.

In the model that we estimate, a labor supply shock refers to a change in labor force participation. This shift can result from various factors, such as demographic changes, immigration patterns, or individuals opting out of employment during the pandemic due to infection concerns or household responsibilities. It is worth mentioning that labor force participation decreased primarily at the onset of the pandemic, and more recently, it has been recovering. Conversely, a wage bargaining shock occurs when workers or their representatives, such as

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<sup>1</sup>The link between the Mexican economy and the United States economy at the aggregate level has been widely documented. See, for instance, Chiquiar and Ramos-Francia (2004), Hernández (2004), Sosa (2008), Mejía-Reyes and Campos-Chávez (2011), Delajara (2012), and Chavarín et al. (2023).

labor unions, gain increased bargaining power and negotiate for improved compensation and working conditions. This heightened bargaining power can stem from successful negotiations or other influencing factors, such as improved labor conditions by law. Importantly, while both labor supply and wage bargaining shocks can lead to changes in wages, the key distinction is that wage bargaining shocks are primarily the result of negotiations and changes in bargaining power of workers, whereas labor supply shocks stem from shifts in the overall availability of labor. Increased external demand might have driven a higher demand for labor. However, due to the difficulty of disentangling between a demand shock for manufactured goods and a labor demand shock, our analysis concentrates exclusively on identifying labor supply and wage bargaining shocks concerning labor market dynamics.<sup>2</sup>

Given the array of internal and external supply and demand shocks, as well as labor market disruptions that economies worldwide encountered during the pandemic, there has been an increasing interest in discerning the respective contributions of each type of shock to the dynamics of output and prices.

In this paper, we aim to address the research question: To what extent have local and external supply and demand shocks, along with labor market shocks, influenced the evolution of regional production and inflation dynamics in manufactured goods during the COVID-19 pandemic? To answer this question, we undertake two analyses. First, using monthly data from January 2007 to September 2022, we examine the impact of local and external supply and demand shocks on the production and inflation of manufactured goods, encompassing both transportation equipment and manufactured goods excluding transportation equipment.

In a second analysis, exclusively focused on the aggregate manufacturing industry, we utilize monthly data from January 2013 to September 2022 to investigate the impacts of labor supply and wage bargaining shocks. Additionally, we assess how local and external

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<sup>2</sup>Disentangling labor demand shocks from demand shocks for goods and services within VAR models presents a considerable challenge due to the intricate interplay and shared responses between these economic drivers. Both types of shocks often yield similar effects on economic variables. For instance, an upswing in economic activity triggered by a demand shock can concurrently drive up labor demand and the demand for goods and services. Moreover, labor market shifts, such as wage hikes resulting from labor demand shocks, can influence consumer spending behaviors, further muddling the differentiation of these shocks. Structural identification methods, such as sign restrictions, may encounter difficulties in establishing distinct identifying criteria, thereby complicating the task of attributing observed changes to specific shocks in these closely interconnected economic systems.

supply and demand shocks influence the production growth and inflation of manufactured goods. Our chosen approach stems from the lack of data on real average compensations for the transportation equipment industry and the manufacturing industry excluding transportation equipment goods, at the state level. As a result, we are unable to identify labor market shocks at this level of disaggregation.

In estimating the shock contributions, we use a historical decomposition analysis. For this purpose, we employ a structural vector-autoregressive model (SVAR) estimated with sign and zero restrictions.<sup>3</sup>

Our contribution is twofold: firstly, we perform a regional analysis of the effects of local and external supply and demand shocks on the production and inflation of manufactured goods across different regions of Mexico. Previous studies in this field have primarily concentrated on the national level, specifically examining sectoral production dynamics, without considering the analysis of manufactured goods' inflation across different Mexican regions. Secondly, we undertake a comprehensive examination, assessing, simultaneously, the influence of labor market shocks on both the production growth rate and the inflation of manufactured goods. To the best of our knowledge, no prior research has explored labor market shocks within the context of the pandemic and their specific impact on inflation and the production of manufactured goods in Mexico with the proposed methodology.

Among the main findings of our paper stand out that, starting in 2021, external demand shocks have fostered manufacturing goods output growth, mainly in the North, North-Central and Central regions. During the same time period, consumer prices of manufacturing goods excluding transport equipment underwent similar upward pressures in all regions, although these pressures were explained by heterogeneous contributions of supply and demand shocks. For instance, in the North, such pressures were mostly attributed to external supply shocks, while in the South, they were accounted for to a greater extent by local demand shocks.

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<sup>3</sup>In this paper we employ the regions defined in the Reporte sobre las Economías Regionales by Banco de México. 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.

Equally significant is our finding that emphasizes that labor supply shocks have contributed to explaining both manufacturing production growth and inflation, especially in the Northern and North-Central regions since 2022. Furthermore, we have observed that wage bargaining shocks have emerged as drivers of some inflationary pressures starting in 2022.

Our findings suggest that while internal and external supply and demand shocks have been the predominant factors explaining inflationary pressures and output growth in the manufacturing sector during the COVID-19 pandemic, labor market shocks have recently gained some significance as drivers of the manufacturing industry. This shift is particularly notable due to signals of tightening in labor markets. These results offer valuable insights into the primary drivers of economic fluctuations in the studied regions and contribute to enhancing our understanding of the complex interplay between labor market dynamics and inflationary pressures.

The paper is organized as follows. Section 2 outlines our approach to estimate the impact of supply, demand, and labor market shocks on production growth and inflation during the COVID-19 pandemic. It also explains the econometric methodology used and provides an overview of the data for the empirical analysis. Sections 3 to 5 present the estimation results, while Section 6 concludes.

## **2 Empirical Framework and Data**

This paper offers an analysis of the drivers behind both output growth and inflation, all within a regional framework. In particular, it explores not only the conventional supply and demand shocks but also labor market shocks. To do so, we develop a robust identification strategy covering labor supply and wage bargaining shocks, guided by insights gleaned from the following empirical studies. To clarify our approach, inspired by Chavarín et al. (2023), we devise a strategy capable of discerning internal and external supply and demand shocks. Furthermore, building upon the insights from Consolo et al. (2023), we expand this framework to incorporate labor market shocks. In order to improve the precision in estimating the

contributions of these shocks, our variable selection process relies on Brinca et al. (2021) and Shapiro (2022).

Regarding the above, for the Mexican case, Chavarín et al. (2023) utilize an SBVAR model with sign restrictions to examine the sources of heterogeneity in the evolution of economic activity during the pandemic. The authors find that demand shocks were the primary driver of the decline in production across most economic sectors during the second quarter of 2020. They also observe that external supply shocks have negatively impacted the evolution of economic activity, particularly in the industrial production sector, since the beginning of 2021. However, internal and external demand shocks have contributed positively to the evolution of sectoral production during this time.

It is worth mentioning that the analysis of the effects of supply and demand, which also includes labor market shocks, on the evolution of production and inflation during the COVID-19 pandemic has been focused on the Euro Zone and the United States. For example, Consolo et al. (2023) employ a Bayesian mixed-frequency VAR model to analyze the labor market in the aggregate Euro area. This approach involves structural identification using sign restrictions. Their research reveals that the decline in the employment rate observed during the pandemic was primarily driven by a combination of supply and demand shocks. The former can be attributed to government-imposed lockdowns that compelled numerous businesses to either shut down or temporarily curtail their operations. On the other hand, the latter may be linked to limitations on the demand for services due to pandemic-related measures, as well as factors like increased uncertainty during the pandemic, which likely reduced private consumption of certain services, especially those involving large gatherings.

In the case of the United States, Shapiro (2022) proposes a methodology that breaks down headline inflation into supply and demand shocks. Using the price and production time series of more than 100 goods and services to calculate the personal consumption expenditures (PCE) index, he finds that, at the onset of the pandemic, demand shocks contributed to the decline in headline PCE inflation. However, these shocks began to influence positively since the second quarter of 2021, coinciding with the economy's reopening and the implementation of the American Rescue Plan. Shapiro (2022) also finds that additional supply-driven inflation



emerged in early 2022, likely due to the economic disruptions associated with the armed conflict in Ukraine.

In another work, Brinca et al. (2021) use a Bayesian structural vector autoregression approach to measure the contribution of supply and demand shocks to the evolution of labor market variables using monthly data on hours worked and real wages for a set of economic sectors in the United States. The authors report that aggregate hours worked were heterogeneously affected by labor market supply and demand shocks at the beginning of the pandemic. Specifically, they find that the manufacturing sector, particularly the food industry, was the least affected by the drop in hours worked during this period.

Taking the above into consideration, in what follows we discuss our identification of local and external supply and demand shocks, while leaving the explanation of identifying the two additional labor market shocks to Section 5. Notably, the analysis of labor market shocks is limited to the manufacturing industry at the aggregate level due to data constraints pertaining to labor market variables for the transportation industry and manufacturing, excluding transportation equipment, at the regional level. In order to identify the contribution of the different supply and demand shocks that may have influenced the evolution of regional production and consumer prices of manufactured goods in Mexico we follow Chavarín et al. (2023). Using data spanning January 2007 to September 2022, we estimate two SBVAR models for each region: one for the manufacturing sector excluding transportation equipment, and another for the transportation equipment industry.<sup>4</sup> The reduced-form representation of each SBVAR model is described below:

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

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  $\Sigma$  is the  $N \times N$  variance-covariance

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<sup>4</sup>The period chosen for the analysis was determined by data availability.

matrix of residuals.<sup>5</sup> Given the large number 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.<sup>6</sup> 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:

$$u_t = A\epsilon_t \quad (2)$$

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:  $\Sigma = AA'$ .<sup>7</sup> Therefore, in order to identify  $A$  we impose some sign restrictions. Our identification scheme relies on the restrictions imposed on impact on the sign of the endogenous variable’s response to each structural shock by Chavarín et al. (2023).

In Equation 1,  $y_t$  refers to the monthly variations of the log-levels of the following endogenous variables: regional real manufacturing production; regional consumer price index for manufactured goods excluding fuel prices; real manufacturing production in the United States; producer price index for the manufacturing sector in the United States, and the bilateral real

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<sup>5</sup>The Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ) both selected  $p = 1$  for most of the 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. We also considered that the estimates may be affected by the inclusion of the COVID-19 pandemic in the period of analysis. On an alternative specification of Equation 1, following Kang et al. (2016), Carriero et al. (2022), and Hartwig (2022), we included an exogenous dummy variable set equal to 1 for Mar-2020 and Apr 2020, and 0 otherwise. Our analysis suggests that the historical decomposition estimates at the monthly frequency remain qualitatively similar for most of the time span, regardless of the inclusion of the dummy variable.

<sup>6</sup>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 ( $\lambda_1$ ) to vary between 0.05 and 0.2 and the lag decay hyperparameter ( $\lambda_3$ ) 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.

<sup>7</sup>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.

exchange rate between Mexico and the United States.<sup>8</sup> The sources of information are Banco de México, the National Mexican Institute of Statistics (INEGI), and the Federal Reserve of St. Louis.

It must be emphasized that the SBVAR methodology allows for the identification of the structural shocks in which we are interested. For the estimation of these models, and in order to identify the supply and demand shocks, we impose sign restrictions on the response on impact of the endogenous variables. For the case of the endogenous variables in which we do not impose a sign restriction, we allow them to freely respond on impact.<sup>9</sup> In what follows, we provide a description of the structural shocks' identification, while Table 1 summarizes this identification scheme.<sup>10</sup>

- ❖ **Local supply shock:** We assume that following a positive local supply shock, production increases and local prices decrease. As Mexico is considered a small open economy, we propose that local variables do not affect United States production and prices. Therefore, given a reduction in domestic prices and no effect on United States prices, we should also observe a real depreciation of the Mexican peso.<sup>11</sup>

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<sup>8</sup>All variables, except for the real exchange rate, are seasonally adjusted using the X-12 monthly adjustment method.

<sup>9</sup>In estimating the VAR model for the manufacturing sector excluding transportation equipment, and in order to identify local shocks, we use the information on the production value in real terms and on the prices of a set of goods that, according to the North American Industry Classification System (NAICS) 2018 classification, correspond to manufactured goods from sectors 31-33, excluding the transportation equipment industry (subsector 336) and the petroleum and coal products manufacturing industry (subsector 324). On the other hand, to estimate the VAR model for transportation equipment, we only consider information on the real production value and prices of manufactured goods from industry 336 from the NAICS classification. Hence, the price index for manufactured goods excluding transportation equipment is a weighted price index that includes the prices of 182 groups of goods used for the calculation of core inflation and five groups of goods used in the calculation of non-core inflation (pork, beef, lard, chicken and beef viscera). We exclude transportation equipment and fuel prices from that index. The weights to build that index are those of the INPC, while the transportation equipment price index considers only the prices of new cars and auto parts, also weighted with the INPC weights.

<sup>10</sup>As we do not include the identification of an exchange rate shock, our BSVAR model remains unidentified. This choice is based on the recognition that, in a small open economy like Mexico, the exchange rate functions primarily as a shock absorber, rather than as a source of shocks. Our assumption aligns with the seminal work of Mundell (1961), which argues that, in the case of flexible exchange rates, the exchange rate acts as a "shock absorber", helping to stabilize the economy when faced with external shocks.

<sup>11</sup>The Bilateral Real Exchange Rate Index (*RER*) is calculated as the product of the nominal exchange rate times the price relationship between the two countries. Specifically, the RER index is equal to:  $RER = e_t * (p_t^*/p_t)$ , where  $p_t$  is the National Consumer Price Index of Mexico (INPC) in month  $t$ ;  $p_t^*$  is the US consumer price index in month  $t$ ; and  $e_t$  is the average nominal exchange rate index in Mexican pesos for one

The assumption that Mexico is a small open economy is supported by the fact that, according to the World Bank, Mexico's Gross Domestic Product represented 10.8 percent of the United States GDP in 2021. Additionally, approximately 80 percent of Mexico's exports are sent to the United States, which represents around 40 percent of Mexico's GDP. Consequently, the identification strategy presented in Table 1 imposes zero restrictions on impact on the United States variables following local shocks, forming an exogeneity block similar to the approach proposed by Cushman and Zha (1997) and Kim and Roubini (2000). However, following Kim and Roubini (2000), we only impose restrictions on the contemporaneous relationships of the variables without further restrictions on the lagged structural parameters.

The exogeneity block implies that, within the model's endogenous variables, the United States variables cannot be affected on impact by the Mexican variables. To support this assumption, we estimate Granger causality tests, as shown in Table 2, and provide statistical evidence that the United States variables help predict production growth and inflation in Mexico. However, the lagged values of the Mexican variables do not help predict economic variables for the United States, which further supports the block exogeneity assumption in the shocks' identification strategy.

- ❖ **Local demand shock:** Following a positive local demand shock, we assume that local production increases without inducing firms to adjust their production capacity immediately, which pushes prices up. As in the case of the local supply shock, we also assume that the local demand shocks do not influence the dynamics of the United States variables. The domestic inflationary pressures and null effects on United States prices would lead to an appreciation of the real exchange rate.
  
- ❖ **External supply shock:** Following a positive external supply shock, we assume that on impact, in the United States and Mexico, production increases, and prices go down. This happens because we impose that the external supply shock stimulates both the supply

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US dollar in month  $t$ . The interpretation of the index is as follows: an increase in the RER index represents a depreciation of the Mexican peso relative to the US dollar, while a decrease in the index represents an appreciation of the peso.

of the manufacturing sector in the United States and the Mexican regions, given that the value chains of both economies are highly integrated. We let the response of the real exchange rate following an external supply and demand shock be determined by the data.<sup>12</sup>

- ❖ **External demand shock:** We assume that following a positive external demand shock, United States production and prices of manufactured goods go up. Regarding the impact of an external demand shock on local variables, we maintain a narrow approach by refraining from imposing any restrictions on their contemporaneous response.

In terms of what we may expect from the results, we can observe in panel a) of Figure 1, that the Northern and Central states of the country are more manufacturing-intensive producers than the Southern states. In particular, for some of the Northern states, manufacturing production represents around one-third of their GDP, while for some Southern states that proportion is, at most, 6 percent. In line with that, Northern states are more export-intensive, with some of them reaching exports as a fraction of their GDP exceeding 50 percent.

According to Figure 2, many Southern states are more service-intensive producers, especially in the tourism industry. Naturally, those states benefit from visitors, many of them from the United States. Thus, production and prices of manufactured goods in the country's Northern states may have a significant influence from external factors, given their higher exposure to the United States economy.

For Southern states, we expect an important contribution from local supply and demand shocks in explaining the dynamics of both production and prices of manufactured goods, given their high service intensity orientation. However, external demand shocks may also drive Southern states' variables, given their high dependence on international tourists.<sup>13</sup>

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<sup>12</sup>One crucial aspect of our analysis is the implementation of an alternative identification strategy inspired by Barišić et al. (2022). In this approach, we omit the sign restrictions on impact of local variables following a United States supply shock, and we allow the data to speak freely by remaining agnostic about the effects of an external supply shock at the local level. The results obtained using this alternative strategy are qualitatively similar to those obtained under the strategy presented in Table 1.

<sup>13</sup>Appendix B presents a reduced-form analysis to investigate the interrelation between local and United States variables.

### 3 Effects of Local and External Shocks on Regional Manufacturing Production

In this section, we provide the results regarding the effects of local and external shocks on regional manufacturing production. Figure 3 shows each region's estimated contribution of each identified shock to the deviation of the annual variation of manufacturing production excluding transportation equipment from its long-term mean.<sup>14</sup> It can be seen that, at the beginning of the pandemic, external demand shocks were the most important in explaining the negative growth rate of this industry in the North. The previous finding could be attributed to the high export orientation of that region.

At the beginning of the pandemic, we also find that local and external supply shocks had a modest negative contribution to the production growth of these manufactured goods. Among these products, a significant proportion corresponds to the food industry, considered in the group of essential productive activities in Mexico and the United States. Hence, it seems that this industry experienced fewer operational limitations at the beginning of the pandemic.

Figure 3 also suggests that, more recently, external demand shocks have been the most important in accounting for the favorable evolution of this class of manufactured goods, mainly in the Central, Northern, and North-Central regions, in that order. This finding could be associated with the reopening of some productive sectors and the massive fiscal stimulus granted in the United States, which stimulated Mexican exports. It stands out that, in the Central region, the positive relative contribution of local demand shocks observed at the beginning of 2021 was less relevant when comparing it with the rest. Concerning the Southern region, the influence of external demand shocks seems to be closely connected to the dynamic performance of exports from basic metal and chemical industries, which hold a significant share in the regional economy. In addition, during the last months of 2022, local demand shocks in

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<sup>14</sup>For additional details on the estimation of the historical decomposition of the variables in deviations from their long-term mean based on Equation 1, please refer to Dieppe et al. (2016), p.89. It is worth noting that the point estimates of the historical decompositions correspond to the median of each posterior distribution. Dieppe et al. (2016) argues that, in practice, the median is typically preferred over the mean as a point estimate for two reasons. First, the median is less sensitive to extreme values than the mean. Second, as the median corresponds to the 50th percentile, it is guaranteed to be included within the bounds of a credibility interval. Appendix C shows the Impulse Response Functions (IRFs) of the endogenous variables to the identified structural shocks, while Appendix D contains a visualization of the historical decompositions (shown in sections 3 to 5) of the variables relative to their long-term mean in the complete period of analysis.

the Southern region account for an important contribution to the recovery of manufacturing production, excluding transportation equipment. This finding may be explained in the context, for instance, of high public investment levels and the impulse of demand for some processed goods, such as food and beverages, derived from the gradual increase in domestic and foreign tourists.

However, across all regions, it can be observed that during the third quarter of 2022, external demand shocks have decreased their positive contribution to the growth of manufacturing production, excluding transportation equipment, especially in the Northern and North-Central regions. This could be attributed to the decrease in economic activity in the United States. During this period, local supply shocks have increased their negative contribution, particularly in the Northern, North-Central, and Central regions, while the negative contribution of external supply shocks has decreased. In the Southern region, local supply shocks have been the main contributor to the negative impact on production growth.

Figure 4 shows, in turn, that the deep contraction in transportation equipment output at the beginning of the pandemic was mainly driven by external demand shocks, and local and external supply shocks, in the different regions. The supply shocks would be related to the temporary closure of operations by automakers in Mexico and the United States. As of 2021, in the North, North-Central, and Central regions, external demand shocks contributed positively to the deviation of the real annual variation in the production of transportation equipment from its historical mean. This finding could be associated with the fact that, after the reopening, global demand for vehicles recovered rapidly (Banco de México, 2021a).<sup>15</sup> It also highlights that, in the Northern region, local demand shocks contributed positively and over a longer period to the evolution of the production of transportation equipment compared to the rest of the regions. This finding could be associated with the greater recovery of its labor market.

Figure 4 also indicates that, since the start of the pandemic, the contribution of external supply shocks has been negative and very persistent in the evolution of the production of transportation equipment. This result could be explained in an environment in which the global

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<sup>15</sup>Banco de México. Quarterly Report, April-June 2021, Box 3: Estimation of the Impact of Disruptions in Inputs' Supply on Automotive Production and Economic Activity. Downloadable at <https://www.banxico.org.mx/publications-and-press/quarterly-reports/quarterly-reports-prices-banc.html>.

installed capacity for the production of semiconductors was insufficient to simultaneously meet, since the beginning of 2021, the high demand of the sectors with linkages to industries such as vehicles, and the manufacture of electrical goods and electronics. In addition to the shortage of semiconductors, the automotive industry has also faced logistics and supply problems for other inputs (Banco de México, 2021a).

#### **4 Effects of Local and External Shocks on Inflation of Manufactured Goods**

In this section, we provide one of the key contributions of this paper. In particular, we present the results regarding the effects of local and external shocks on the inflation of manufactured goods. Figure 5 shows that, at the beginning of the pandemic, demand shocks contributed significantly to the downward deviation from the mean of consumer price inflation of manufactured goods excluding transportation equipment, primarily in the Central region. As of 2021, significant inflationary pressures have been observed in all regions. Although they have registered relatively similar behavior, the contribution of supply and demand shocks to these pressures has been heterogeneous across regions. We also find that external factors mostly explain these pressures in the Northern, North-Central, and Central regions; while in the South, inflationary pressures are mainly explained by local demand shocks.

On the supply side, external factors could be associated with global supply chain disruptions and the military conflict between Russia and Ukraine that started in February 2022; while from the demand side, external factors could be related, for instance, to the high demand generated by the massive fiscal stimulus in the United States. The growing contribution of external supply shocks has been more evident in the North, a finding that could be attributed to the greater integration of the productive chains of this region with the United States. On the other hand, in the South, unlike the other regions, local demand shocks have shown a positive and more persistent contribution in explaining the inflationary pressures of these products. For this region, local demand shocks and external factors have generated a higher inflation rate for these products relative to the other regions. In the Central region, the contribution of



local demand shocks in explaining the inflationary pressures of these products has been lower relative to the other regions.

Figure 6 shows that, since the outset of the pandemic, the annual change in the consumer price index for transportation equipment goods has shown a positive deviation from its long-term mean in all regions. However, since 2021, this gap has been relatively higher in the North. In particular, we find that the inflation of these products in this region is distinguished by a positive and more persistent contribution of local demand shocks, probably associated with a greater recovery in its economic activity than in the rest of the regions. It is also observed that, since the onset of the pandemic, local supply shocks have shown a positive contribution to the inflationary pressures of these goods. However, the incidence of these factors was more relevant in 2020 and 2021. Since 2021, external supply shocks have shown an upward contribution to explain these inflationary pressures. The supply shocks could be attributed to the technical stoppages in Mexico and the United States due to the global shortage of semiconductors, as well as to the difficulties in obtaining other inputs, among others. On the other hand, although to a lesser extent, it is estimated that, in all regions, external demand shocks contributed to the hike in transportation equipment inflation.<sup>16</sup>

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<sup>16</sup>Under an alternative approach, where we incorporate supply and demand shocks from “other regions” into the analysis of regional inflation and production growth, alongside the region-specific supply and demand shocks and external shocks, we find that our results are qualitatively robust to the inclusion and exclusion of inter-regional shocks. Specifically, this alternative method involved breaking down national-level production and price indices into their counterparts for the specific region under consideration and those from “other regions.” For instance, in the case of the Northern region, in addition to utilizing the production and price indices for the Northern region, we included the production and price indices of the North-Central, Central, and Southern regions to identify supply and demand shocks originating from “other regions.” This same methodology was replicated for all other regions. Moreover, as per the Multi-State Input-Output Matrix (2022) published by INEGI, it is noteworthy that the trade of intermediate goods and services between regions is predominantly intraregional. In other words, the majority of the trade in intermediate goods and services within the manufacturing sector occurs among states within a given region, with interregional trade playing a minimal role. On the other hand, we also find that our results are robust when using industrial production and the US CPI instead of manufacturing sector variables when identifying external shocks.

## 5 Effects of Local, External and Labor Market Shocks on Production and the Inflation of Manufactured Goods

In this section, we extend the analysis of the effects of local and external supply and demand shocks on the dynamics of inflation and output growth, as discussed in Sections 3-5. This extension involves exploring the impact of labor market shocks on both output growth and inflation in the realm of manufactured goods, which is the key contribution of the paper. In line with Consolo et al. (2023), we introduce two labor market shocks into the identification strategy outlined in Section 2.<sup>17</sup> We want to highlight that a key contribution of this study to the Mexican economy is the concurrent consideration of jointly assessing the effects of local and external supply and demand shocks, along with labor market shocks, on the dynamics of inflation and output growth within the manufactured goods sector. Importantly, our analysis centers on the manufacturing industry at its most generalized level, due to a lack of available data for labor market variables at the disaggregated level of the manufacturing industry at the regional level. This constraint led us to shift our focus to the broader context of the manufacturing sector while recognizing the absence of comprehensive regional data. In particular, we were unable to identify labor market shocks for the industries analyzed in Sections 3 and 4, specifically, the transportation equipment industry and the industry of manufactured goods (excluding cars and motor vehicle parts) due to the absence of regional-level compensation per employee data for these sectors. The labor market shocks analyzed in this paper are described as follows:

- ❖ **Labor supply shock:** The first shock we consider is a labor supply shock, which assumes that following a positive exogenous shock, households reduce their disutility of working and become more active in the labor market. This leads to an increase in job seekers, and as a result, unemployment rises, making it easier for firms to fill vacancies and reduce hiring costs. Faced with lower wage pressures, firms may respond by increasing their production levels, resulting in lower marginal costs and sales prices.

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<sup>17</sup>Other references in which labor market shocks are implemented in a similar fashion are Brinca et al. (2021) and Foroni et al. (2018).

- ❖ **Wage bargaining shock:** The second labor market shock that we incorporate is a wage bargaining shock, which assumes that workers have more bargaining power to achieve wage increases. Thus, following a positive shock of this nature, we impose that compensation per employee increases on impact. However, since firms would face higher production costs, they increase their sales prices and reduce their vacancy postings to hire. As a result, we expect production to decrease and unemployment to increase.

According to Foroni et al. (2018), an exogenous increase in labor supply may lead to some of the new participants experiencing a period of unemployment during the initial months, although many may secure employment within that timeframe. In contrast, an increase in workers' bargaining power can result in higher wages, prompting firms to reduce job postings and potentially lay off employees, ultimately leading to an elevated unemployment rate. This response of the unemployment rate plays a crucial role in disentangling between the two labor market shocks. Therefore, within our identification strategy, following a positive wage bargaining shock and a labor supply shock, we would expect to observe an increase in the unemployment rate.

On the other hand, a positive shock to local demand for manufactured goods bolsters both output and prices, resulting in a decrease in the unemployment rate. Conversely, a local supply shock in manufactured goods enhances firms' efficiency, leading to increased production and a reduction in unemployment. In the case of both labor market shocks, we assume that they do not have significant effects on the United States variables. It is worth noting that the identification of external shocks remains consistent with the previous identification strategy. The identification strategy which incorporates the two labor market shocks is summarized in Table 3.

We utilize compensation per employee data obtained from the Monthly Survey of the Manufacturing Industry (referred to as "Encuesta Mensual de la Industria Manufacturera" or EMIM in Spanish). Additionally, data concerning the unemployment rate is collected from the National Occupation and Employment Survey Industry (referred to as "Encuesta Nacional de

Ocupación y Empleo” or ENOE in Spanish). The information regarding these two variables serves as the basis for identifying labor market shocks. The dataset spans from January 2013 to September 2022.<sup>18</sup>

According to Figure 7, the manufacturing industry experienced a pronounced downturn in annual production growth across the Northern, North-Central, and Central regions at the onset of the pandemic, primarily attributable to external demand shocks. However, subsequent to the economic reopening, the negative impact of external demand shocks underwent a reversal, emerging as a foremost driver behind the industry’s recovery. Concurrently, internal demand shocks exhibited a favorable influence across all regions, particularly from 2022 onwards. Nonetheless, the positive contribution of demand shocks was offset from supply-side factors, predominantly of external origin. These external supply shocks have assumed relatively heightened significance in all regions, with the exception of the Southern region. Regarding labor market shocks, it is observed that supply-side shocks from 2022 onwards, have manifested as adverse determinants of manufacturing production dynamics in all regions. Of particular note, the Northern and North-Central regions have endured a somewhat prolonged negative impact since late 2021. Conversely, wage bargaining shocks have demonstrated a limited role in explaining the trajectory of manufacturing production.

Transitioning to the counterpart facet, i.e., the inflation of manufactured goods, Figure 8 portrays the inflationary pressures exerted by external supply and demand shocks in all regions during the most recent period under scrutiny. Regarding the impact of labor market

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<sup>18</sup>Data availability on labor market variables for Mexico motivates our use of monthly data starting in January 2013. Due to the lack of monthly unemployment rate data by state and, consequently, by region, we first calculate the state unemployment rate by subtracting the state employment rate from 1. The employment rate is available from INEGI and is calculated based on the National Occupation and Employment Survey Industry (referred to as “Encuesta Nacional de Ocupación y Empleo” or ENOE in Spanish). Our approach for calculating the unemployment rates is based on defining the EAP (Economically Active Population) as the combined total of employed and unemployed individuals, expressed as  $E + U = EAP$ . By dividing both sides of the equation by EAP, we obtain  $E/EAP + U/EAP = 1$ , which is equivalent to  $e + u = 1$ , where “e” represents the employment rate, and “u” represents the unemployment rate. Solving for “u”, we find  $u = 1 - e$ , which is the base for the calculation of our monthly unemployment rates at the state level. Once we calculate the state unemployment rates, to derive the regional unemployment rate, we assign each state’s unemployment rate a time-varying weight based on its share in the economically active population of the respective region to which it belongs. Importantly, as a robustness check, once we obtain the regional monthly unemployment rates, we calculate the quarterly unemployment rates and compare them to the quarterly regional unemployment rates published in the Regional Economic Report of Banco de México. We observe that they align very closely.

shocks on inflation in manufactured goods, we observe that since 2022, labor supply shocks have increased their relative contribution to inflation compared to other factors.<sup>19</sup> This shift is particularly pronounced in the North and North-Central regions. It is important to note that labor force participation experienced a significant decline at the beginning of the pandemic, but in recent times, it has been on the path to recovery. Furthermore, it is worth noting that wage bargaining shocks have also played a role, albeit relatively modest, in explaining inflationary pressures across all regions, with a particular impact on the Central region since 2021.

## **6 Concluding Remarks**

This document presents pioneering findings on the impact of local and external supply and demand shocks and, importantly, labor market shocks, on the evolution of output growth and inflation of manufactured goods across regions in Mexico. The main results of this paper suggest that, as of 2021, there has been an increasing contribution of external factors in explaining the dynamics of production and prices of manufactured goods excluding transportation equipment, mainly in the North, North-Central, and Central regions.

Also, external demand shocks have contributed positively to the evolution of transportation equipment production, while adverse external supply shocks have counteracted those positive contributions. These negative external supply shocks may be associated, for instance, with disruptions in global supply chains and shortages of semiconductors, which helps explain the low dynamism of production and inflationary pressures in the transportation equipment industry.

A key finding of this paper is that labor supply shocks have started to appear as drivers, particularly since 2022, in explaining the dynamics of both manufacturing production growth and inflation, primarily within the Northern and North-Central regions. Furthermore, we observe that incipient wage bargaining shocks have emerged from 2022 onwards. As a result, these findings provide insights into the primary drivers of economic fluctuations within the

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<sup>19</sup>We acknowledge the possibility that following a positive demand shock in manufactured goods or a negative labor supply shock, we may observe an increase in wages and a reduction in the unemployment rate.

studied regions and enhance our understanding of the intricate interplay between labor market dynamics, output growth, and inflationary pressures.

	Local Supply	Local Demand	External Supply	External Demand
Local Manufacturing Production	+	+	+	
Consumer Prices Index of Manufactured Goods	-	+	-	
US Manufacturing Production	0	0	+	+
US Manufacturing Producer Price Index	0	0	-	+
Real Exchange Rate	+	-		

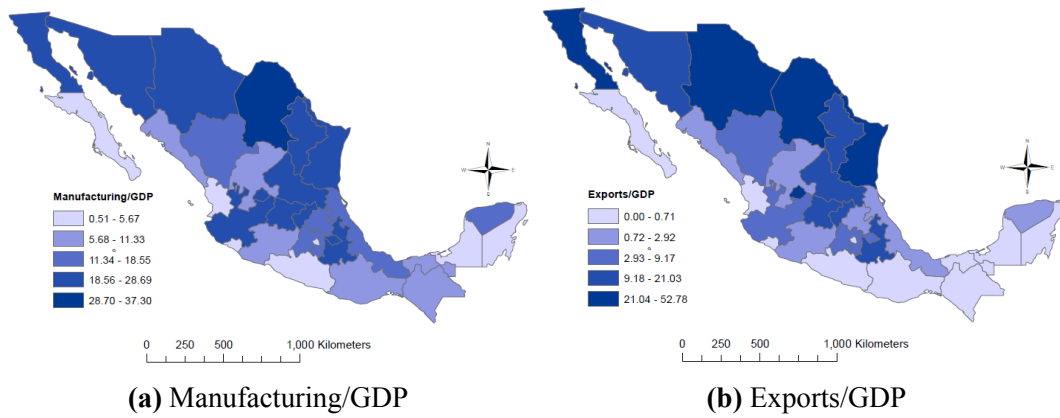
**Table 1: Identification Strategy for Local and External Supply and Demand Shocks.**

Dependent Variable	Independent Variable	$\chi^2$	$p - value$
US Industrial Production	MX Aggregate Production (IGAE)	1.9	0.168
US Industrial Production	MX Industrial Production	2.9	0.238
US Industrial Production	MX Manufacturing Production	3.6	0.161
US Manufacturing Production	MX Manufacturing Production	2.2	0.330
MX Aggregate Production (IGAE)	US Industrial Production	34.7	0.000*
MX Industrial Production	US Industrial Production	39.6	0.000*
MX Manufacturing Production	US Industrial Production	33.7	0.000*
MX Manufacturing Production	US Manufacturing Production	42.2	0.000*
US CPI	MX INPC	11.3	0.506
MX INPC	US CPI	20.4	0.060

**Table 2: Granger Causality Tests for Growth Rates of Economic Variables at the National Level.**

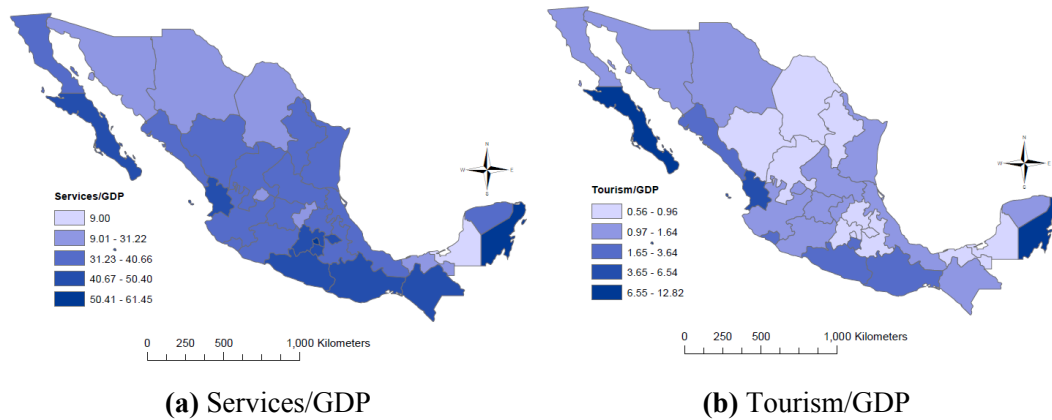
**Note:** \* Denotes  $p - value$  consistent with 5% statistical significance for testing the hypothesis:  $H_0 =$  “Independent Variable Fails to Granger Cause Dependent Variable.”

**Source:** Own calculations using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure 1: Manufacturing Production and Exports as a fraction of GDP, by State (in percent).**

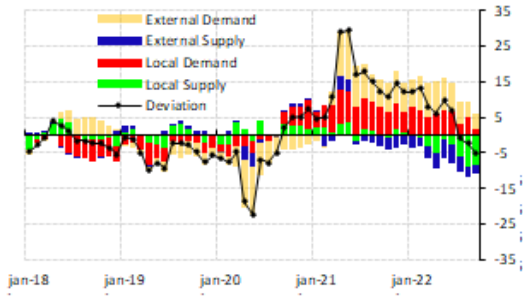
Source: Own calculations using data from INEGI (2020).



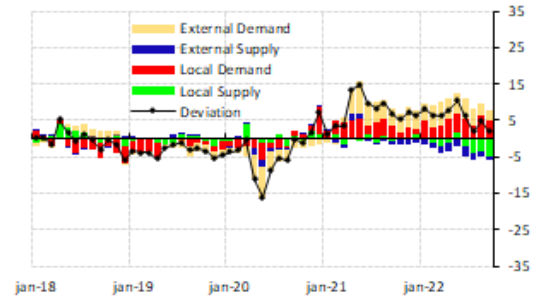
**Figure 2: Production of the Services and Tourism Sectors as a fraction of GDP, by State (in percent).**

Source: Own calculations using data from INEGI (2020).

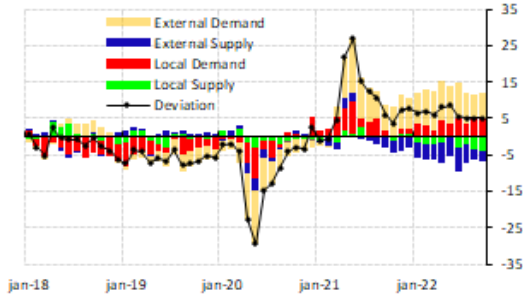




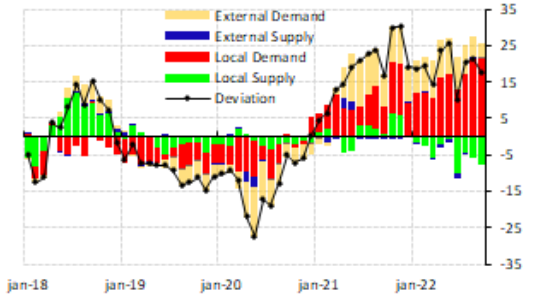
(a) Northern



(b) North-Central



(c) Central

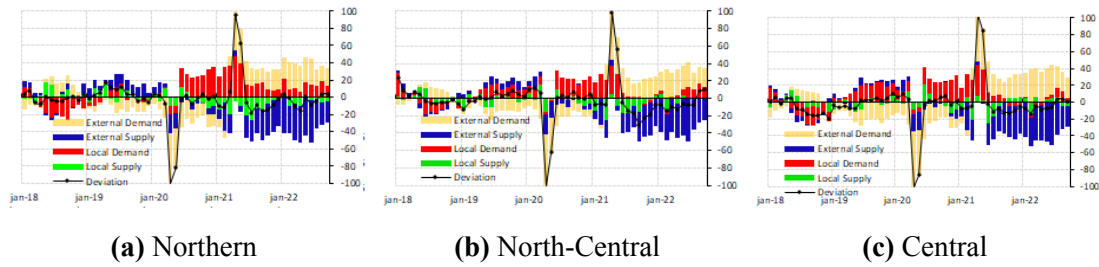


(d) Southern

**Figure 3: Historical Decomposition of the Regional Production of the Manufacturing Sector excluding Transportation Equipment.**

**Notes:** The black line denotes the deviation of the real annual growth rate of the manufacturing production value excluding transportation equipment from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition.

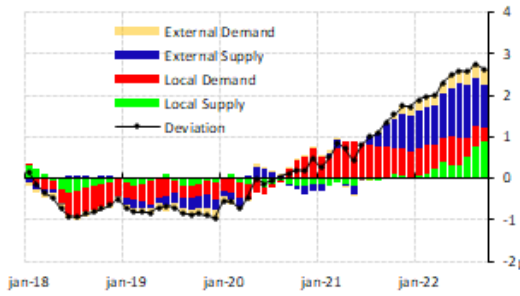
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



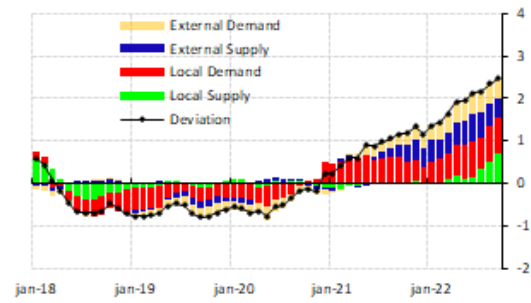
**Figure 4: Historical Decomposition of the Regional Production of Transportation Equipment.**

**Notes:** The black line denotes the deviation of the real annual growth rate of the transportation equipment production value from its long-term mean. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition.

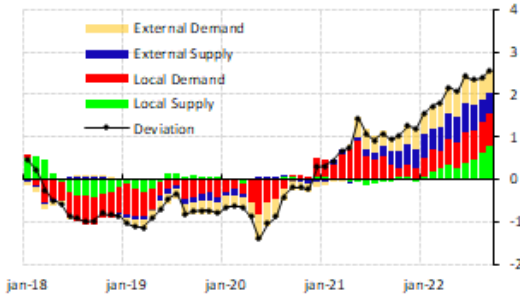
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



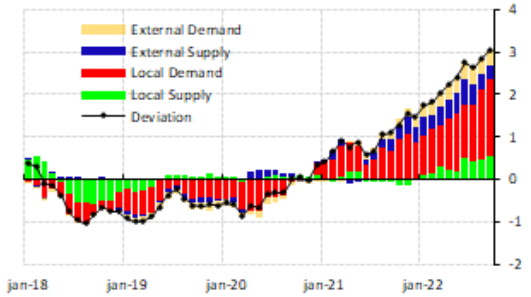
(a) Northern



(b) North-Central



(c) Central

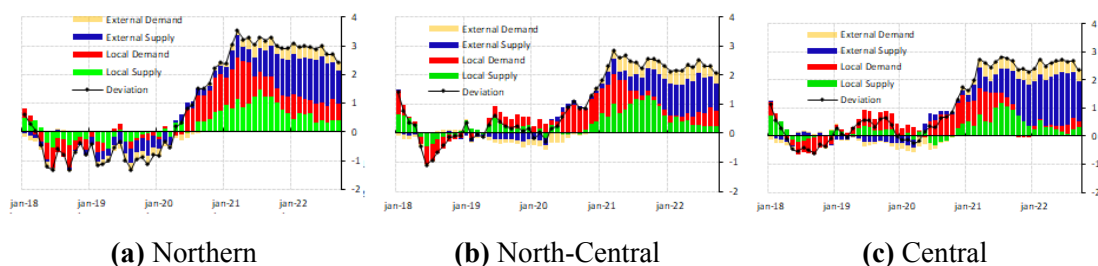


(d) Southern

**Figure 5: Historical Decomposition of the Regional Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts.**

**Notes:** The black line denotes the deviation of the annual growth rate of the regional price index of manufactured goods excluding cars and motor vehicle parts from its long-term mean. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022. 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, Banco de México, and the Federal Reserve of St. Louis.



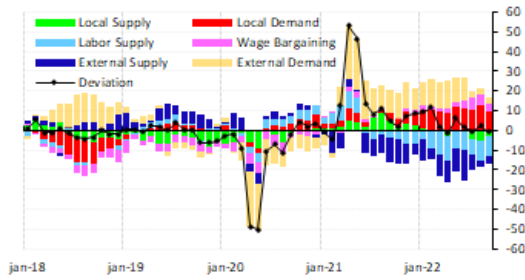
**Figure 6: Historical Decomposition of the Regional Price Index of Cars and Motor Vehicle Parts.**

**Notes:** The black line denotes the deviation of the annual growth rate of the regional price index of cars and motor vehicle parts from its long-term mean. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition.

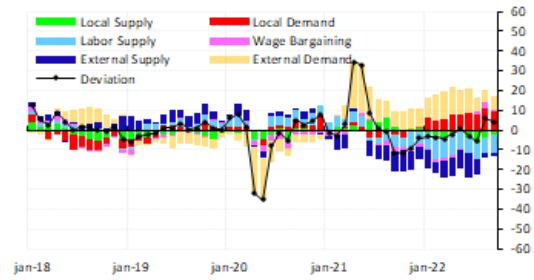
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

	Local Supply	Local Demand	Labor Supply	Wage Bargaining	External Supply	External Demand
Local Manufacturing Production	+	+	+	-	+	
Consumer Prices Index of Manufactured Goods	-	+	-	+	-	
Compensation per Employee	+		-	+		
Unemployment Rate	-	-	+	+		
US Manufacturing Production	0	0	0	0	+	+
US Manufacturing Producer Price Index	0	0	0	0	-	+
Real Exchange Rate	+	-				

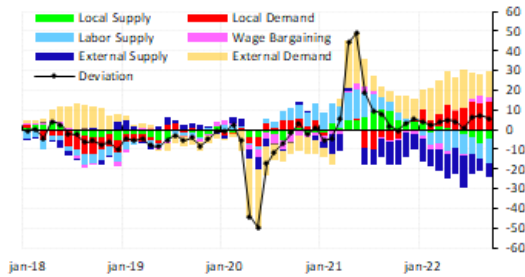
**Table 3: Identification Strategy for Local and External Supply and Demand Shocks, Including Labor Market Shocks.**



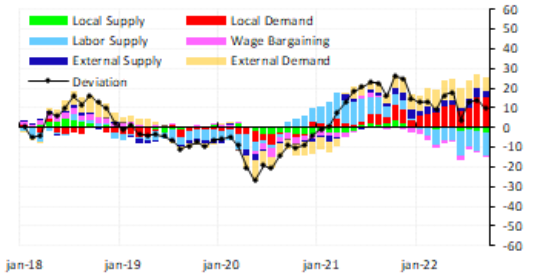
(a) Northern



(b) North-Central



(c) Central

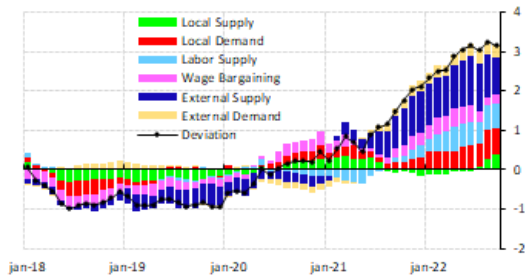


(d) Southern

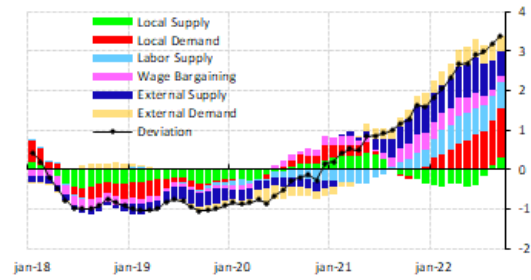
**Figure 7: Historical Decomposition of the Regional Production Index of Manufactured Goods.**

**Notes:** The black line denotes the deviation of the annual growth rate of the regional production index of manufactured goods from its long-term mean. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition. These results differ from the ones presented in Figure 3 due to the distinction in the scope of analysis. In Figure 3, the focus was solely on goods within the manufacturing industry, excluding transportation equipment. However, in this instance, we are analyzing all manufactured goods without excluding any specific sector.

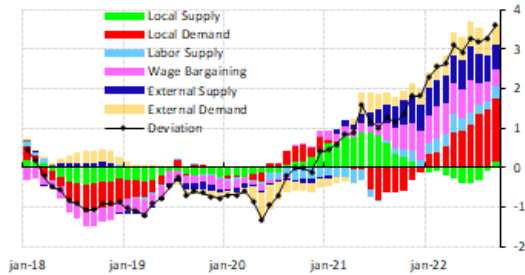
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



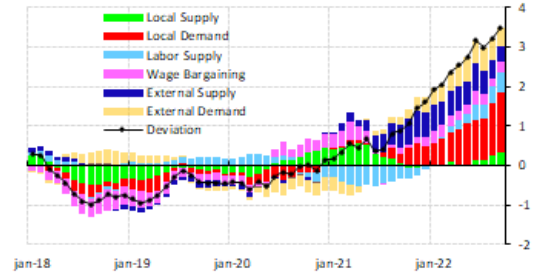
(a) Northern



(b) North-Central



(c) Central



(d) Southern

**Figure 8: Historical Decomposition of the Regional Price Index of Manufactured Goods.**

**Notes:** The black line denotes the deviation of the annual growth rate of the regional price index of manufactured goods from its long-term mean. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022. Since roots of the characteristic polynomial (modulus) do not lie outside the unit circle, the estimated VAR models satisfy the stability condition. These results differ from the ones presented in Figure 5 due to the distinction in the scope of analysis. In Figure 5, the focus was solely on goods within the manufacturing industry, excluding transportation equipment.

**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

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### Appendix A: Historical Decomposition Analysis

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

$$y_t = \mu_t + \sum_{i=1}^p B_i y_{t-i} + u_t, \quad (1)$$

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

The structural shocks can be expressed as:

$$\epsilon_t = A^{-1} u_t, \quad (2)$$

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:

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

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

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

$$\Delta y_{j,t}^{shocks} = \sum_{i=1}^p \Delta y_{j,t}^i. \quad (4)$$

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

$$\Delta y_{j,t}^{deterministic} = \mu_{j,t} - \mu_{j,t-1}. \quad (5)$$

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

$$\Delta y_{j,t} = \Delta y_{j,t}^{shocks} + \Delta y_{j,t}^{deterministic}. \quad (6)$$

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.

### **Appendix B: *Reduced-Form Analysis***

Prior to conducting the structural analysis, we undertook a reduced-form analysis to investigate the interrelation between local and United States variables. We started by calculating the correlation coefficients between local and lagged United States variables, and the results are presented in Table B1. The table shows that the annual growth rate of regional economic activity and the lagged annual growth rates of industrial production in the United States are positively correlated with coefficients around 0.44 and 0.53 across regions, with stronger correlations observed mainly contemporaneously and with the first lag of the United States industrial production. Moving to Table B2, we observe that the correlation between the annual growth rate of manufacturing production in the Mexican regions and the United States is higher than that of industrial production, with slightly higher contemporaneous correlation coefficients for the country's Northern regions.

We also examined the correlation between the United States and regional inflation rates, and the results are presented in Table B3. We find that inflation rates in the four regions of Mexico are positively correlated with the United States inflation rates, with correlation coefficients ranging from 0.48 to 0.61 across regions. The Northern regions show the highest correlation with the contemporaneous inflation rate in the United States, while the Central and Southern regions have the highest correlation with the six-month lag of the United States inflation.

Finally, Table B4 shows that the inflation rate of manufactured goods in the four Mexican regions is correlated with the lagged United States inflation of manufactured goods up to 6 months. In both cases, we observe persistent correlations with the United States inflation rates for general regional inflation and for manufactured goods.

Secondly, we estimate Granger causality tests to analyze the relationship between Mexican and United States variables. Table B5 shows that lagged values of United States manufacturing production help predict manufacturing production of the four Mexican regions. Thus, the reduced-form analysis provides compelling evidence highlighting the interrelation between regional economic activity and United States industrial production. Table B6, in turn, shows

that the United States lagged inflation rate Granger causes inflation rates only for the Northern and Southern regions.

Thus, using these correlation coefficients and the two-sided Granger causality tests, we find that by using reduced-form evidence, the United States variables affect the dynamics of local variables.

Regional Economic Activity and US Industrial Production													
<i>k</i>	12	11	10	9	8	7	6	5	4	3	2	1	0
Northern	-0.03	-0.12	-0.13	-0.18	-0.19	-0.18	-0.20	-0.18	-0.16	-0.19	0.09	0.29	0.53
North-Central	0.03	-0.04	-0.05	-0.10	-0.13	-0.13	-0.17	-0.16	-0.15	-0.21	0.05	0.25	0.47
Central	-0.01	-0.07	-0.07	-0.14	-0.17	-0.16	-0.18	-0.15	-0.13	-0.19	0.07	0.24	0.44
Southern	-0.08	-0.15	-0.16	-0.21	-0.21	-0.22	-0.23	-0.22	-0.22	-0.20	0.10	0.31	0.53

**Table B1: Correlation Coefficients Between Regional Economic Activity and United States Industrial Production.**

**Note:** These correlation coefficients consider the correlation between the annual growth rate of regional economic activity and the US industrial production lagged by  $k$  quarters. For each row of the table, the lower correlation coefficients are highlighted in red, while those higher are highlighted in green.

**Source:** Own calculations using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

Regional Manufacturing Production and US Manufacturing Production													
<i>k</i>	12	11	10	9	8	7	6	5	4	3	2	1	0
Northern	-0.31	-0.38	-0.30	-0.16	-0.06	0.00	0.06	0.12	0.18	0.27	0.32	0.40	0.63
North-Central	-0.21	-0.26	-0.18	-0.07	0.00	0.04	0.08	0.11	0.15	0.22	0.28	0.38	0.61
Central	-0.23	-0.26	-0.16	-0.05	0.02	0.06	0.11	0.14	0.17	0.22	0.27	0.37	0.62
Southern	-0.05	0.02	0.06	0.12	0.18	0.25	0.35	0.42	0.45	0.49	0.53	0.55	0.57

**Table B2: Correlation Coefficients Between Regional Manufacturing Production and United States Industrial Manufacturing Production.**

**Note:** These correlation coefficients consider the correlation between the annual growth rate of regional manufacturing production and the US manufacturing production lagged by  $k$  months. For each row of the table, the lower correlation coefficients are highlighted in red, while those higher are highlighted in green.

**Source:** Own calculations using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

**Regional Headline Inflation and US Headline Inflation**

<i>k</i>	12	11	10	9	8	7	6	5	4	3	2	1	0
Northern	0.21	0.28	0.35	0.41	0.45	0.49	0.51	0.52	0.51	0.51	0.51	0.51	0.52
North-Central	0.16	0.25	0.32	0.38	0.43	0.48	0.53	0.55	0.57	0.59	0.60	0.61	0.61
Central	0.20	0.30	0.38	0.45	0.50	0.54	0.57	0.57	0.56	0.56	0.54	0.52	0.48
Southern	0.30	0.39	0.46	0.51	0.54	0.57	0.59	0.58	0.58	0.57	0.55	0.53	0.51

**Table B3: Correlation Coefficients Between Regional Headline Inflation and US Headline Inflation.**

**Note:** These correlation coefficients consider the correlation between the regional headline inflation rate and the US headline inflation rate lagged by *k* months. For each row of the table, the lower correlation coefficients are highlighted in red, while those higher are highlighted in green.

**Source:** Own calculations using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

**Regional Inflation of Manufactured Goods and US PPI-Manufacturing Growth**

<i>k</i>	12	11	10	9	8	7	6	5	4	3	2	1	0
Northern	0.23	0.29	0.33	0.37	0.40	0.42	0.44	0.44	0.44	0.44	0.44	0.45	0.45
North-Central	0.20	0.26	0.31	0.34	0.37	0.41	0.44	0.46	0.48	0.50	0.52	0.55	0.57
Central	0.34	0.39	0.43	0.45	0.47	0.48	0.49	0.48	0.47	0.47	0.48	0.48	0.48
Southern	0.32	0.37	0.41	0.43	0.46	0.48	0.49	0.49	0.49	0.49	0.49	0.50	0.50

**Table B4: Correlation Coefficients Between Regional Inflation of Manufactured Goods and US PPI-Manufacturing Growth.**

**Note:** These correlation coefficients consider the correlation between the regional inflation rate of manufactured goods and the US PPI-Manufacturing annual growth rate lagged by *k* months. For each row of the table, the lower correlation coefficients are highlighted in red, while those higher are highlighted in green.

**Source:** Own calculations using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

Region	Dependent Variable	Independent Variable	$\chi^2$	$p - value$
Northern	Manufacturing Production	US Manufacturing Production	61.9	0.000*
Northern	ITAER	US Industrial Production	5.0	0.071
North-Central	Manufacturing Production	US Manufacturing Production	73.1	0.000*
North-Central	ITAER	US Industrial Production	0.8	0.380
Central	Manufacturing Production	US Manufacturing Production	87.1	0.000*
Central	ITAER	US Industrial Production	2.8	0.092
Southern	Manufacturing Production	US Manufacturing Production	15.0	0.000*
Southern	ITAER	US Industrial Production	9.1	0.002*

**Table B5: Granger Causality Tests for Growth Rates of Economic Activity and Manufacturing Production.**

**Note:** \* Denotes  $p - value$  consistent with 5% statistical significance for testing the hypothesis:  $H_0 =$  “Independent Variable Fails to Granger Cause Dependent Variable.”

**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

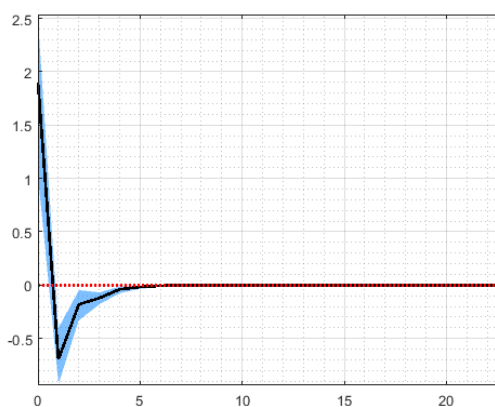
Region	Dependent Variable	Independent Variable	$\chi^2$	$p - value$
Northern	Manufactured Goods (INPC)	US PPI-Manufacturing	1.0	0.310
Northern	INPC	US CPI	26.3	0.000*
North-Central	Manufactured Goods (INPC)	US PPI-Manufacturing	1.3	0.261
North-Central	INPC	US CPI	1.2	0.265
Central	Manufactured Goods (INPC)	US PPI-Manufacturing	3.2	0.075
Central	INPC	US CPI	1.1	0.289
Southern	Manufactured Goods (INPC)	US PPI-Manufacturing	0.6	0.437
Southern	INPC	US CPI	16.8	0.018*

**Table B6: Granger Causality Tests for Inflation.**

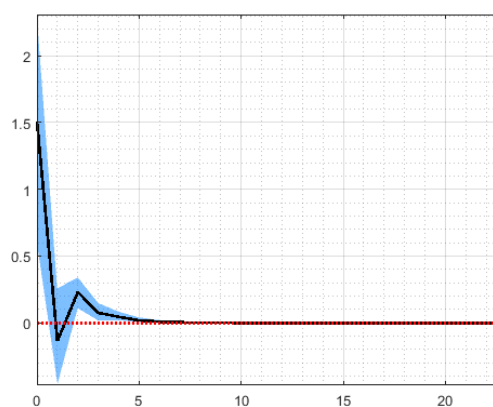
**Note:** \* Denotes  $p - value$  consistent with 5% statistical significance for testing the hypothesis:  $H_0 =$  “Independent Variable Fails to Granger Cause Dependent Variable.”

**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

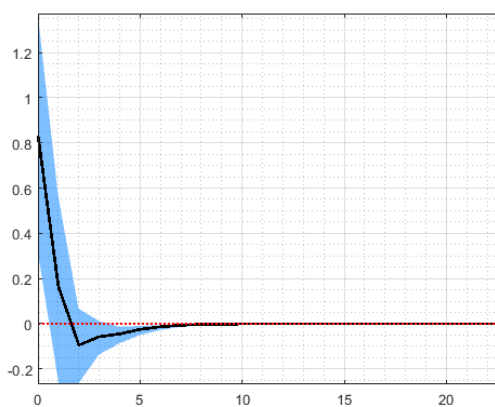
### Appendix C: Impulse Response Functions



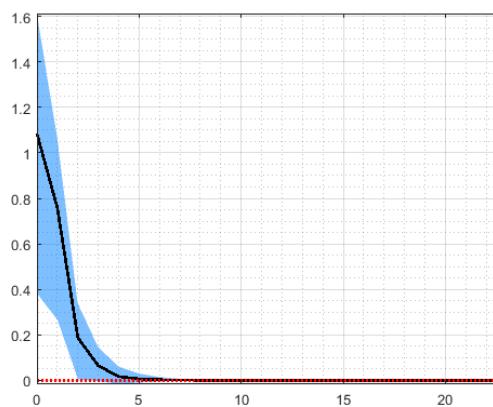
(a) Local Supply



(b) Local Demand



(c) External Supply

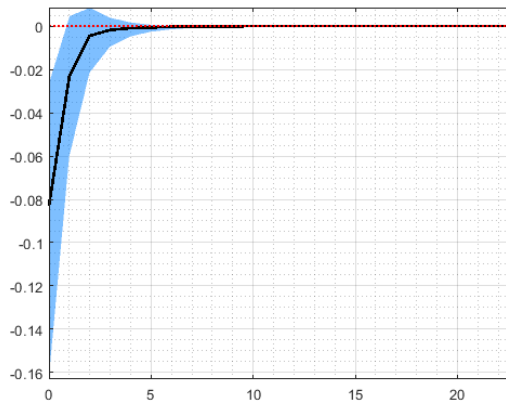


(d) External Demand

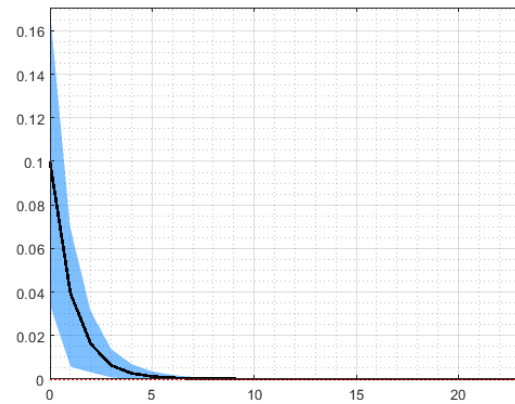
**Figure C1: (Northern Region). Impulse Response Functions of the Monthly Growth Rate of the Price Level of the Manufacturing Sector excluding Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

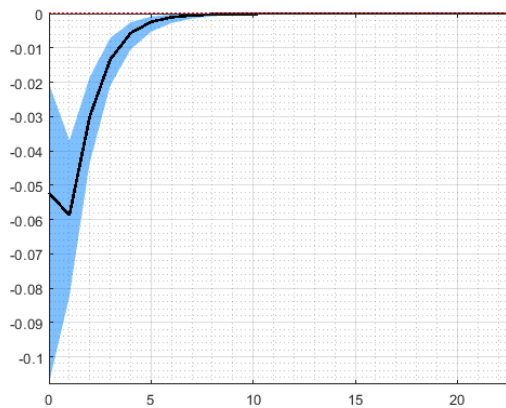
**Source:** Own estimates based on data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



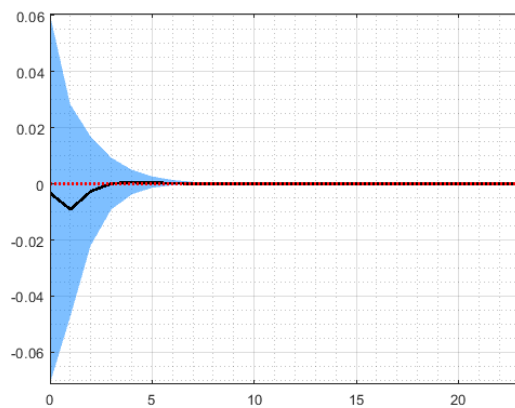
(a) Local Supply



(b) Local Demand



(c) External Supply



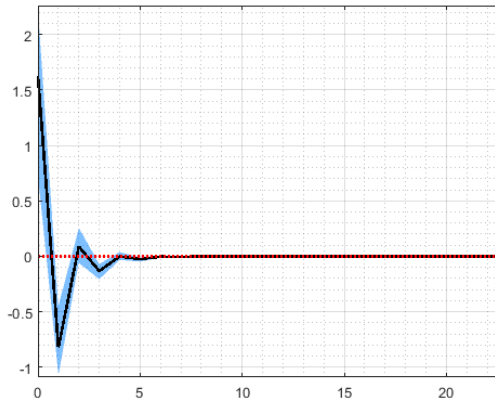
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**Figure C2: (Northern Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

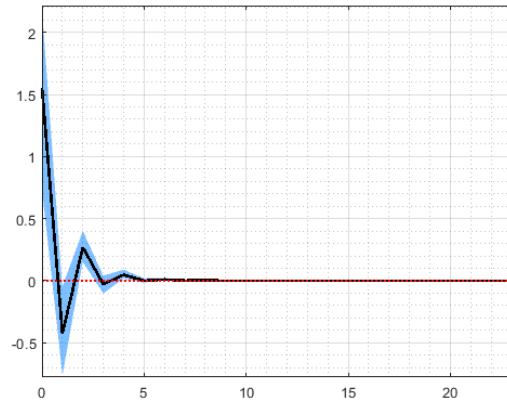
**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

**Source:** Own estimates based on data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

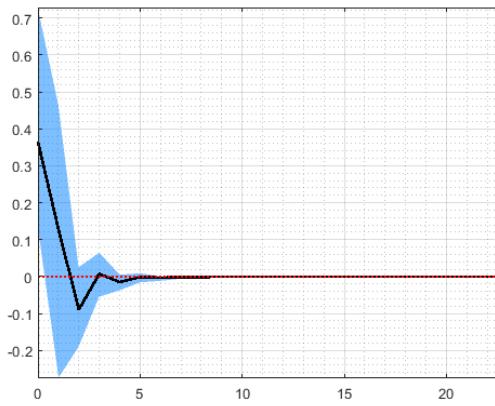




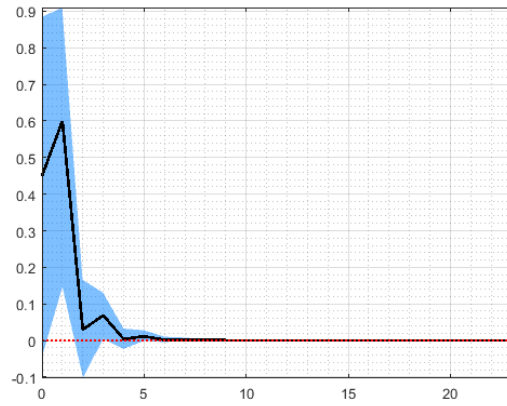
(a) Local Supply



(b) Local Demand



(c) External Supply

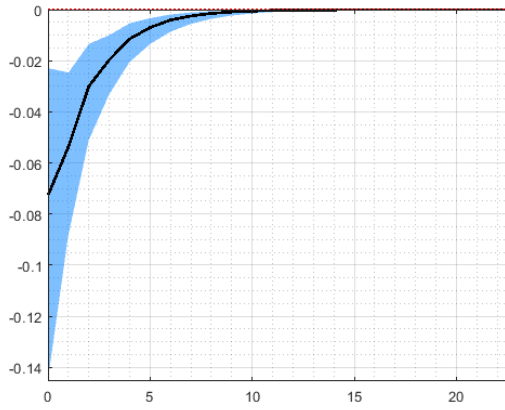


(d) External Demand

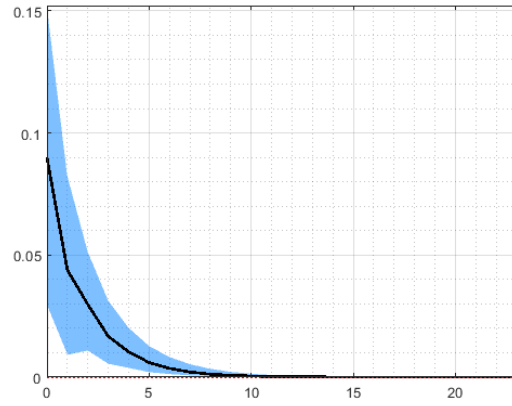
**Figure C3: (North-Central Region). Impulse Response Functions of the Monthly Growth Rate of the Production Level of the Manufacturing Sector excluding Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

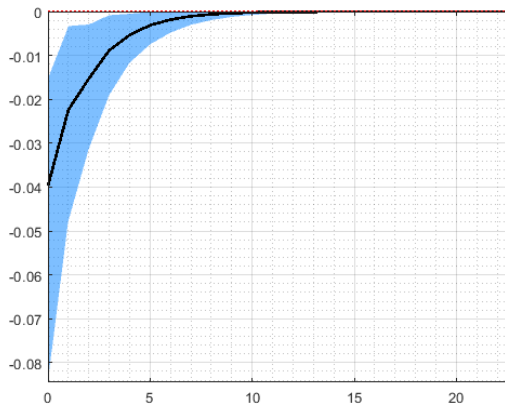
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



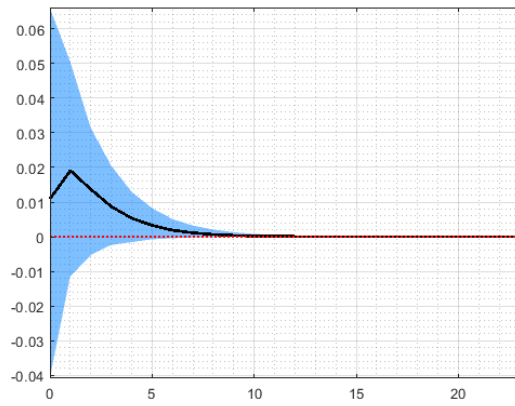
(a) Local Supply



(b) Local Demand



(c) External Supply

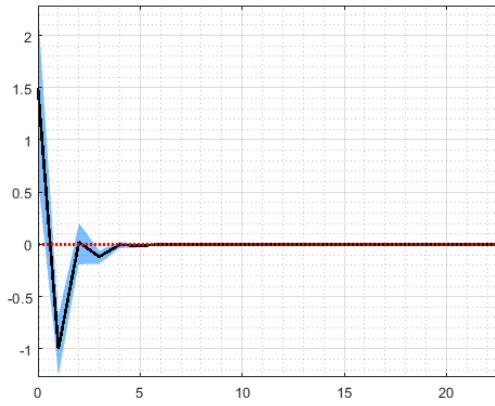


(d) External Demand

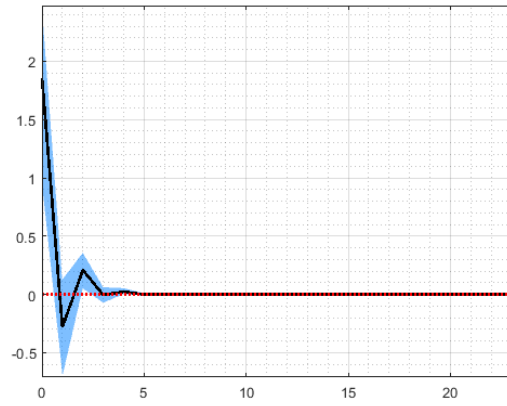
**Figure C4: (North-Central Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

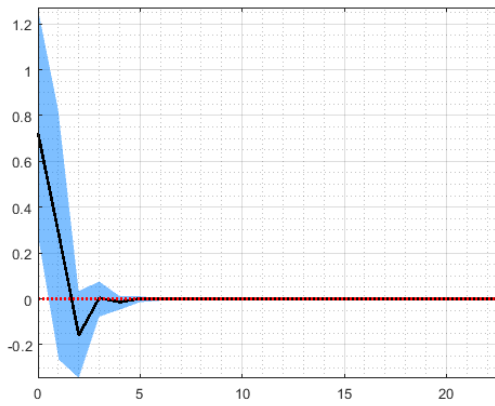
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



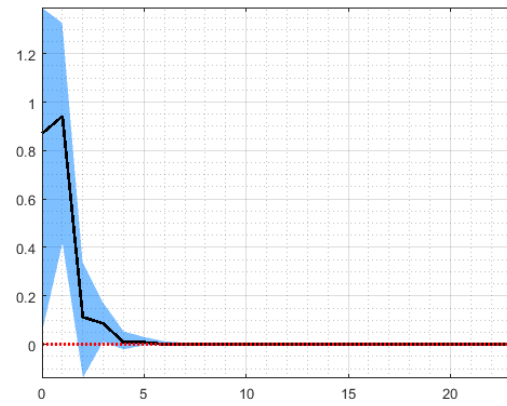
(a) Local Supply



(b) Local Demand



(c) External Supply

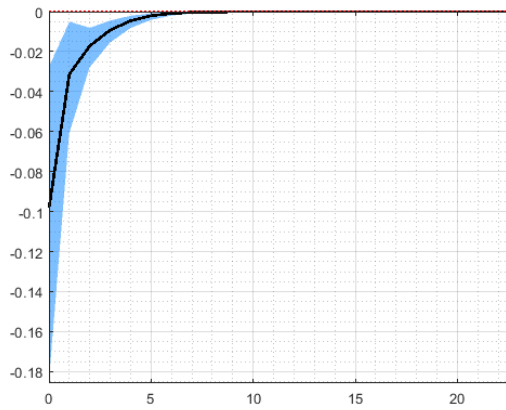


(d) External Demand

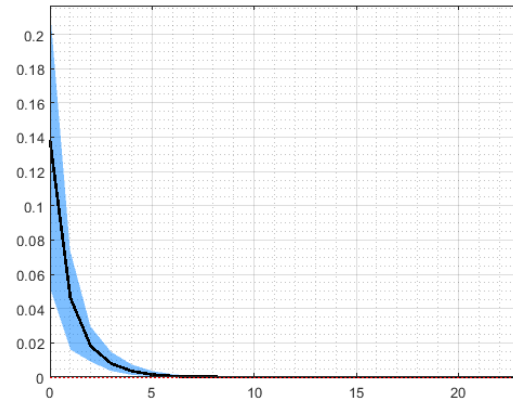
**Figure C5: (Central Region). Impulse Response Functions of the Monthly Growth Rate of the Production Level of the Manufacturing Sector excluding Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

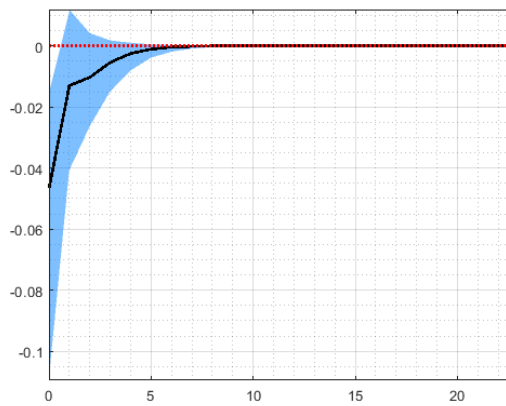
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



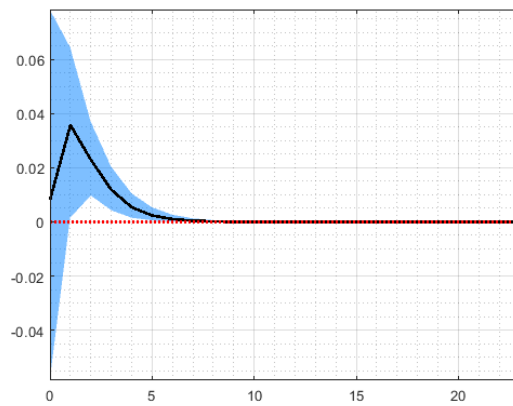
(a) Local Supply



(b) Local Demand



(c) External Supply

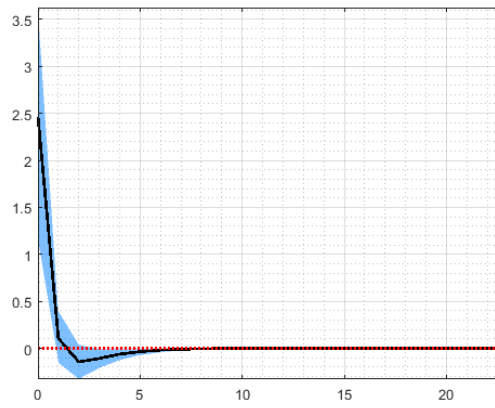


(d) External Demand

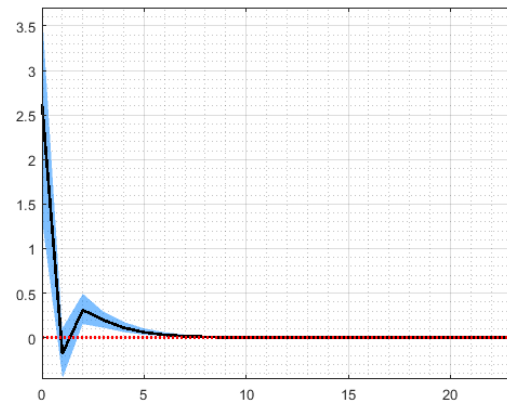
**Figure C6: (Central Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

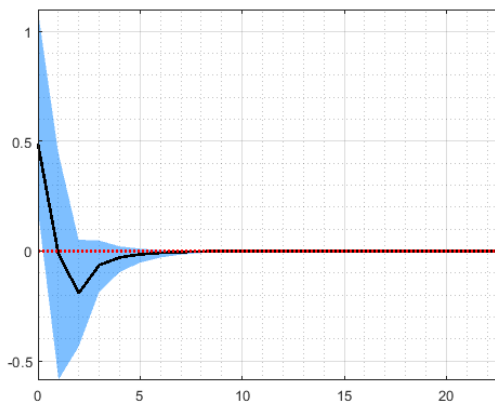
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



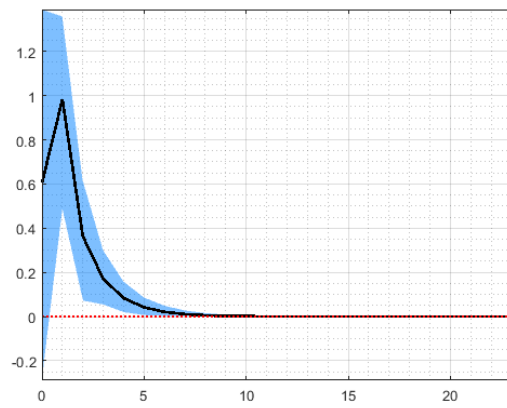
(a) Local Supply



(b) Local Demand



(c) External Supply

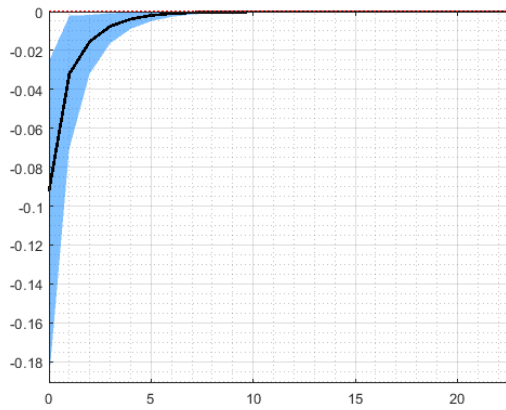


(d) External Demand

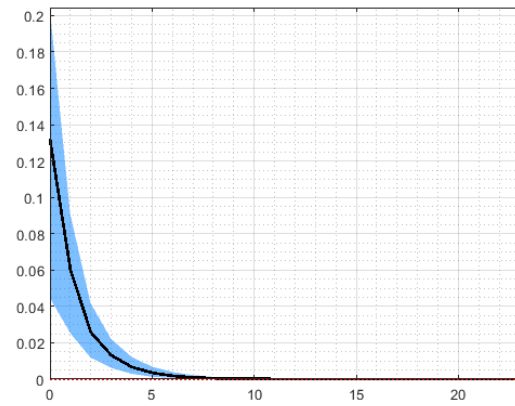
**Figure C7: (Southern Region). Impulse Response Functions of the Monthly Growth Rate of the Production Level of the Manufacturing Sector excluding Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

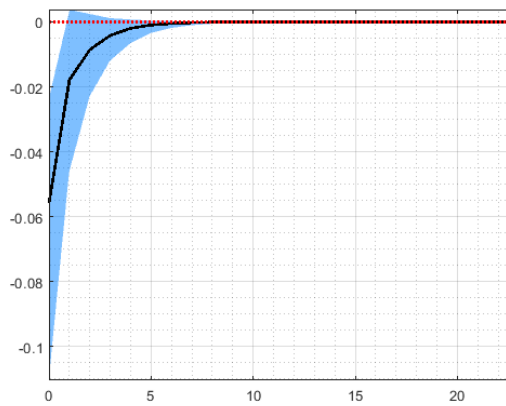
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



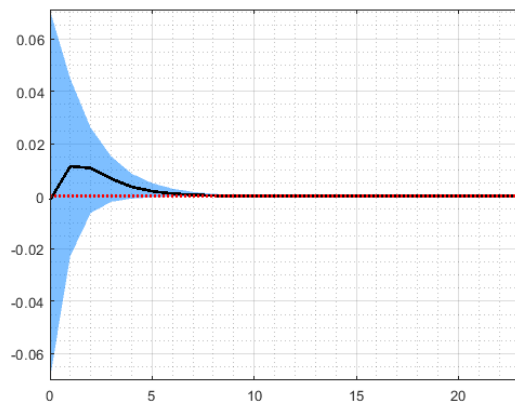
(a) Local Supply



(b) Local Demand



(c) External Supply

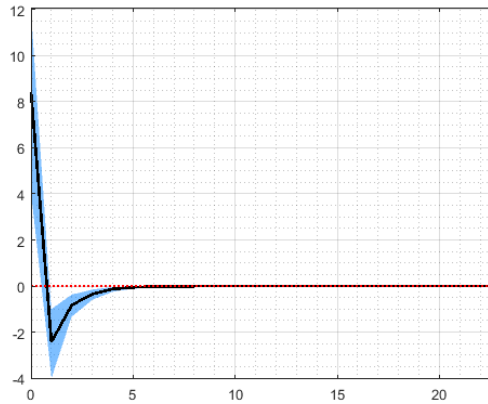


(d) External Demand

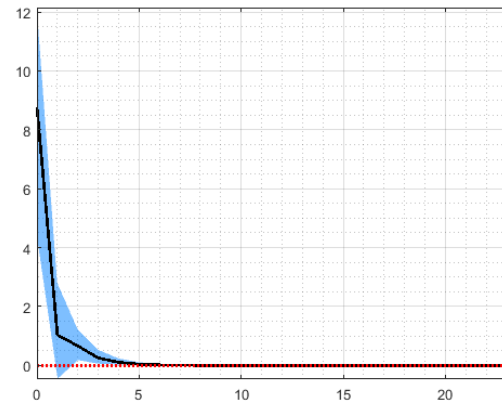
**Figure C8: (Southern Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

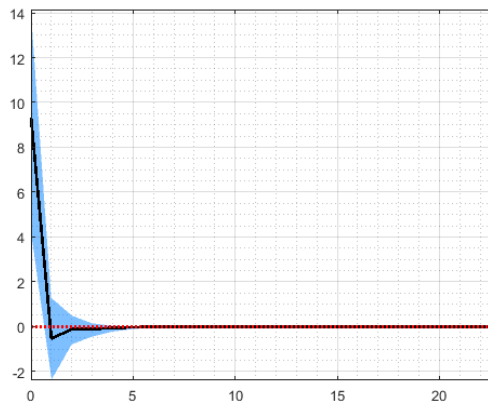
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



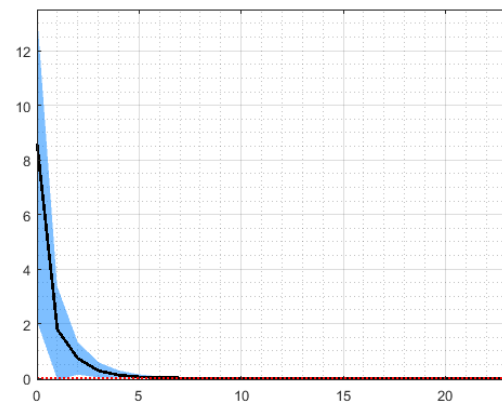
(a) Local Supply



(b) Local Demand



(c) External Supply

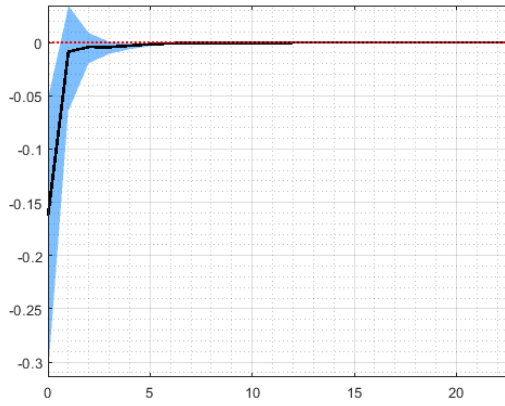


(d) External Demand

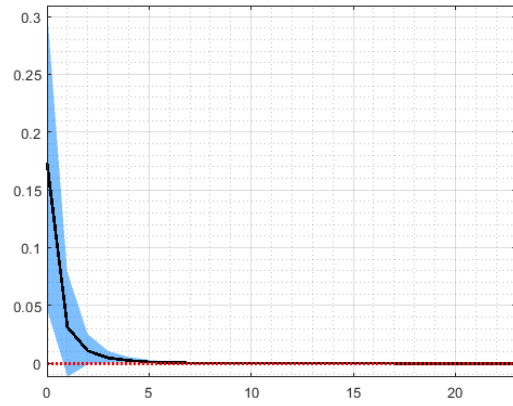
**Figure C9: (Northern Region). Impulse Response Functions of the Monthly Growth Rate of the Production Level of Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

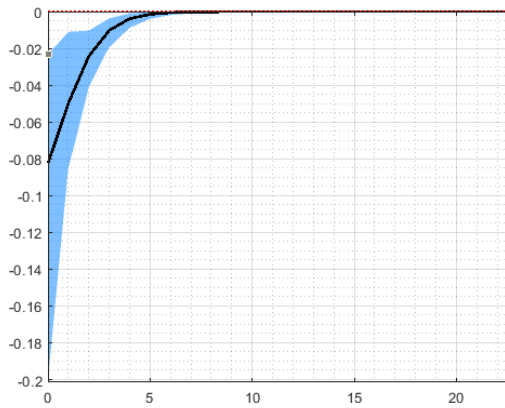
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



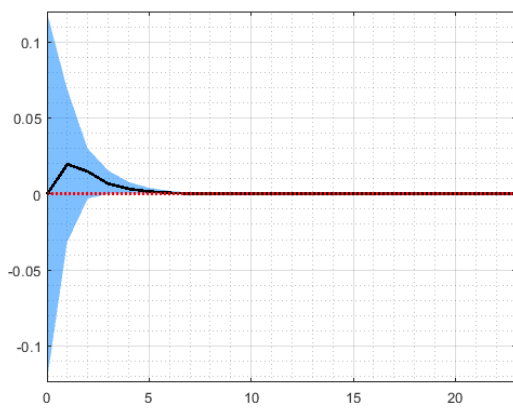
(a) Local Supply



(b) Local Demand



(c) External Supply



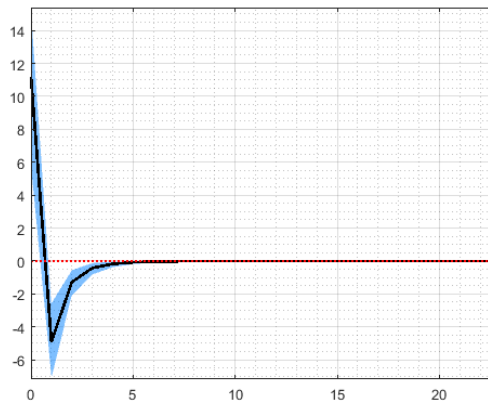
(d) External Demand

**Figure C10: (Northern Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

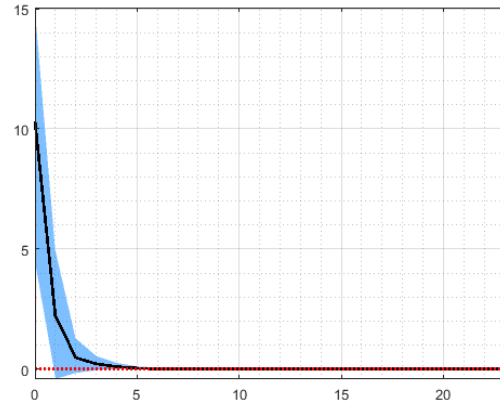
**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

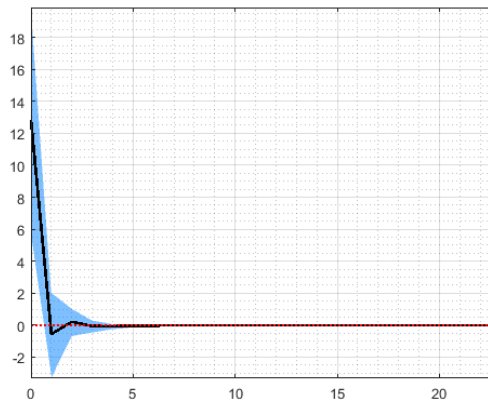




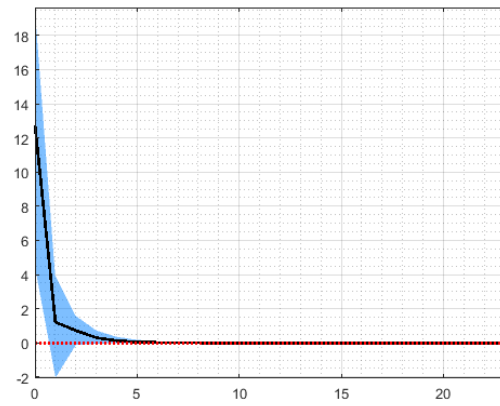
(a) Local Supply



(b) Local Demand



(c) External Supply

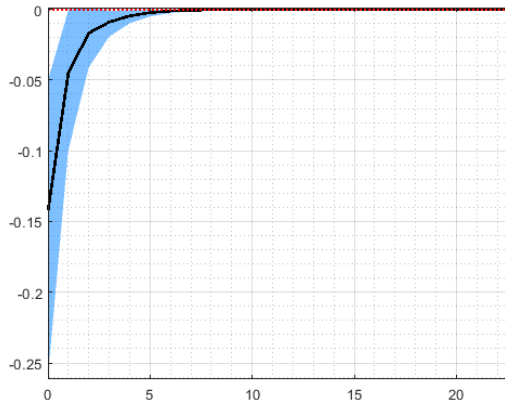


(d) External Demand

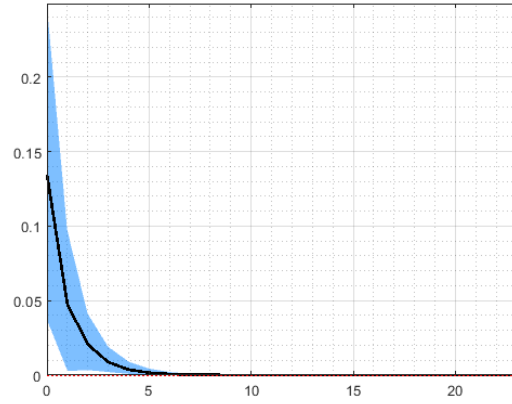
**Figure C11: (North-Central Region). Impulse Response Functions of the Monthly Growth Rate of the Production Level of Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

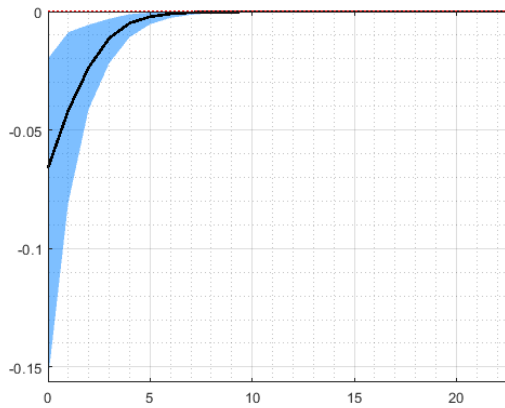
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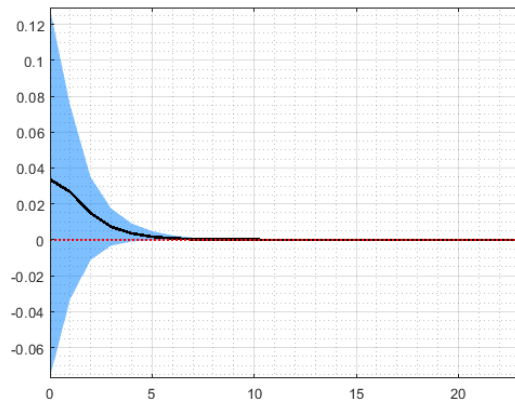
(a) Local Supply



(b) Local Demand



(c) External Supply

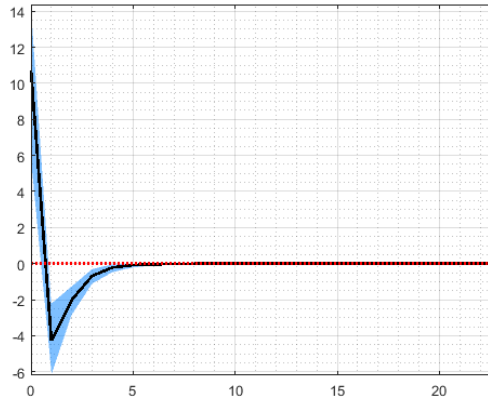


(d) External Demand

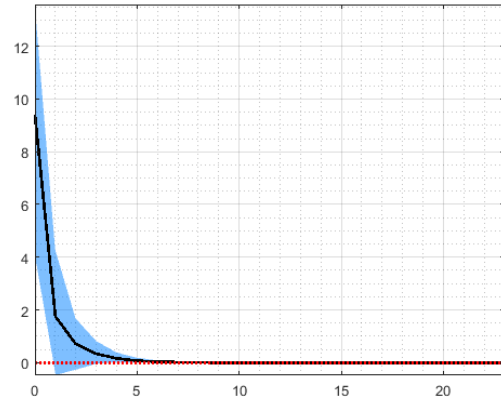
**Figure C12: (North-Central Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

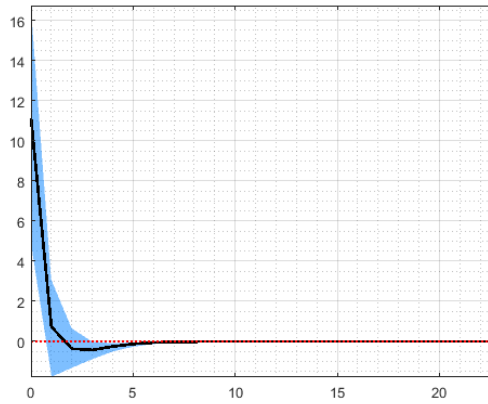
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



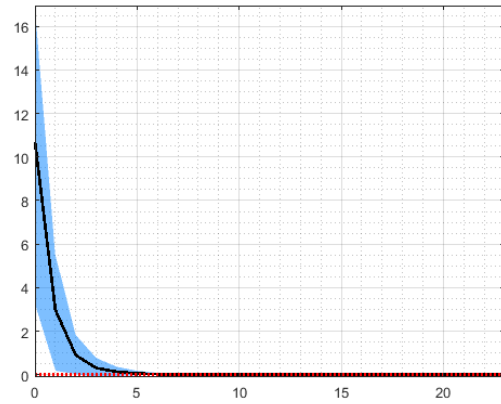
(a) Local Supply



(b) Local Demand



(c) External Supply

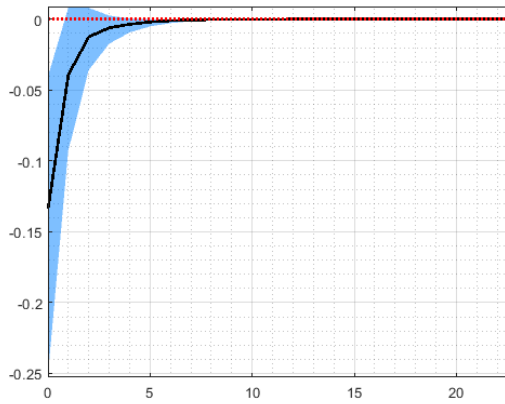


(d) External Demand

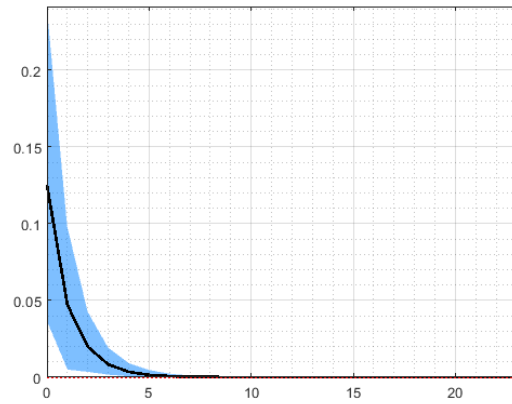
**Figure C13: (Central Region). Impulse Response Functions of the Monthly Growth Rate of the Production Level of Transportation Equipment to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

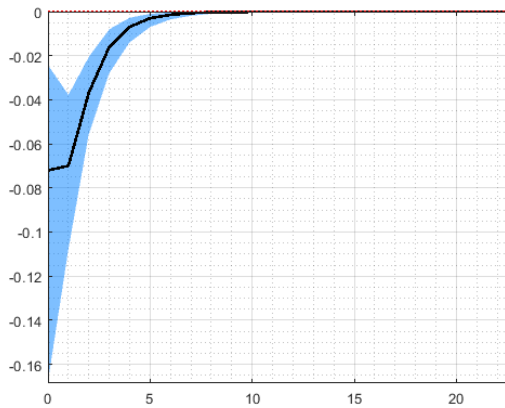
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



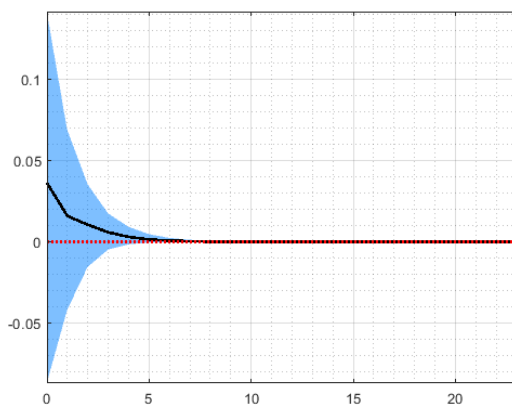
(a) Local Supply



(b) Local Demand



(c) External Supply

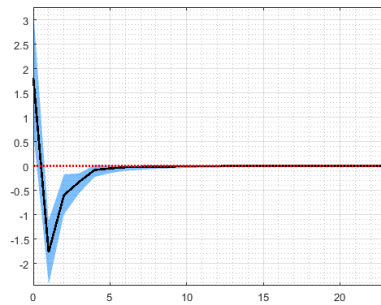


(d) External Demand

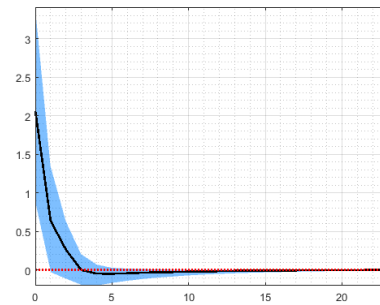
**Figure C14: (Central Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Cars and Motor Vehicle Parts to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

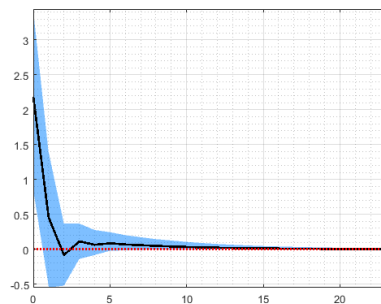
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



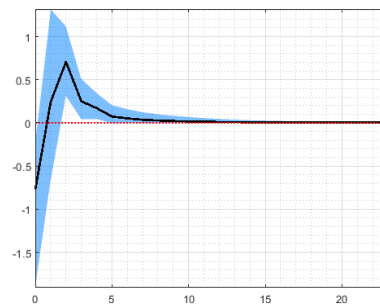
(a) Local Supply



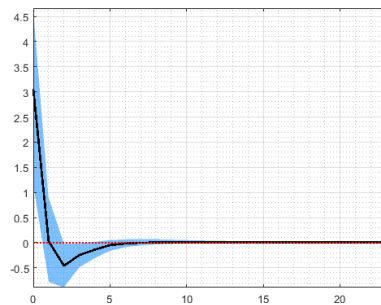
(b) Local Demand



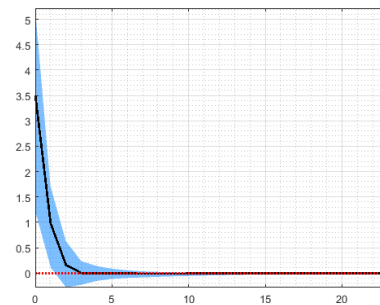
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply

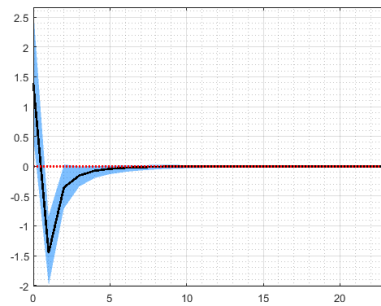


(f) External Demand

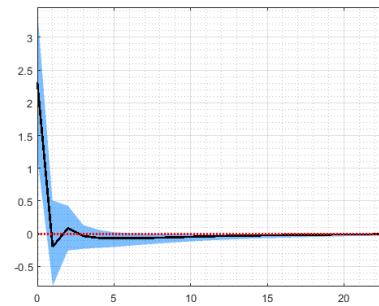
**Figure C15: (Northern Region). Impulse Response Functions of the Monthly Growth Rate of the Production Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

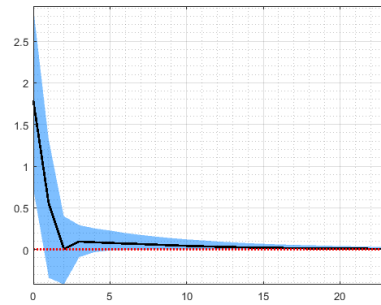
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



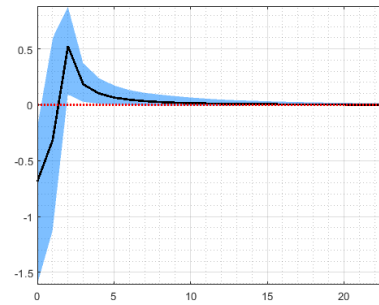
(a) Local Supply



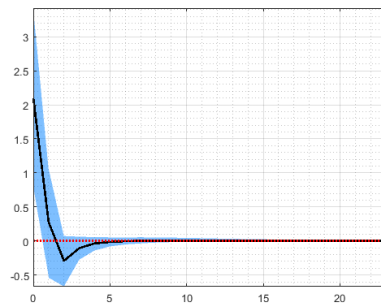
(b) Local Demand



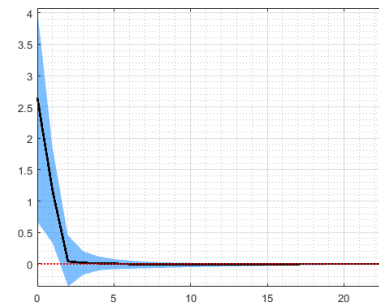
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply

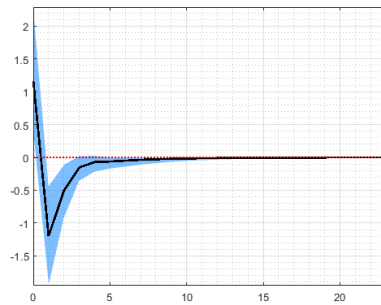


(f) External Demand

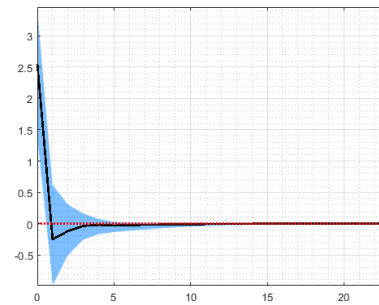
**Figure C16: (North-Central Region). Impulse Response Functions of the Monthly Growth Rate of the Production Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

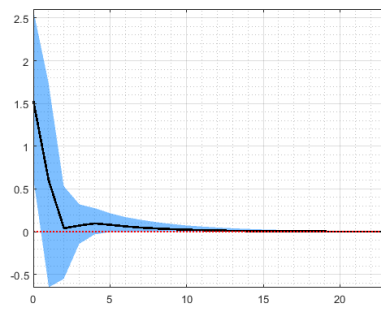
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



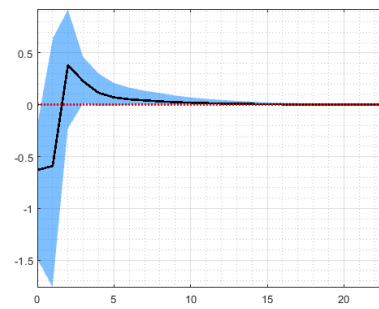
(a) Local Supply



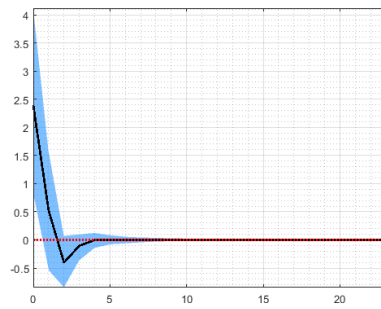
(b) Local Demand



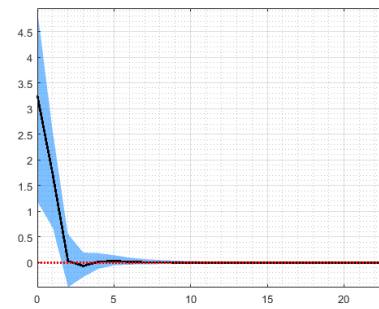
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply

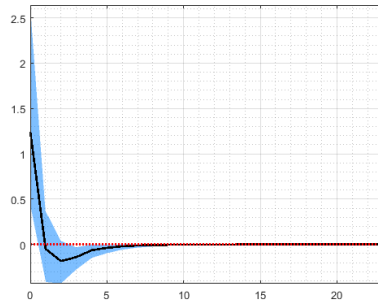


(f) External Demand

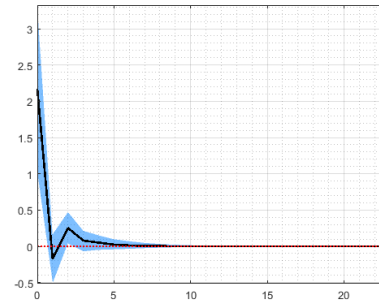
**Figure C17: (Central Region). Impulse Response Functions of the Monthly Growth Rate of the Production Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

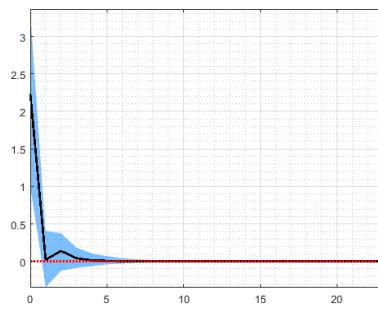
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



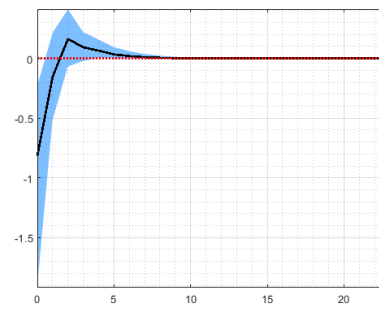
(a) Local Supply



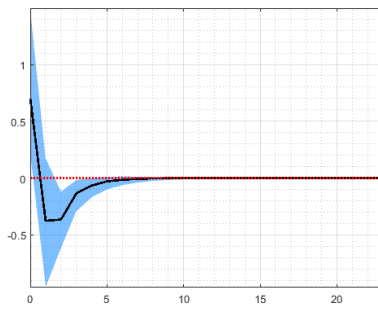
(b) Local Demand



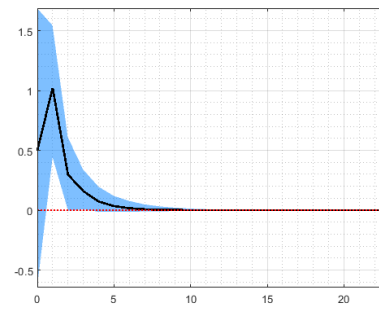
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply



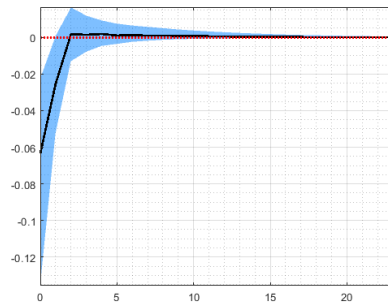
(f) External Demand

**Figure C18: (Southern Region). Impulse Response Functions of the Monthly Growth Rate of the Production Index of Manufactured Goods to the Indicated Structural Shock.**

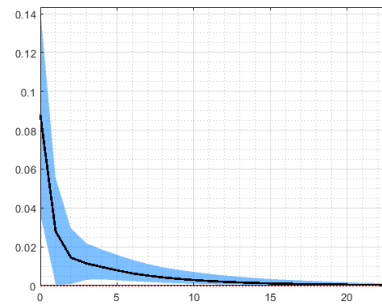
**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

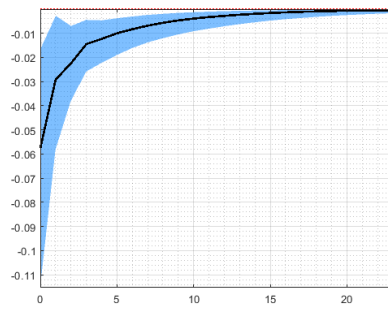




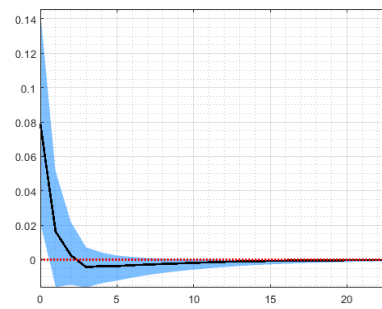
(a) Local Supply



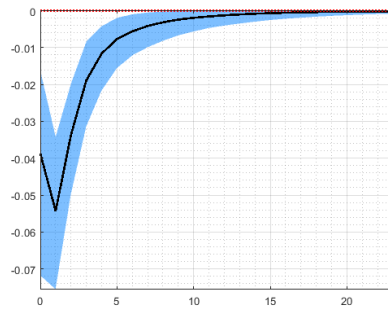
(b) Local Demand



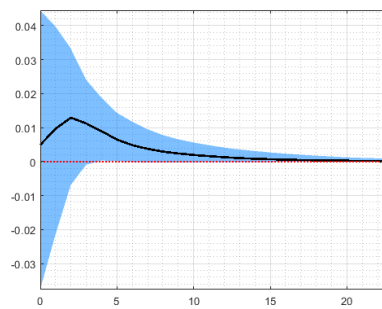
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply

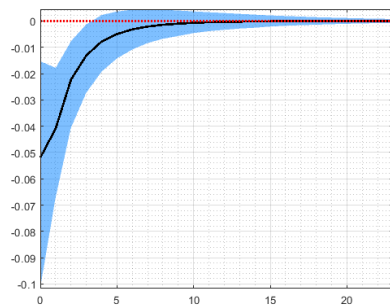


(f) External Demand

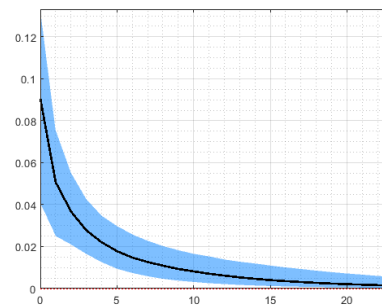
**Figure C19: (Northern Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

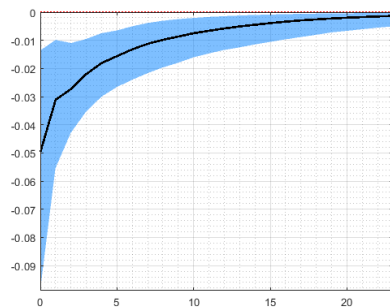
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



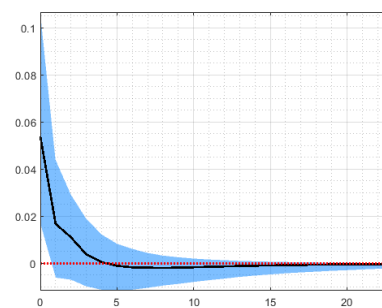
(a) Local Supply



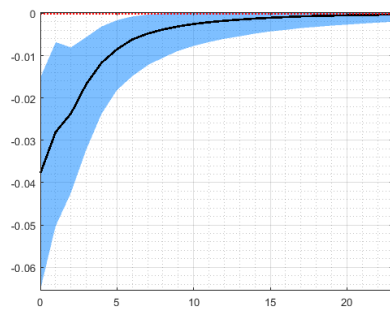
(b) Local Demand



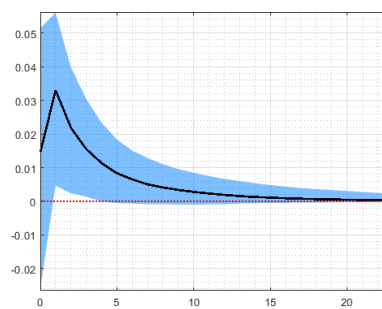
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply

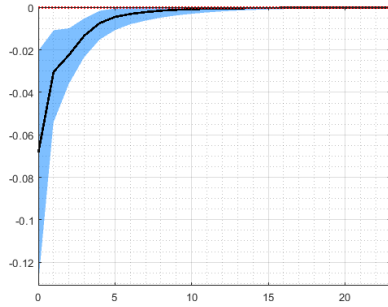


(f) External Demand

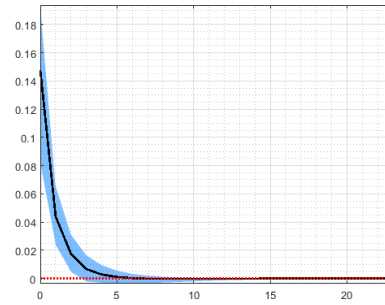
**Figure C20: (North-Central Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

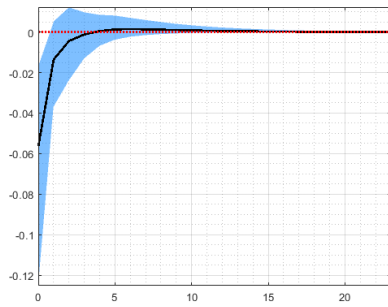
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



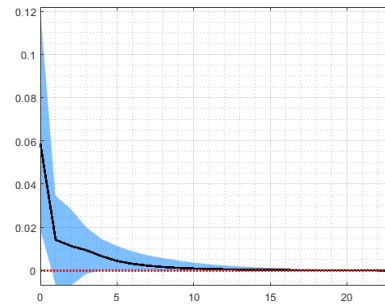
(a) Local Supply



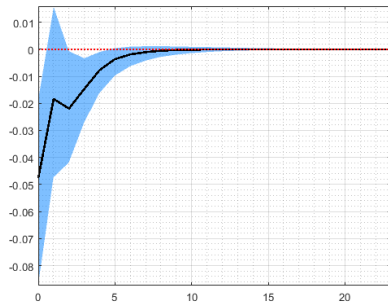
(b) Local Demand



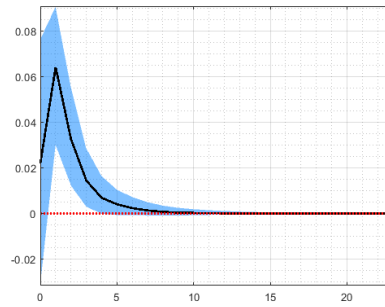
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply

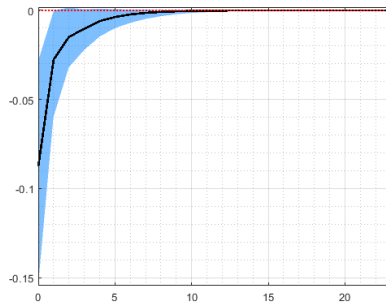


(f) External Demand

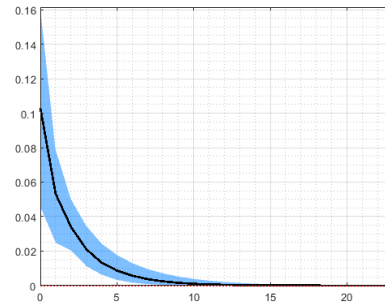
**Figure C21: (Central Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

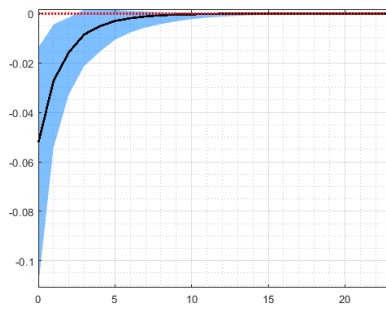
**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



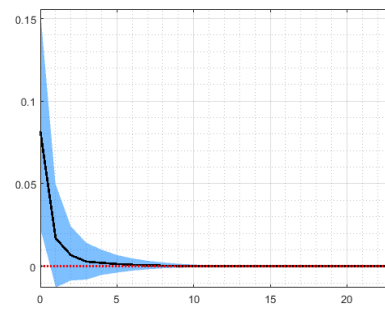
(a) Local Supply



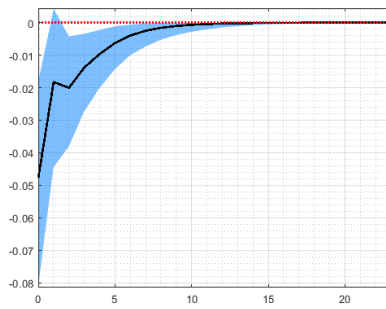
(b) Local Demand



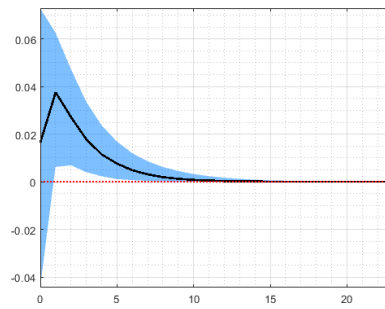
(c) Labor Supply



(d) Wage Bargaining



(e) External Supply



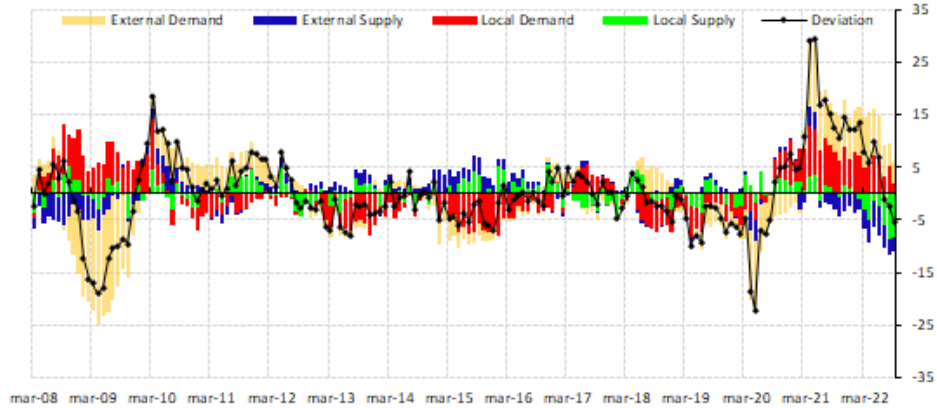
(f) External Demand

**Figure C22: (Southern Region). Impulse Response Functions of the Monthly Growth Rate of the Price Index of Manufactured Goods to the Indicated Structural Shock.**

**Notes:** Time in months (horizontal axis) and units in percent (vertical axis). Shaded area represents 68 percent credibility intervals.

**Source:** Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

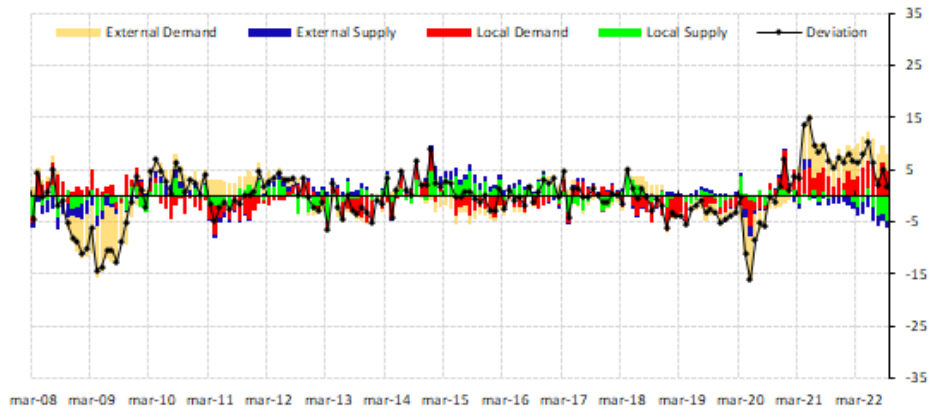
**Appendix D: Historical Shock Decompositions for Local Variables over the Full Sample Period**



**Figure D1: (Northern Region). Historical Decomposition of the Regional Production of the Manufacturing Sector excluding Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of the manufacturing production value excluding transportation equipment from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

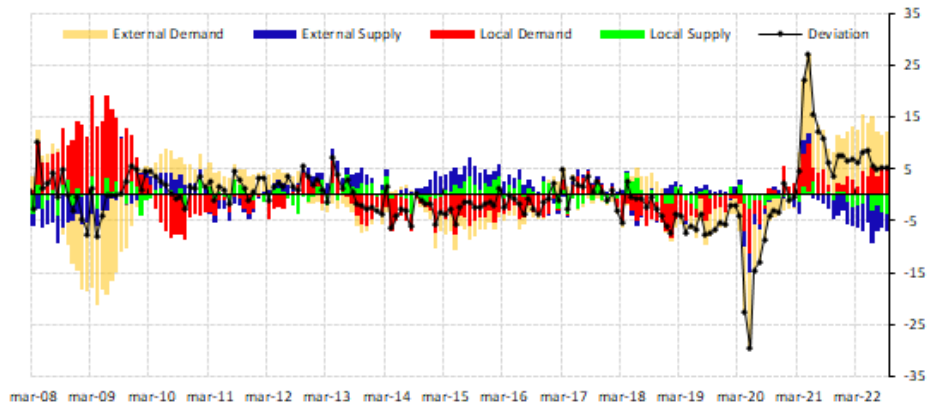
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D2: (North-Central Region). Historical Decomposition of the Regional Production of the Manufacturing Sector excluding Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of the manufacturing production value excluding transportation equipment from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

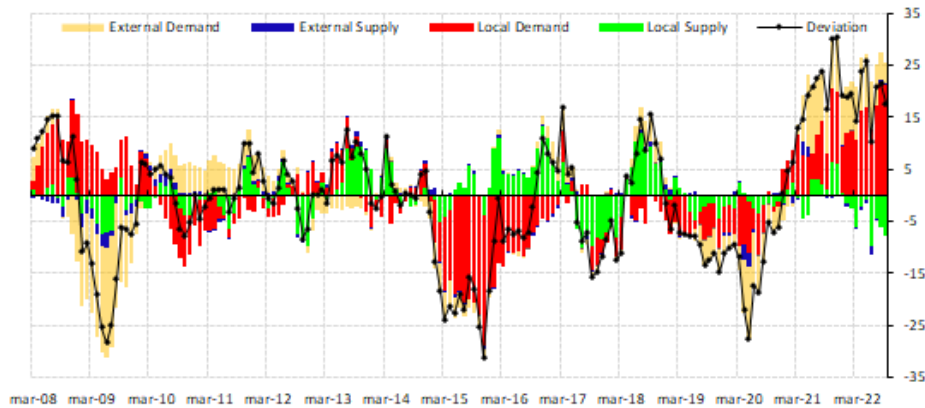
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D3: (Central Region). Historical Decomposition of the Regional Production of the Manufacturing Sector excluding Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of the manufacturing production value excluding transportation equipment from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

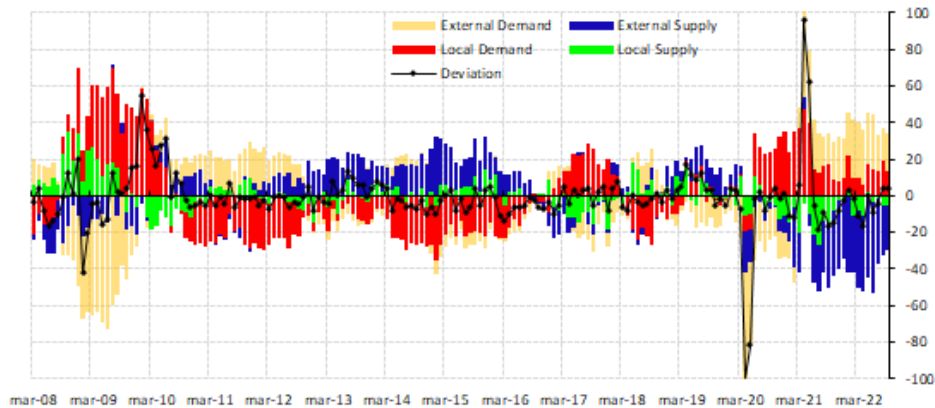
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D4: (Southern Region). Historical Decomposition of the Regional Production of the Manufacturing Sector excluding Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of the manufacturing production value excluding transportation equipment from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

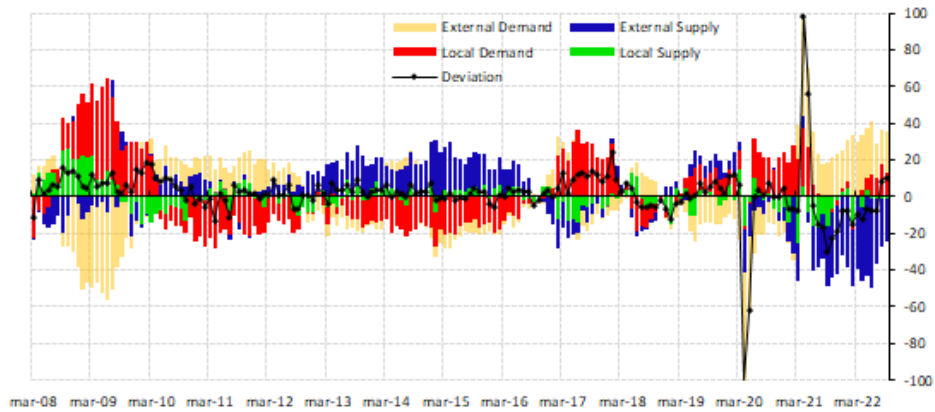
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D5: (Northern Region). Historical Decomposition of the Regional Production of Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of the transportation equipment production value from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

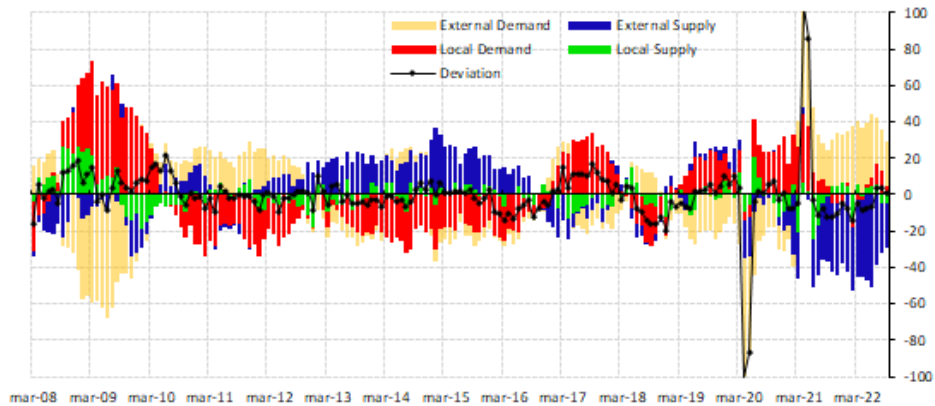
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D6: (North-Central Region). Historical Decomposition of the Regional Production of Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of the transportation equipment production value from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

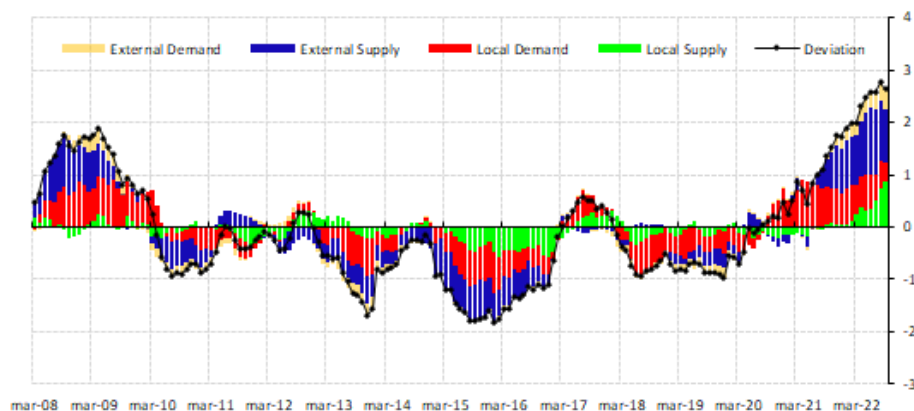


**Figure D7: (Central Region). Historical Decomposition of the Regional Production of Transportation Equipment.**

Note: The black line denotes the deviation of the real annual growth rate of of the transportation equipment production value from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.

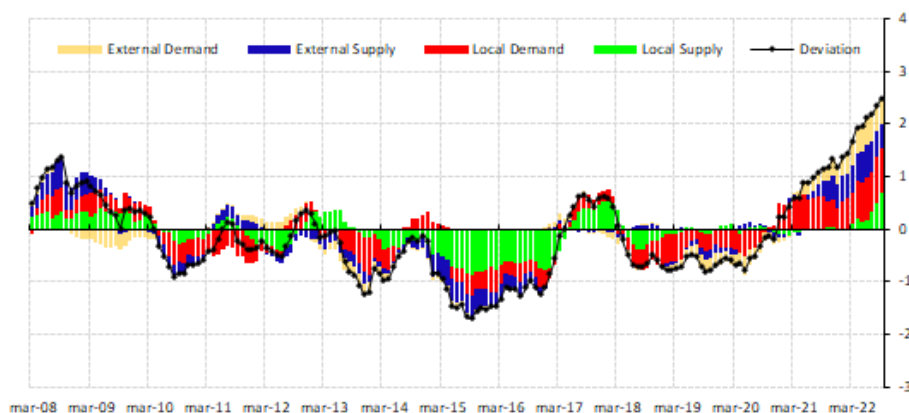




**Figure D8: (Northern Region). Historical Decomposition of the Regional Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods excluding cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

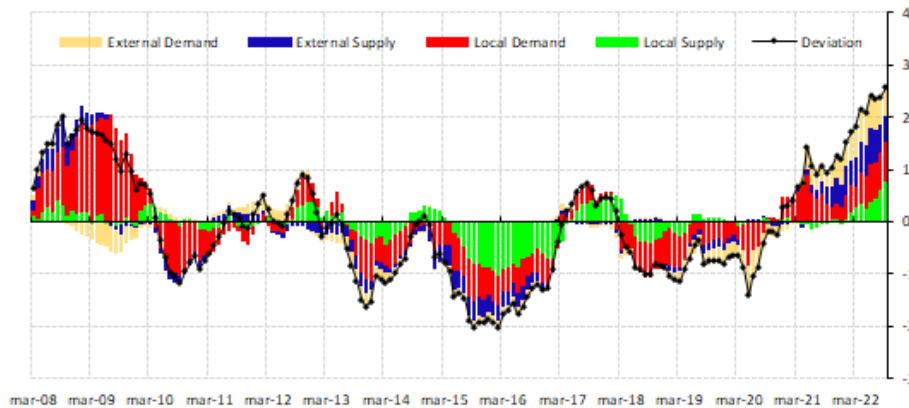
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D9: (North-Central Region). Historical Decomposition of the Regional Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods excluding cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

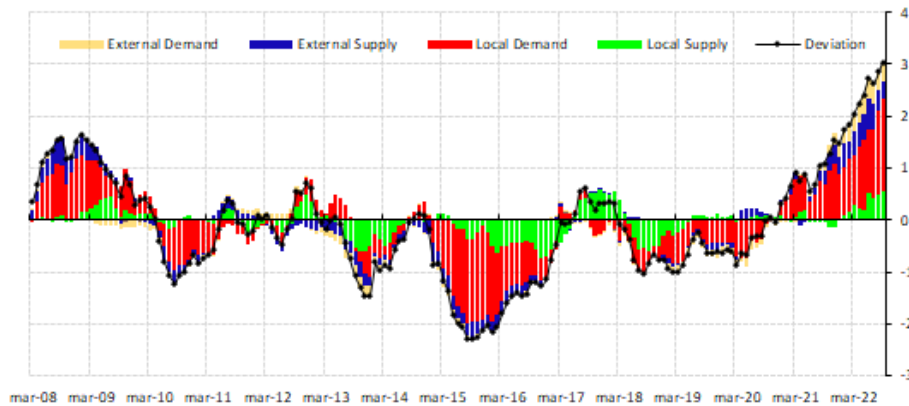
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D10: (Central Region). Historical Decomposition of the Regional Production of the Manufacturing Sector excluding Transportation Equipment.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods excluding cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

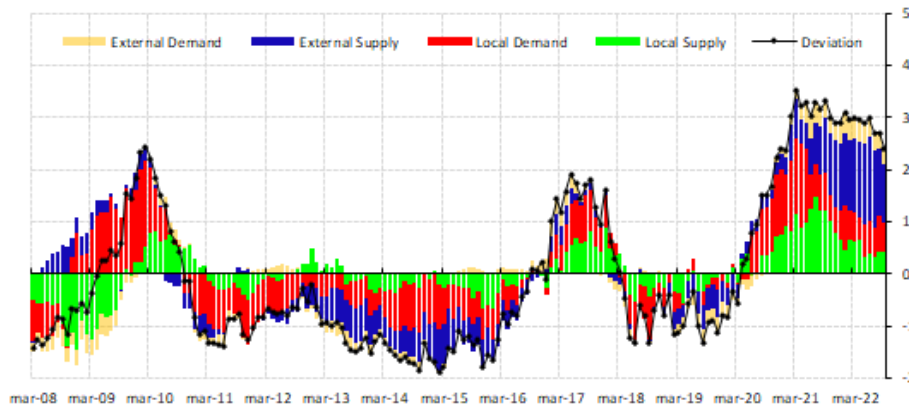
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D11: (Southern Region). Historical Decomposition of the Regional Price Index of Manufactured Goods excluding Cars and Motor Vehicle Parts.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods excluding cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

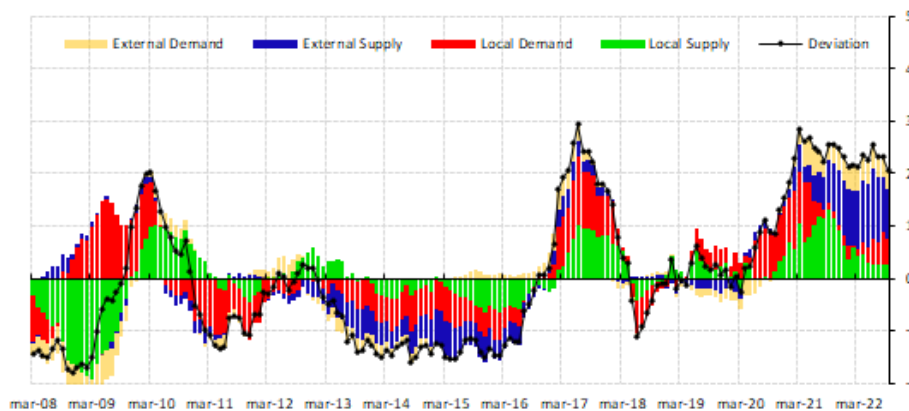
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D12: (Northern Region). Historical Decomposition of the Regional Price Index of Cars and Motor Vehicle Parts.**

Note: The black line denotes the deviation of the annual growth rate of the price index of cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

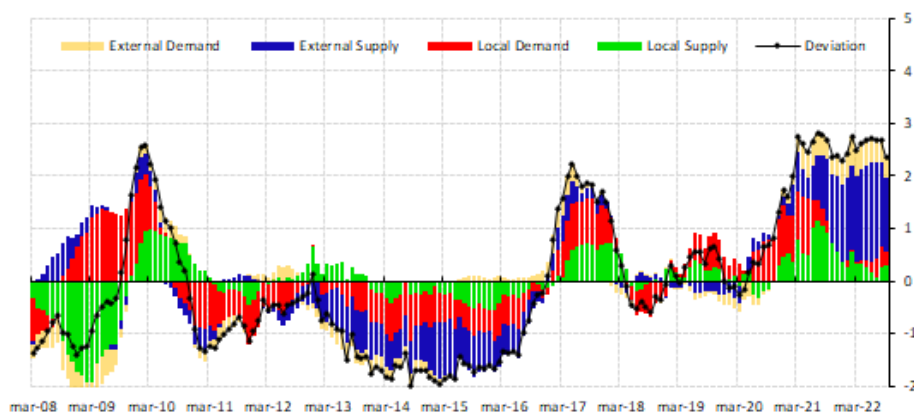
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D13: (North-Central Region). Historical Decomposition of the Regional Price Index of Cars and Motor Vehicle Parts.**

Note: The black line denotes the deviation of the annual growth rate of the price index of cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

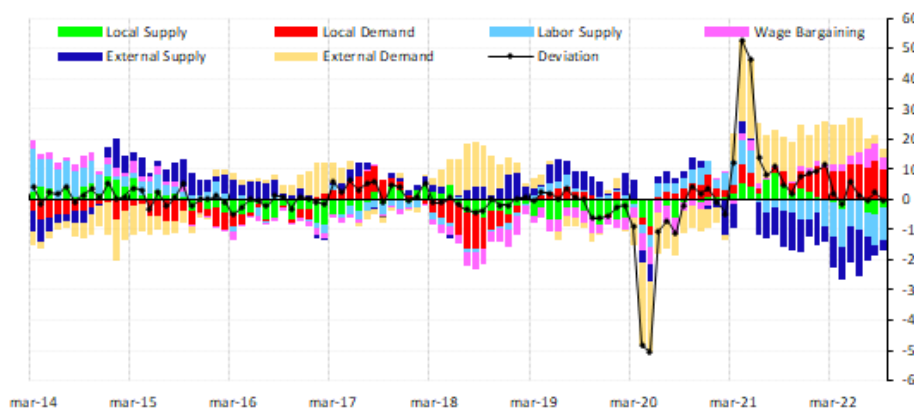
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D14: (Central Region). Historical Decomposition of the Regional Price Index of Cars and Motor Vehicle Parts.**

Note: The black line denotes the deviation of the annual growth rate of the price index of cars and motor vehicle parts from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2007 to September 2022.

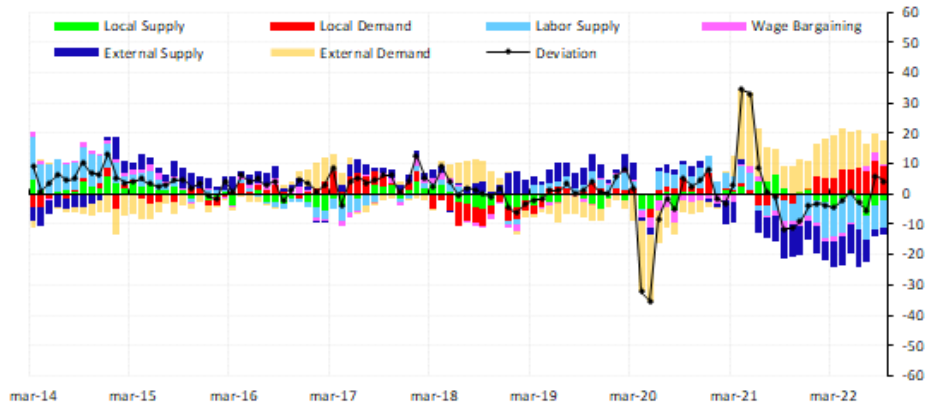
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D15: (Northern Region). Historical Decomposition of the Regional Production Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the production index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

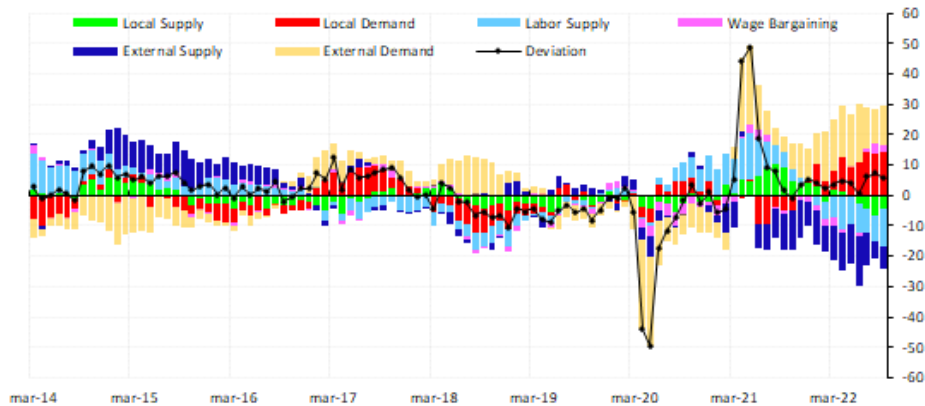
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D16: (North-Central Region). Historical Decomposition of the Regional Production Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the production index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

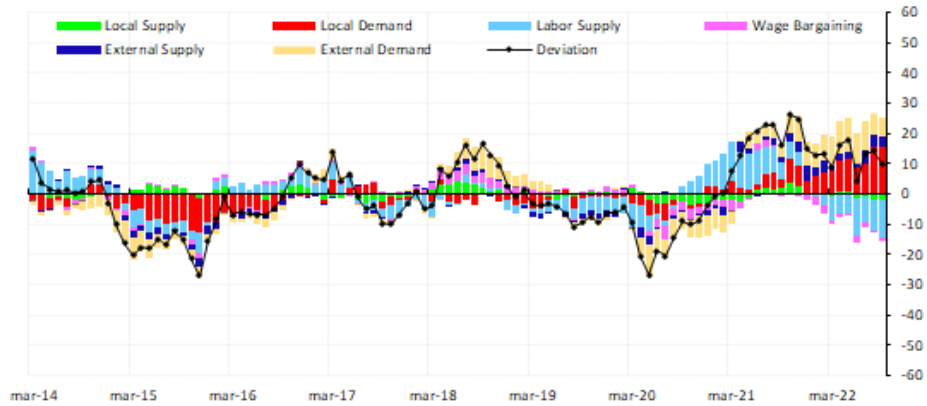
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D17: (Central Region). Historical Decomposition of the Regional Production Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the production index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

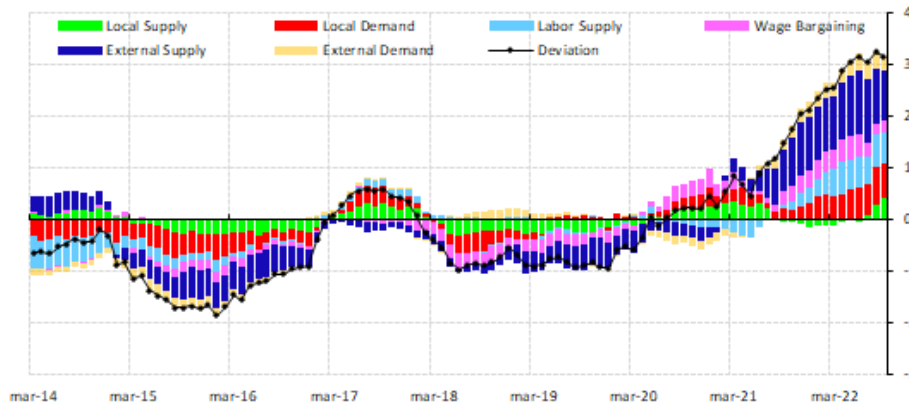
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D18: (Southern Region). Historical Decomposition of the Regional Production Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the production index of of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

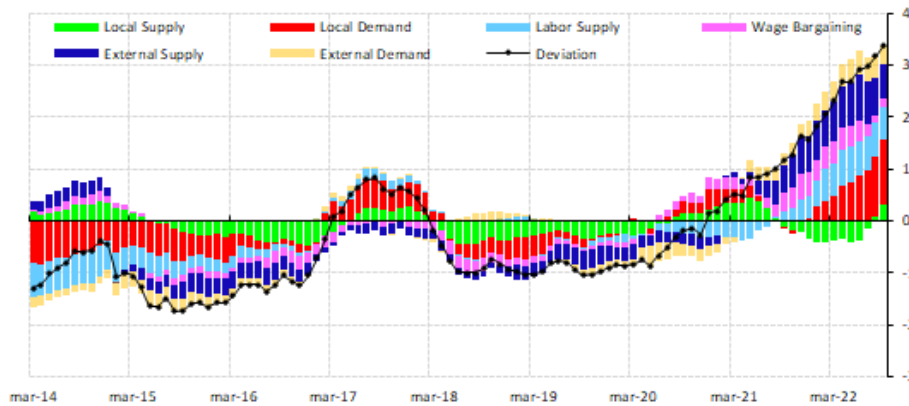
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D19: (Northern Region). Historical Decomposition of the Regional Price Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the production index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

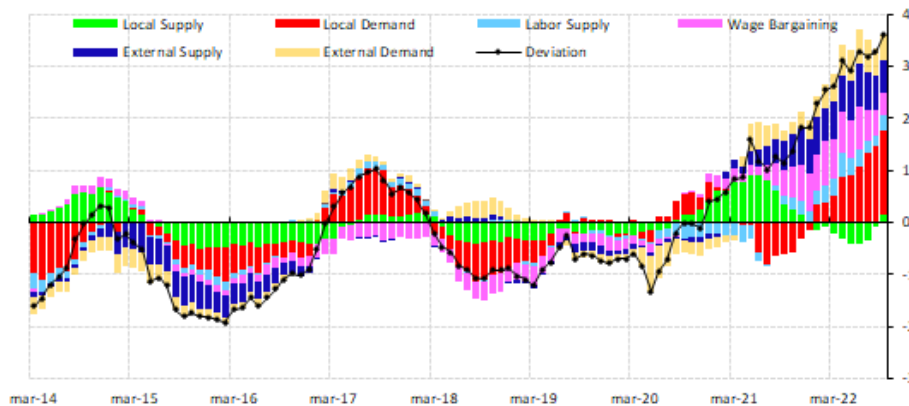
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D20: (North-Central Region). Historical Decomposition of the Regional Price Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

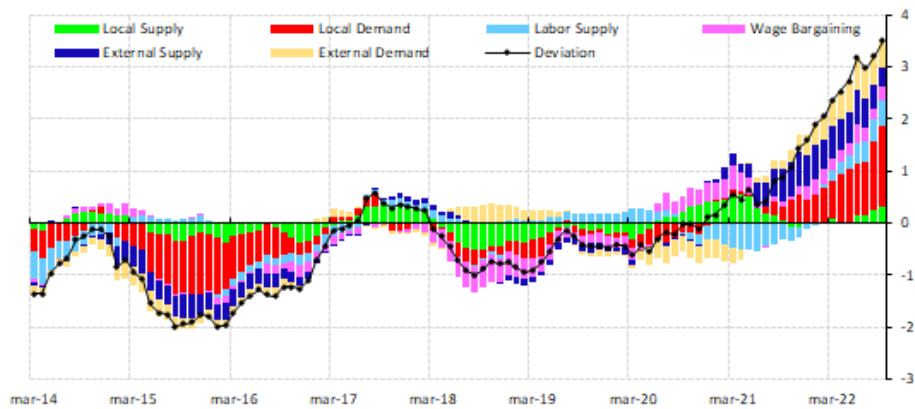
Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D21: (Central Region). Historical Decomposition of the Regional Price Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.



**Figure D22: (Southern Region). Historical Decomposition of the Regional Price Index of Manufactured Goods.**

Note: The black line denotes the deviation of the annual growth rate of the price index of manufactured goods from its long-term average. The annual variations and shock contributions are calculated from the twelve-month rolling sum of the monthly variations and contributions estimated with the model. The long-term mean corresponds to the period spanning February 2013 to September 2022.

Source: Own estimates using data from INEGI, Banco de México, and the Federal Reserve of St. Louis.