Revista de Análisis Económico, Vol. 41, Nº 2, pp. 103-142 (Octubre 2026)

TRANSITORY INFLATION SHOCKS: A STRUCTURAL VECTOR AUTOREGRESSIVE WITH EXOGENOUS VARIABLES (SVARX) MODEL FOR MEXICO*

CHOQUES TRANSITORIOS DE LA INFLACION: UN MODELO DE VECTORES AUTORREGRESIVOS ESTRUCTURALES CON VARIABLES EXOGENAS (SVARX) PARA MEXICO

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Abstract

The present study analyzes the impact of temporary economic shocks on inflation in Mexico. To this end, a structural vector autoregression model with exogenous variables (SVARX) was employed for the period 2001-2024. The monthly data are employed to evaluate the impact of temporary disturbances in demand and supply on inflation dynamics in Mexico. The findings of the study indicated that, in accordance with the short-term SVAR model, inflation in Mexico is predominantly influenced by shocks originating from the components of inflation (energy, education, and food), which collectively account for approximately 35% of the variance in inflation. Concurrently, a

* This document is part of the project «La movilidad de capital en el siglo XXI: una mirada a las instituciones y mercados de América Latina». The following paper is to be presented to the Programa de Apoyo a Proyectos de Investigación e Innovación Tecnológica (PAPIIT) at the Universidad Nacional Autónoma de México (UNAM).

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robust inertial component is evident, with approximately 53% of the variance in inflation being attributed to this component. In the long-run SVAR model, the inertial component remains important (approximately 51%), the share of the components of inflation rises to approximately 41%, mainly because of food prices, while the aggregate of monetary and real shocks contributes only about 8% of inflation fluctuations.

Keywords: *Inflation persistence, monetary policy, inflation expectations, inflation target, SVARX model.*

JEL Classification: *C32, E31, E32, E52, E58*

Resumen

Este estudio analiza el impacto de choques económicos temporales a la inflación en México, empleando un modelo de vectores autorregresivos estructurales con variables exógenas (SVARX) para el periodo 2001-2024, se utilizan datos mensuales para evaluar cómo las perturbaciones temporales en demanda y oferta impactan la dinámica inflacionaria en México. Se encontró que según el SVAR de corto plazo la inflación en México se encuentra determinada principalmente por los choques provenientes de los componentes de la inflación (energético, educativo y alimentario), ya que aproximadamente representan el 35% de la varianza en la inflación, a su vez, se observa un fuerte componente inercial, ya que cerca del 53% de la varianza en la inflación provienen de sí misma. En el SVAR de largo plazo el componente inercial se mantiene relevante (cerca del 51%), la participación de los componentes de la inflación aumenta a cerca del 41%, principalmente por los alimentos, mientras que la combinación de choques monetarios y reales representa apenas el 8% de las fluctuaciones de la propia inflación.

Palabras clave: *Persistencia de la inflación, política monetaria, expectativas de inflación, objetivo de inflación, modelos SVARX.*

Clasificación JEL: *C32, E31, E32, E52, E58*

INTRODUCTION

Inflation is one of the most difficult phenomena of macroeconomic theory to explain. The specialized literature groups its explanations into three main approaches. The first approach focuses on imbalances in aggregate demand, and the second on

structural distortions of the economy. Both are shaped by several factors, such as demand shocks, fiscal and monetary policies, and their interaction with real indicators of economic activity. The third approach holds that current inflation will probably remain close to its levels in previous periods because of the inertia accumulated in the past (Gutierrez & Zurita, 2006).

Friedman & Schwartz (1963) and Cole (2007) examine the relationship between the money supply and changes in inflation within a monetary framework; their research focuses on the United States over a specific historical period (1867–1960). Later studies applied this approach and its methodology to the Mexican case. Their findings indicate that large fluctuations in the money supply tend to translate into higher inflationary pressures over the medium term.

Changes in inflation and in monetary aggregates can significantly affect economic activity, and the reverse also holds. For instance, an increase in inflationary levels, resulting from an acceleration in the generalized rise in prices, can lead to a greater availability of money in circulation. This, in turn, may have adverse effects on the purchasing power of consumers and the investment levels of companies. In their studies on the relationship between monetary aggregates and economic activity in Mexico, Sánchez *et al.* (2001) and Ortiz (2002) investigate the impact of money supply fluctuations on economic growth and inflation in Mexico.

In the case of Mexico, Rodríguez & Pérez (2017) investigate the relationship between some macroeconomic indicators such as the consumer price index (CPI), the monetary aggregate (M1), economic activity and the interest rate. Consequently, understanding the dynamics between these variables is fundamental given their capacity to affect aggregate economic performance.

Galindo and Jaime (2018) identify three distinct phases in the conduct of monetary policy and the exchange rate regime in Mexico since the 1990s. The first phase, preceding the 1994 crisis, involved an exchange rate target within a regime of exchange rate bands. In the second phase, a monetary aggregate targeting regime was introduced together with a period of free floating of the exchange rate, which was cut short by the 1994 crisis. The third phase began with a transition in 1995 and led to the adoption of an inflation targeting policy in 1999. This entailed the announcement by Banco de México of a medium-term inflation target based on the consumer price index, with the institution subsequently commencing the publication of quarterly reports on the evolution of inflation from 2000 onwards.

Since 2000, the monetary policy of the Banco de México has sought to influence interest rates in such a way that price developments are congruent with the evolution of inflation towards its long-run target, on the assumption that inflation hampers economic growth. According to Dossche & Everaert (2004), it is generally accepted that in the medium and long run inflation is a monetary phenomenon (determined by monetary policy). However, in the short run, it is possible that a number of macroeconomic variables, such as changes in economic activity or production costs, may temporarily push inflation away from the central bank's target.

Thus, inflation in Mexico has been volatile in recent decades, with periods of high inflation interspersed with periods of moderate inflation, which suggests that this is at least partly due to temporary shocks in some macroeconomic indicators. This makes it necessary to examine the extent to which the recent evolution of the monetary aggregate (M1) has influenced the inflationary dynamics observed in recent years, also taking into account the role of other determinants of inflation and changes in the monetary policy framework of the Banco de México.

The aim of the present research is to analyze the nature of inflationary shocks, including the role of the monetary aggregate (M1) relative to other determinants. This paper investigates the link between changes in inflation and changes in different macroeconomic fundamentals, both monetary and real. In order to achieve this objective, the paper is structured as follows: the first section presents a literature review, the second section outlines the methodology, the third section displays the results obtained, and finally, the fourth section presents the main conclusions.

1. LITERATURE REVIEW

1.1. Analysis of Inflation Persistence and Inflation Targeting

The study of the impact of shocks, whether short or long term, requires attention, as well as an investigation of their persistence in times of stability or crisis. Therefore, research is important to provide an appropriate policy response to soften the effects of transitory shocks on the economy. In measuring the historical persistence of inflation, a common practice in empirical time series research is to use univariate autoregressive (AR) models and calculate this persistence as the sum of the estimated AR coefficients (Levin *et al.*, 2004). From these models, it is observed that high to very high inflation persistence implies that persistence is a random walk. It is crucial to acknowledge that the estimation of this elevated persistence must be interpreted as an unconditional measure of inflation persistence, as this body of literature does not account for the possibility that the inflation data generation process may comprise a number of discrete components, each exhibiting its own level of persistence (Dossche & Everaert, 2004).

Dossche & Everaert (2004) identify several factors behind the historical persistence of inflation.

1. Over the past four decades, the monetary policy strategies of industrialized economies changed considerably, and these changes later shaped the inflation targeting approaches of central banks in less developed economies. This has resulted in the emergence of a non-stationary component in observed inflation series.
2. As a consequence of information asymmetry and imperfect credibility, private agents may perceive the central bank's inflation target differently from its actual

value. Persistence of such deviations can be defined as expectations-based persistence.

3. The sluggish response of inflation to various macroeconomic shocks is likely to be associated with the mechanisms governing wage and price setting. In the event that wages and prices are adjusted infrequently, the effects of these shocks will be incorporated gradually, which will result in a reduction of deviations from the observed inflation rate.
4. The persistence of inflation is contingent upon the persistence of the various macroeconomic shocks that affect inflation. For example, persistent deviations of output from its potential level can be considered a form of extrinsic inflation persistence.

It is thus evident that in order to obtain a reliable estimate of the various forms of inflation persistence, it is essential to consider all the aforementioned components when developing the inflation data generation process. First, it is necessary to consider the effect of permanent changes in the central bank's inflation target, which give rise to permanent changes in inflation. This is because standard AR models assume that inflation has a stable mean, and thus these changes induce an upward bias in the measured inflation persistence. Secondly, in the event that the inflation target set by the central bank is not transparent to economic agents or perceived as unreliable, the inflation targets as understood by these agents may diverge from the actual target set by the central bank. In this instance, the measurement of intrinsic and extrinsic inflation persistence should be conducted in accordance with the persistence of inflation deviation. Thirdly, a reliable estimate of intrinsic and extrinsic inflation persistence also requires modeling the persistence of the macroeconomic shocks that affect inflation.

1.2. Empirical Background to the Study of Inflation Targeting

After the 1994 crisis, Mexico adopted a series of economic policies aimed at keeping inflation low and stable. Several theories examine how inflation affects economic growth. Okun (1971) and Friedman (1977) argued that inflation creates uncertainty that hampers decision-making and, ultimately, economic growth. The link between inflation and the money supply, in turn, rests on the quantity theory of money, according to which the quantity of money determines the price level in the long run. Over shorter horizons, however, other factors such as demand, production, and expectations also influence inflation.

To study transitory shocks in time series, early researchers first used univariate methods to identify the sources of economic fluctuations in developed economies, focusing in particular on the behavior of output. In this regard, Nelson & Plosser (1982) used a historical time series for the United States to test the unit root hypothesis. The authors could not reject the null hypothesis of a unit root, which shows that the series were generated by a non-stationary process with no tendency to revert to a trend line. In contrast, theorists such as Campbell & Mankiw (1987)

argued that output fluctuations are not merely temporary deviations. Their findings indicated that an unexpected change in real gross national product (GNP) of one percent should result in a forecast change of more than one percent over an extended period (León, 2018).

Multivariate approaches have been used since the 1980s to study the importance of permanent and transitory shocks in a set of macroeconomic variables; these methods are preferable because they use information from several time series and treat shocks independently, this treatment allowing a structural interpretation. Shapiro & Watson (1988), Bullard & Keating (1995), Keating & Nye (1998) and Perilla (2010) used the vector autoregressive model (VAR) to study how output fluctuations are the result of a mixture of shocks: technological shocks, price changes (inflation) and changes in labour supply, among others.

Capistrán *et al.* (2012) and Cortés Espada (2013) find that for Mexico, since the adoption of the inflation targeting regime, regarding the interaction of inflation with other endogenous macroeconomic variables (Global Economic Activity Index, 28-day Cetes interest rate, exchange rate and national consumer price index), they find a reduction in the pass-through of exchange rate fluctuations to inflation. Acosta (2017), for his part, shows that the statistical behavior of inflation in Mexico changes from the year 2000 onwards, as from that year shocks to inflation are diluted over time and do not generate second-order effects that could alter the price-setting process in the economy.

Campos-Vázquez *et al.* (2022), on the other hand, try to obtain information on the process of expectation formation through a controlled intervention, as well as to investigate which products have the greatest impact on expectations. The authors find that individuals have a higher inflation expectation than experts, in the sense that inflation expectations depend mainly on everyday consumption products such as food. Valle e Azevedo *et al.* (2022), Uribe (2022) and García-Cicco *et al.* (2023), using a simplified VAR-based methodology, find a strong long-run relationship between the nominal interest rate and inflation in six advanced economies with historically high inflation.

1.3. Inflation in Mexico. Stylized Facts

During the mid-1970s, a period marked by a global economic slowdown, there was a deterioration in balance of payments imbalances and a process of stagflation worldwide. This led to the failure of the industrialization processes of Latin American economies. In the case of Mexico, the nation underwent a transformation of its accumulation model in 1983, formally adopting neoliberal economic policies with the central objective of controlling inflation. However, it was not until 1988 that a policy of exchange rate pacts and bands was imposed, explicitly including inflation control through the setting of predetermined floating bands and exchange rate slides; in other words, the exchange rate anchored domestic prices (Levy Orlik, 2012).

According to Levy Orlik (2012), the strategy of exchange rate bands and pacts was accompanied by the regulation of fundamental prices, particularly wages and public sector prices (gasoline, electricity, gas). The Central Bank of Mexico varied interest rates to intervene in the foreign exchange market and thereby influence capital inflows and outflows. The sharp devaluation of 1994 showed that limited exchange rate control was ineffective under economic openness, particularly with strong capital movements between financial markets.

After the 1994 crisis, financial policy changed: the accommodative monetary policy that had been tied to financing the fiscal deficit and to channeling financial resources directly to production was abandoned. Given the new international financial order and the paradigms of the financialized neoliberal model, the instruments and foundations of monetary policy were modified, which led to inflation control through inflation targeting. This policy originated in the autonomy of the central bank, granted in April 1994. The main objective of this policy was to restrict monetary policy to the pursuit of price stability. Accordingly, from 1994 onward the Bank of Mexico aligned its policies with the prevailing international consensus and with the anti-inflationary efforts under the North American Free Trade Agreement (NAFTA), thereby ensuring fiscal balance (Levy Orlik, 2014).

According to Levy Orlik (2014), central bank autonomy came with a shift toward a free-floating exchange rate regime, which became the nominal anchor for prices. This author divides the implementation of inflation targets by the Bank of Mexico into four stages:

- From 1995 to 1997, monetary policy went through a transition in which its actions aimed at restoring orderly conditions in financial markets and containing inflationary pressures in the economy.
- From 1998 to 2000, the monetary authority began to publish annual inflation targets and sought to control monetary aggregates as a way of managing inflation.
- From 2001 to 2008, the inflation-targeting scheme was formally adopted through the interest rate. The funding rate set a floor for the interest rate in 2008. The inflation targets, defined through accumulated and short balances, were implemented through the CETES rate.
- In 2008, the monetary policy framework changed, and the former inflation target was replaced by an interest rate target.

Graphical analysis is a useful tool for understanding the macroeconomic evolution of Mexico. It allows us to examine the behavior of inflation, economic growth, exchange rates, fiscal balance, and interest rates, and thus to obtain a fuller picture of the country's economy. The behavior of inflation in Mexico also differs in some respects from that of other countries in the region. The significance of food, energy, and intermediate inputs necessary for production in the export manufacturing sector is accentuated due to productive specialization and heavy dependence on the international

market. Multinational corporations have a strong presence in these sectors. The Inflation Targeting Regime (RMI) established the use of accumulated balances as a component of the modus operandi of monetary policy. This mechanism operated by leveraging the money supply to exert influence on market interest rates. In 2002, the Governing Board established an inflation target of 3±1 percentage points. By 2008, the overnight interbank funding rate had been designated as the nominal anchor for prices (Muller Durán & Osorio-Caballero, 2023).

Figure 1 illustrates the dynamics of the inflation process and demonstrates that price stability is the result of a combination of monetary instruments, as previously discussed. It is evident that the utilization of the money supply up to 2007 led to a disinflation in price levels, which converged at the central bank's target (averaging 4.52%). Subsequently, the adoption of the short-term nominal interest rate has been observed to give rise to more volatile behavior. Despite the monetary authority's unwavering dedication to its objective, exogenous shocks have the potential to disrupt a stable trajectory within the established ranges. The crisis resulting from the novel Coronavirus disease (Covid-19) pandemic is a clear example of this phenomenon. The contraction of supply and demand in the goods market, external demand conditions, and domestic economic policies contributed to the loss of purchasing power of the Mexican peso (Muller Durán & Osorio-Caballero, 2023).

FIGURE 1

INFLATION RATE TRENDS 2002–2023



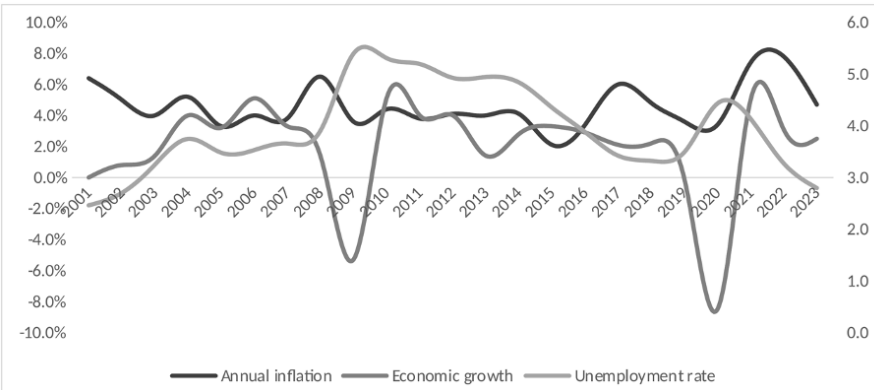
Note: Prepared by authors based on information from the Bank of Mexico.
Annual inflation (%), Bank of Mexico target, Lower bound, Upper bound.

For the Mexican economy, Levy Orlik (2022) asserts that the 1990s were marked by several sharp declines in the growth rate of GDP, particularly in 1995, after the Mexican financial crisis. From 1998, the economy recovered rapidly, in step with globalization and the ratification of the North American Free Trade Agreement

(NAFTA), a pivotal event driven by strong export activity. In 2009, GDP fell by 5.3% after the global financial crisis of 2008. A favorable external environment with high commodity prices then brought a swift recovery that lasted until 2020, when the health crisis reduced production by 8%. It is noteworthy that, despite the stability of the purchasing power of the Mexican peso, the economy stagnated at minimal growth rates between 2017 and 2020 (see Figure 2). It may therefore be concluded that price stability has not been sufficient to ensure accelerated economic growth.

FIGURE 2

INFLATION RATE, UNEMPLOYMENT RATE, AND ECONOMIC GROWTH 2001–2023



Note: Prepared by authors based on information from the Bank of Mexico.
Annual inflation, Economic growth, Unemployment rate.

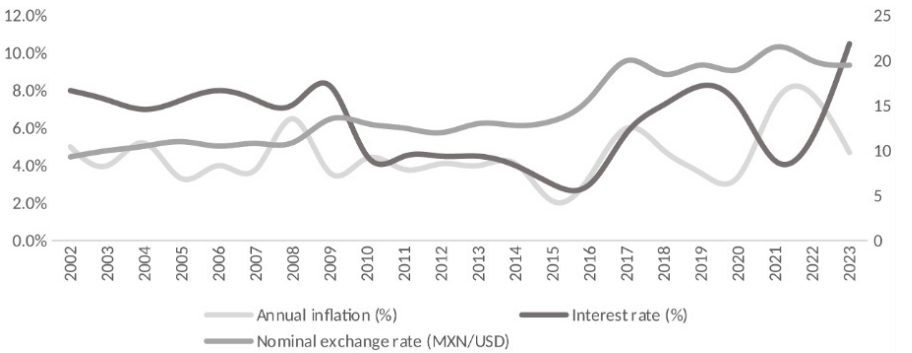
As for interest rates, the figure shows the behavior of the rate on 28-day treasury certificates (CETES 28). Figure 3 shows a positive correlation between interest rates and inflation, but this does not ensure that the aggregate demand transmission mechanism has been effective. At the end of 2015, uncertainty about the change of administration in the US depreciated the Mexican peso against the dollar, which aggravated the increases in the minimum wage and in energy prices that followed from the liberalization process (see Figure 3).

In 2020, the central bank endeavored to stimulate economic activity, which had been stifled by the ongoing pandemic, by reducing the interest rate. However, in 2022 the opposite monetary policy was adopted because of the rising cost of living. As for the exchange rate, the largest depreciations occurred in 2009, 2017, and 2021 and were associated with economic disturbances (see Figure 3). Exchange rate fluctuations have likewise been shown to move together with inflation and with higher import prices. These costs are subsequently passed on to consumers. A depreciation raises the cost of raw materials and, with it, prices (Muller Durán & Osorio-Caballero, 2023).

Between 2014 and 2017 the nominal exchange rate depreciated by 36%, owing to domestic pressures, concerns about the new administration's economic program, and uncertainty over the implementation of the TMEC. This trend, however, has reversed since 2021 (Galicia Martínez and Martínez Nicolás, 2020).

FIGURE 3

INFLATION RATE, EXCHANGE RATE, AND INTEREST RATE 2002–2023

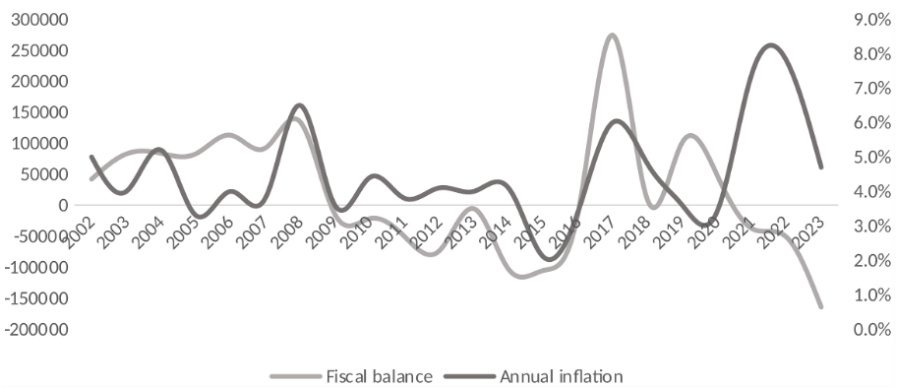


Note: Prepared by authors based on information from the Bank of Mexico.
Annual inflation (%), Interest rate (%), Nominal exchange rate (MXN/USD).

In contrast, the fiscal balance was in deficit during most of the period of the Bank of Mexico's autonomy (see Figure 4), except in the subperiods 2002–2009 and

FIGURE 4

INFLATION RATE AND FISCAL BALANCE 2002–2023



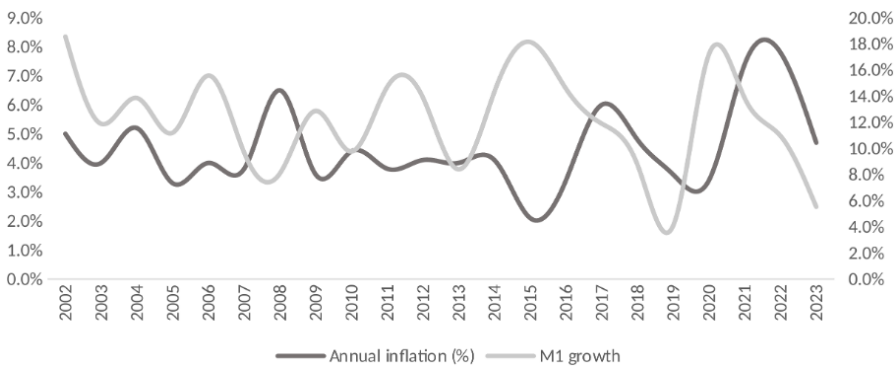
Note: Prepared by authors based on information from the Bank of Mexico.
Fiscal balance, Annual inflation.

2017–2020. The deficit in public finances widened after the 2008 financial crisis. In recent years, the Mexican government has reportedly followed budgetary practices under which expenditures exceed revenues without eroding the purchasing power of the national currency. Moreover, our findings show that this increase in the deficit did not coincide with the expected acceleration in economic growth, which contradicts the conventional hypothesis (Novelo Urdanivia and Muller Durán, 2020).

The relationship between inflation and the money supply (M1) follows a similar pattern, stable between 2002 and 2023 except in 2015, 2019, and 2020. In those years extreme values appear that are not consistent with the behavior of M1. These anomalies can be attributed to the effects of the 2008 financial crisis, the change of government in the United States, and the global impact of the novel coronavirus (see Figure 5). Financial innovation has also had a substantial effect on the velocity of money circulation. This transformation has reduced the effectiveness of monetary aggregate targets as a policy instrument (Ortiz Zarco and Perrotini Hernández, 2019).

FIGURE 5

INFLATION RATE AND GROWTH OF MONEY SUPPLY (M1) 2001–2023



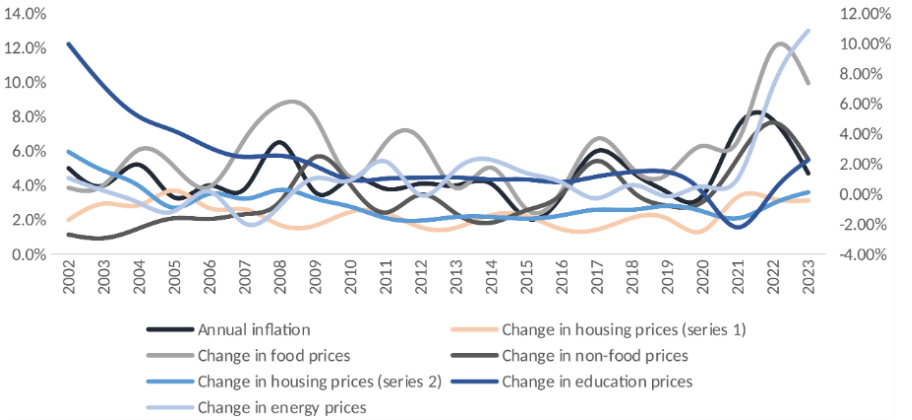
Note: Prepared by authors based on information from the Bank of Mexico. Annual inflation (%), M1 growth.

In 2018, inflation stayed outside the target range of the Bank of Mexico (± 1%), although it trended downward until 2020. Figure 6 indicates that one specific component of inflation is mainly associated with the dynamics of food and energy prices and of government-regulated tariffs.

Taken together, the macroeconomic variables show that the autonomy of the Bank of Mexico has been a key factor in achieving price stability. This autonomy, however, has also entailed considerable costs for Mexico in terms of lower economic growth, larger fiscal deficits, weaker productive investment, and reduced employment.

FIGURE 6

INFLATION RATE AND ITS COMPONENTS



Note: Prepared by authors based on information from the Bank of Mexico.
Annual inflation, Change in housing prices (series 1), Change in food prices, Change in non-food prices, Change in housing prices (series 2), Change in education prices, Change in energy prices.

There also seems to be little coordination between monetary and fiscal policy, which is necessary to achieve equilibrium in the domestic market.

2. METHODS

2.1. Data

Following the variable selection approach of Cuevas (2007), this study uses a simplified aggregate supply and demand model, consistent with a medium-sized open economy that operates under a floating exchange rate regime and unrestricted capital mobility. The demand function, derived from the equilibrium between the goods market and the money market, can be written as follows:

$$Y_D = D\left(\frac{M}{P}, DF, RER\right) \tag{1}$$

Therefore, it can be argued that aggregate demand is a function of real balances (M/P), the real public sector deficit (DF), and the real exchange rate $\left(RER = QP^*/P\right)$, where Q is the nominal exchange rate and P^* the foreign price level). The three partial derivatives are positive, although a real depreciation can also lower output by making imported inputs more expensive (Cuevas, 2007). Demand is therefore

inversely related to the domestic price level. Aggregate supply, in turn, is represented by a pricing mechanism similar to the one proposed by Tobin (1972) (Cuevas, 2007):

$$W = W(P, CU, \xi) \tag{2}$$

$$P = \gamma(W - \xi) \tag{3}$$

Equation (2) describes the dynamics of nominal wages (W), which are positively related to the price level (P), which determines the cost of living, and to installed capacity utilization (CU), a key factor in labor demand. Increases in labor productivity (ξ) are also assumed to raise wages. Equation (3) describes the behavior of prices: when nominal wages grow faster than labor productivity, prices rise. According to Cuevas' (2007) research, substituting equation (2) into equation (3) eliminates the wage rate and yields the inverse supply function:

$$P_S = S^{-1}(CU, \xi) \tag{4}$$

Equation (4) implies that in order to encourage an increase in installed capacity utilization and, therefore, in the production of goods and services, a higher price level would be required. Equations (3) and (4) suggest that producers set their prices above unit production costs and satisfy any quantity demanded at those prices, given the existing installed capacity (Cuevas, 2007). In equilibrium it is satisfied that $Y_D = Y_S$ and $P_D = P_S$.

The aggregate supply and demand equations serve as the basis for selecting the following macroeconomic variables: price level (P), economic growth (Ψ) whose proxy variable is the overall indicator of economic activity (IGAE[1]), real money supply $\left(\frac{M_1}{P}\right)$, government deficit (DF), unemployment rate (μ) as a proxy variable for installed capacity utilization (CU) , nominal exchange rate (Q), the education price index (P_{educ}), the food price index (P_{alim}) and the energy price index (P_{energ}), while the United States industrial production index (θ_{USA}) and the terms of trade index of Mexican imports (τ_{mex}) are considered as exogenous variables. It should be noted that, with the exception of the growth rate of the public deficit, the variables are expressed in logarithmic terms. The present study utilizes monthly data from January 2001 to September 2024. In the course of collecting and arranging data, which played an essential role in comprehending and investigating the underlying relationships between

[1] The Global Economic Activity Indicator (IGAE) is a monthly index calculated by INEGI that reflects economic activity through the value added of the primary, secondary, and tertiary sectors. In Mexico, this measure has been highly volatile, with contractions linked to financial and external crises such as the subprime mortgage crisis of 2008 and the 2020-2021 pandemic. (Comisión Económica para América Latina y el Caribe (CEPAL), 2009)

variables, 285 data points were obtained from official sources such as the National Institute of Statistics and Geography (INEGI) and the Bank of Mexico (BANXICO).

The framework translates into the variables of the model as follows. Equation (1) corresponds to the activity equation, in which economic activity (Ψ) depends on real balances, the public deficit, and the exchange rate. Equations (2) to (4) correspond to the price equation, in which inflation depends on capacity utilization (proxied by unemployment), economic activity, and the cost pressures reflected in energy, food, and education prices. Since the price level is endogenous in the system, the domestic-price component of the real exchange rate is picked up by the dynamics of inflation; the foreign price level is left out. The U.S. industrial production index and the terms of trade of Mexican imports have no counterpart in the theoretical model and enter as exogenous variables that control for external conditions.

Two remarks on the correspondence between this theoretical framework and the empirical specification are in order. First, the demand function depends on the real exchange rate, whereas the model is estimated with the nominal exchange rate, the variable that transmits directly to import prices. Likewise, Cuevas's (2007) model works with installed capacity utilization and does not include the unemployment rate, which is used here as a proxy: it is an imperfect measure of capacity utilization and also captures labor-market slack, so that it combines the capacity-utilization channel with a Phillips-curve channel that the specification cannot distinguish. Second, the structural identification adopted in Section 2.2 is recursive and is not derived from the theoretical model: it assumes that, within a month, the prices of education, food, and energy are predetermined with respect to the remaining variables; that the fiscal deficit, unemployment, and economic activity are predetermined with respect to the real money supply and the exchange rate; and that aggregate inflation reacts contemporaneously to all of them without feeding back into any variable within the month. Section 3.2.4 complements the baseline with an overidentified structure whose restrictions are informed by equations (1) to (4).

2.5. Econometric Methodology

In order to rigorously analyze the impact of time shocks on inflation and to explore the relationship between the relevant macroeconomic variables. In this context, the vector autoregressive (VAR[2]) methodology is used when we seek to characterize the simultaneous interactions between a group of macroeconomic variables. This methodological choice is appropriate based on what is presented in the literature review, since it seeks to deepen the understanding of permanent and transitory shocks

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[2] It is crucial to take into account the impulse response functions, a fundamental facet of the VAR model. Because it allows us to analyze the underlying dynamics of the estimated system, these functions reveal how the dependent variables react over time to changes in the errors. In other words, they examine the effect of a particular shock on a specific variable.

in a set of macroeconomic variables and treats empirical shocks independently, which allows a structural interpretation.

The vector autoregressive (VAR) model is based on the premise that there is no a priori distinction between endogenous and exogenous variables, and is flexible in structure, analyzing interdependencies between time series. In this model, each dependent variable is explained by its own lagged values. The great usefulness of the model lies in its ability to capture the dynamic interrelationships between variables over time by including the lagged values of all variables as regressors, which allows to represent how the economic system transmits variations to itself over a certain number of periods (Díaz *et al.*, 2014). This model can be expressed as follows:

$$Y_t = A_0 + \theta_1 Y_{t-1} + \ldots\ldots + \theta_p Y_{t-p} + \varepsilon_t \tag{5}$$

$$Y_{i,t} = A_0 + \theta^1_{i,1} Y_{1,t-1} + \ldots + \theta^1_{i,k} Y_{k,t-1} + \ldots + \theta^p_{i,1} Y_{1,t-p} + \ldots + \theta^p_{i,k} Y_{k,t-p} + e_{i,t} \tag{6}$$

When analyzing a time series vector denoted by Y_t (where t takes values from 1 to k), it is necessary to check the stationarity of the process. This evaluation is carried out by means of the vector A and the matrix θ_i containing the coefficients for $i = 1 \ldots . p$. Moreover, it is crucial to note that ε_t represents a vector whose behavior is consistent with that of white noise. Equation (6) can be expressed as follows:

$$Y_{i,t} = A_i + \sum_{s=1}^{p} \sum_{j=1}^{k} \theta^s_{i,j} Y_{j,t-s} + e_{i,t} \tag{7}$$

According to Nicholson *et al.* (2017), unrestricted VAR models are inherently subject to the problem of over-parameterization, making their results highly sensitive to changes in the economic variables used. One of the ways to reduce overparameterization is to include unmodeled exogenous variables that are determined outside the VAR. The structural vector autoregressive model with exogenous variables (VARX) is a particularly popular approach to modeling developing open economies, as they tend to be sensitive to a variety of global macroeconomic factors that evolve independently of their domestic indicators:

$$Y_{i,t} = A_0 + \sum_{s=1}^{p} \sum_{j=1}^{k} \theta^s_{i,j} Y_{j,t-s} + \sum_{m=1}^{q} \sum_{n=1}^{Q} \beta^m_{l,n} X_{n,t-m} + e_{i,t} \tag{8}$$

Where $Y_{i,t} \in \mathbb{R}^k$, while $X_{n,t} \in \mathbb{R}^P$ is a vector of exogenous variables, $A_0 \in \mathbb{R}^k$ is a vector of intercepts, the A_i are $k \times k$ coefficient matrices, the $\beta_{l,n}$ are coefficient matrices $k \times P$, and $e_{i,t} \in \mathbb{R}^k$ is a vector of errors. According to Bierens (2004), the crucial condition for the correctness of this model is that: $C_r\ X_{t-r}$

$$E\left[e_{i,t} \middle| \left\{Y_{j,t-s}\right\}, \left\{X_{n,t-m}\right\}\right] = 0 \tag{9}$$

Assuming with probability 1 that $\left[X_t = C_0 + C_1 X_{t-1} + ... + C_r X_{t-r} + \Upsilon_t\right]$ where $E\left[\Upsilon_t \left| \left\{Y_{j,t-s}\right\}, \left\{X_{n,t-m}\right\}\right.\right] = 0$, the VARX can be represented in its reduced form from these definitions:

$$\begin{aligned} Y_t = A_0 + \beta_0 C_0 + \theta_1 Y_{t-1} + \ldots\ldots + \theta_p Y_{t-p} + \beta_0 (C_1 X_{t-1} + ... + C_r X_{t-r}) \\ + \beta_0 \Upsilon_t + \beta_1 X_{t-1} + ... + \beta_r X_{t-r} + \varepsilon_t \end{aligned} \tag{10}$$

In order to systematize transitory and permanent shocks, a structural model is introduced to analyze the implications for the identification of transitory and permanent shocks. This structural model is based on the proposal of Sims (1980) and the approach of Blanchard & Quah (1989). According to Keating & Nye (1998) The Standard Aggregate Supply and Demand Model, permanent shocks to economic activity are caused by supply shocks, while temporary shocks come from demand shocks, Blanchard & Quah (1989) assume that shocks associated with output growth, while shocks associated with price growth have a temporary effect. The structural VAR for the short-run is formulated as follows (Mendoza Velázquez & Smith, 2013):

$$\theta\left(I_k - \theta_1 L - \theta_2 L^2 - ... - \theta_p L^p\right) Y_t = \theta \varepsilon_t = \beta e_t \tag{11}$$

The lag operator is denoted by L, θ, β y $\theta_1 + \ldots\ldots + \theta_p$, are matrices of order $K \times K$, while ε_t is a vector representing innovations. To determine the long-run VAR, the following equation is calculated:

$$\begin{aligned} Y_t &= \theta^{-1} \beta e_t \\ Y_t &= C e_t \end{aligned} \tag{12}$$

A range of variables are employed to capture the behavior of temporary inflation shocks in Mexico. Various variables are used to capture the behavior of temporary inflation shocks in Mexico. In line with the unit root analysis presented in Section 3.1, the unemployment rate, the real money supply, the nominal exchange rate, the public deficit, and the food and education price indices are I(1), so a transformation in first logarithmic differences is used for these variables, whereas inflation, the overall economic activity index, and the energy price index are stationary in levels and enter the system in (log) levels, in order to avoid over-differencing the series. Hereafter, the symbol Δ in the system of equations, the tables, and the figures denotes the stationary transformation of each variable, which for inflation, economic activity, and energy prices is the log-level itself. Monthly seasonal dummy variables are also included among the exogenous variables, since the Lagrange-multiplier test detected

residual autocorrelation at lag 12 in the model without them. Therefore, inflation (P_t); money supply $\left[\left[\left(\frac{M_{1_t}}{P_t}\right)\right]\right]$; the overall economic activity index (Ψ_t) as an approximation of monthly economic activity; the public deficit (DF_t). The unemployment rate (μ_t) is employed as a proxy variable for several economic indicators, including installed capacity utilization (CU), the nominal exchange rate (Q_t), the education price index $\left(P_{educ_t}\right)$, the food price index $\left(P_{alim_t}\right)$, and the energy price index $\left(P_{energ_t}\right)$. Therefore, $Y_t = \left\{\Delta P_t\ ,\ \Delta\mu_t,\ \Delta\left(\frac{M_{1_t}}{P_t}\right),\Delta\Psi_t,\Delta Q_t,\Delta P_{energ_t},\Delta \mathrm{DF}_t,\Delta P_{educ_t},\Delta P_{alim_t}\right\}$. The present case involves exogenous variables, specifically the US industrial production index $\left(\theta_{USA_t}\right)$, the terms of trade index for Mexican imports $\left(\tau_{mex_t}\right)$ and the dichotomous variables, representing different external shocks that affected the Mexican economy $X_t = \left\{\Delta\theta_{USA_t},\Delta\tau_{mex_t},D_q\right\}$ are also of interest. Accordingly, the system of equations is formulated as follows:

$$\begin{bmatrix} \Delta P_t \\ \Delta\mu_t \\ \Delta\left(\frac{M_1}{P}\right)_t \\ \Delta\Psi_t \\ \Delta Q_t \\ \Delta P_{energ_t} \\ \Delta \mathrm{DF}_t \\ \Delta P_{educ_t} \\ \Delta P_{alim_t} \end{bmatrix} = \begin{bmatrix} \phi_{11} \\ \phi_{21} \\ \phi_{31} \\ \phi_{41} \\ \phi_{51} \\ \phi_{61} \\ \phi_{71} \\ \phi_{81} \\ \phi_{91} \end{bmatrix} + \begin{bmatrix} \theta_{11} & \theta_{12} & \theta_{13} & \theta_{14} & \theta_{15} & \theta_{16} & \theta_{17} & \theta_{18} & \theta_{19} \\ \theta_{21} & \theta_{22} & \theta_{23} & \theta_{24} & \theta_{25} & \theta_{26} & \theta_{27} & \theta_{28} & \theta_{29} \\ \theta_{31} & \theta_{32} & \theta_{33} & \theta_{34} & \theta_{35} & \theta_{36} & \theta_{37} & \theta_{38} & \theta_{39} \\ \theta_{41} & \theta_{42} & \theta_{43} & \theta_{44} & \theta_{45} & \theta_{46} & \theta_{47} & \theta_{48} & \theta_{49} \\ \theta_{51} & \theta_{52} & \theta_{53} & \theta_{54} & \theta_{55} & \theta_{56} & \theta_{57} & \theta_{58} & \theta_{59} \\ \theta_{61} & \theta_{62} & \theta_{63} & \theta_{64} & \theta_{65} & \theta_{66} & \theta_{67} & \theta_{68} & \theta_{69} \\ \theta_{71} & \theta_{72} & \theta_{73} & \theta_{74} & \theta_{75} & \theta_{76} & \theta_{77} & \theta_{78} & \theta_{79} \\ \theta_{81} & \theta_{82} & \theta_{83} & \theta_{84} & \theta_{85} & \theta_{86} & \theta_{87} & \theta_{88} & \theta_{89} \\ \theta_{91} & \theta_{92} & \theta_{93} & \theta_{94} & \theta_{95} & \theta_{96} & \theta_{97} & \theta_{98} & \theta_{99} \end{bmatrix} \begin{bmatrix} \Delta P_{t-p} \\ \Delta\mu_{t-p} \\ \Delta\frac{M_1}{P}_{t-p} \\ \Delta\Psi_{t-p} \\ \Delta Q_{t-p} \\ \Delta P_{energ_{t-p}} \\ \Delta DF_{t-p} \\ \Delta P_{educ_{t-p}} \\ \Delta P_{alim_{t-p}} \end{bmatrix}$$

$$+ \begin{bmatrix} \beta_{11}\Delta\theta_{USA_t}+\beta_{12}\Delta\tau_{mex_t}+\beta_{1Q}D_q \\ \beta_{21}\Delta\theta_{USA_t}+\beta_{22}\Delta\tau_{mex_t}+\beta_{2Q}D_q \\ \beta_{31}\Delta\theta_{USA_t}+\beta_{32}\Delta\tau_{mex_t}+\beta_{3Q}D_q \\ \beta_{41}\Delta\theta_{USA_t}+\beta_{42}\Delta\tau_{mex_t}+\beta_{4Q}D_q \\ \beta_{51}\Delta\theta_{USA_t}+\beta_{52}\Delta\tau_{mex_t}+\beta_{5Q}D_q \\ \beta_{61}\Delta\theta_{USA_t}+\beta_{62}\Delta\tau_{mex_t}+\beta_{6Q}D_q \\ \beta_{71}\Delta\theta_{USA_t}+\beta_{72}\Delta\tau_{mex_t}+\beta_{7Q}D_q \\ \beta_{81}\Delta\theta_{USA_t}+\beta_{82}\Delta\tau_{mex_t}+\beta_{8Q}D_q \\ \beta_{91}\Delta\theta_{USA_t}+\beta_{92}\Delta\tau_{mex_t}+\beta_{9Q}D_q \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \\ \varepsilon_{8t} \\ \varepsilon_{9t} \end{bmatrix}$$

3. EMPIRICAL RESULTS

3.1. Unit Root Analysis, Lag Selection, and Structural Change

In order to avoid spurious relationships, unit root tests are performed to evaluate the stationarity of the variables by applying the augmented Dickey-Fuller test and the Phillips-Perron test. In both cases, the null hypothesis of a unit root is rejected if the p-value is less than the significance level of 0.05.

Table 1 presents the findings of the implemented tests. It is evident that inflation, the overall economic activity index, and the energy price index are zero-order integrated (stationary at levels): the ADF, Phillips-Perron, and Zivot-Andrews tests reject the unit root, and the KPSS test does not reject level stationarity. The unemployment rate shows mixed evidence (the Zivot-Andrews test does not reject the unit root and the KPSS test rejects level stationarity at the 5% level), so it is conservatively treated as first-order integrated, as are the remaining variables (stationary in first differences). A recognized deficiency of the Dickey-Fuller or Phillips-Perron unit root tests is their proclivity, in the presence of structural breaks in the series, to fail to reject the unit root null hypothesis, so that a break may be mistaken for a unit root. This phenomenon can be examined through the application of unit root tests, which permit the existence of structural instability within a model that exhibits a deterministic trend. The structural adjustment unit root tests of Zivot and Andrews (1992) are hereby proposed. This test enables the analysis of a single structural break in the intercept and trend of the series. The test proposed by Clemente, Montañés, and Reyes (1998) is also considered, which allows for two events within the time series.

TABLE 1

UNIT ROOT TEST

VARIABLE	SPECIFI-CATION	ADF STATISTICS H0: UNIT ROOT	PP STATISTICS H0: UNIT ROOT	Z-A STATISTICS H0: UNIT ROOT	C-M-R STATISTICS H0: UNIT ROOT
P_t	D	-3.19**	-10.43	-9.67**	-3.203
ΔP_t	D	-21.31**	-23.84**	-13.16**	-10.78*
μ_t	D	-1.778*	-3.19*	-3.71	-2.59
$\Delta\mu_t$	D	-3.32	-26.77	-11.34	-12.07*
$\left(\frac{M_{1_t}}{P_t}\right)$	T	-2.42	-4.54**	-3.41	-2.48
$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	T	-3.80*	-25.63**	-12.68**	-7.34*

VARIABLE	SPECIFI-CATION	ADF STATISTICS H0: UNIT ROOT	PP STATISTICS H0: UNIT ROOT	Z-A STATISTICS H0: UNIT ROOT	C-M-R STATISTICS H0: UNIT ROOT
Ψ_t	T	-5.88**	-13.34**	-10.54**	-4.7
$\Delta\Psi_t$	T	-8.52**	-39.72**	-13.32**	-8.87*
Q_t	D	-1.17	-1.03	-4.20	-5.64*
ΔQ_t	D	-4.91**	-12.59**	-12.53**	-5.67*
P_{energ_t}	D	-4.50**	-11.44**	-10.00**	-3.09
ΔP_{energ_t}	D	-10.24**	-23.61**	-7.33**	-12.20*
DF_t	D	-0.42	-2.38	-3.44	-3.44
ΔDF_t	D	-4.24**	-19.62**	-9.41**	-9.26*
P_{educ_t}	D	0.23	-2.64	-4.72	-2.36
ΔP_{educ_t}	D	-3.97**	-14.48**	-10.00**	-14.14*
P_{alim_t}	D	-0.11	1.20	-3.74	-2.59
ΔP_{alim_t}	D	-2.90**	-9.14**	-6.41**	-5.98*
θ_{USA_t}	D	-2.61**	-1.89	-3.12	-3.97
$\Delta\theta_{USA_t}$	D	-4.46**	-13.58**	-13.26**	-6.37*
τ_{mex_t}	D	-1.16	-0.44	-3.65	-3.55
$\Delta\tau_{mex_t}$	D	-4.11**	-8.90**	-6.34**	-4.95

Note: D = drift, T = trend; '*' and '**' denote rejection of the null at 5% and 1%. Prepared by authors.

Table 1 indicates that for the Zivot-Andrews test and the Clemente, Montañés, and Reyes test, the unit root is, in general, not rejected in levels and is rejected in first differences for the variables classified as I(1), which confirms their order of integration. The Johansen trace test applied to the I(1) variables (unemployment, real money supply, exchange rate, public deficit, and food and education prices) suggests two cointegrating relations (trace statistic of 44.9 against a 5% critical value of 47.2 at rank 2); since the SVARX specification in differences does not model such long-run relations explicitly, the results should be interpreted as short-run dynamics, and a vector error-correction extension is left for future research. The analysis of break periods reveals that these occur primarily in the years 2003, 2008, 2009, and 2020. Determining the order of lags is a crucial decision in the specification of vector autoregressive models. This research implements a rigorously empirical approach to identify the optimal lag length. This procedure evaluated three widely used information criterion estimators: the Akaike Information Criterion (AIC), the Schwarz Bayesian Information Criterion (BIC), and the Hannan Quinn Information Criterion (HQIC). These criteria measure the goodness of fit of the different specifications. The HQIC and SBIC criteria favor the most parsimonious specifications (one and zero lags,

respectively), whereas the AIC attains its overall minimum at twelve lags; among the lag orders from one to seven, however, the AIC is minimized at three lags, which is adopted as a compromise between parsimony and the absence of serial correlation in the residuals of the inflation equation (see Annex 1).

In order to verify the presence of structural changes in the standard autoregressive vector model, the structural break methodology developed by Bai & Perron (1998, 2003) is employed in order to identify the multiple structural changes that minimize the model error. The null hypothesis of this test posits the absence of structural change, in contrast to the alternative hypothesis, which suggests the presence of structural changes. As shown in Annex 2, the evidence of structural change is weak: the sequential F(1|0) statistic (2.66) and the UDmax statistic (2.67) exceed the 10% critical values (2.46 and 2.49) but not the 5% ones (2.70 and 2.72), and the estimated break (August 2018) has a confidence interval that spans well beyond the sample, so no break date is reliably identified. Furthermore, the extreme values in the residuals are presented for the years 2002, 2004, 2008, 2010, 2011, 2012, 2014, 2017, 2020, 2021, 2022, and 2024[3]. Furthermore, post-estimation tests of stability, causality, and residuals in the model were performed. The results of the study are presented in Annexes 3, 4, 5, 6 and 7 of this paper. It can be observed that the roots lie inside the unit circle (the largest modulus is 0.76), which indicates that the system is stable. Parameter constancy is also not rejected by the OLS-CUSUM test of Ploberger and Krämer (1992): in each of the nine equations the standardized cumulative sum of residuals stays well inside the 5% bound of 1.358 (the largest statistic, 0.86, corresponds to economic activity; Annex 4). The residual diagnostics reported in Annex 6 show that the residuals of the inflation equation are serially uncorrelated (Ljung-Box Q (24) = 20.3, p = 0.68) and, once an impulse dummy for January 2017 (the liberalization of fuel prices) is included, the hypothesis of normality is not rejected (kurtosis of 3.3; Shapiro-Wilk p = 0.53; skewness-kurtosis p = 0.49). By contrast, normality is rejected in seven of the other eight equations, so the confidence intervals of the impulse response functions are obtained by residual bootstrap rather than from asymptotic normal approximations. In addition, the Lagrange-multiplier test still detects residual autocorrelation in the system at lags 1, 2, and 12 (5% level) but no longer at lags 3 to 11.

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[3] It is important to note that the autoregressive vector model was estimated with the identified structural break dummies. Moreover, as a consequence of detecting issues with normality in the residuals of this model, outliers were identified and transformed into dummies. These dummies were incorporated into the autoregressive vector model with exogenous variables to mitigate the normality problem, which nevertheless persists in the residuals (see Annex 6). An autoregressive vector model with exogenous variables was constructed, in which the dummies representing the effect of the 2008 crisis that impacted Mexico in 2010, the dummies representing the fall in international oil prices, and the dummies representing the COVID-19 pandemic were found to be significant, as was the dummy for the January 2017 liberalization of fuel prices. Monthly seasonal dummies were also included among the exogenous variables.

3.2 Structural Svar Model With Exogenous Variables: Sensitivity Analysis, Transient Effects, And Permanent Effects

In order to analyze the nature of inflationary shocks in the Mexican case, a structural autoregressive vector model with exogenous variables was estimated to determine how the fluctuations in inflation are related to changes in economic activity, the money supply and the interest rate (monetary policy).

The model was estimated with nine endogenous variables: The following variables were considered in the study: inflation (P_t); money supply $\left[\left(\frac{M_{1_t}}{P_t}\right)\right]$, the overall economic activity index (Ψ_t) as an approximation of monthly economic activity; the public deficit (DF_t). The unemployment rate (μ_t) is employed as a proxy variable for several economic indicators, including installed capacity utilization (CU), the nominal exchange rate (Q_t), the education price index (P_{educ_t}), the food price index (P_{alim_t}), and the energy price index (P_{energ_t}). The following are proposed as exogenous variables: the US industrial production index (θ_{USA_t}), the terms of trade index for Mexican imports (τ_{mex_t}), based on the structural break analysis and outliers in the model residuals, and some dummy variables (2002, 2004, 2008, 2010, 2011, 2012, 2014, 2017, 2020, 2021, 2022, and 2024) that affected public expectations, as well as monthly seasonal dummies. The VAR model yielded several salient results, including:

1. The three lags of inflation are jointly significant ($\chi^2(3) = 31.7$, $p < 0.001$), with a positive coefficient at the first lag (0.29) and a negative one at the second lag (−0.30), so that the autoregressive dynamics of monthly inflation are oscillating and weakly persistent (the sum of the three autoregressive coefficients is −0.13). This points to an inertial component in Mexican inflation.
2. The first and third lags of economic activity (IGAE) have a negative and statistically significant effect on inflation, while the lags of the unemployment rate are not significant. The sign of the activity coefficients is the opposite of what an augmented Phillips curve would predict, so the short-run dynamics do not support that relationship. The unemployment rate also stands in for capacity utilization and captures labor-market slack.
3. The variation in the real money supply is not statistically significant in any lag (joint p-value of 0.97), so the data do not show that increases in the money supply are associated with higher inflation in the short run.
4. Among the price components, only energy prices are jointly significant in the inflation equation ($p = 0.035$; the second and third lags are positive and significant at the 10% level), whereas food and education prices are not significant at conventional levels. In terms of the share of inflation variance explained, however, energy and food prices are the most relevant components (see Section 3.2.3).

3.2.1. *Short run dynamics: transitory effects*

In order to verify the short-term and long-term effects on inflation, it is necessary to extract the components that affect inflation in both the short- and long-term by relating monetary shocks, exchange rate shocks, and real shocks to the effects on inflation in short-term periods. Pursuant to the precepts of economic theory, the gross domestic product (GDP) and the index of economic activity (IGAE) are associated with long-term supply shocks; however, in the short term, there is a correlation between them and demand shocks. Prices are associated with long-term supply and demand shocks. Theory posits that monetary policy in Mexico is founded on a strategy of direct monetary control over inflation. In accordance with the conclusions of Cuevas (2007), it is hypothesized that the inflation rate in Mexico is influenced by a combination of monetary and exchange rate shocks, in addition to exhibiting a significant inertial component.

Therefore, it is assumed that in the short term, the fiscal deficit (instrument) is not affected by shocks from economic activity, inflation, or the money supply. In turn, the monetary aggregate in the short term is not affected by contemporary shocks in output or inflation, although it is affected contemporaneously by the Central Bank's interest rate (instrument) and by itself. The subsequent short-term or transitory effects on inflation are thus derived:

In the context of the Mexican economy, temporary shocks from inflation do not exert immediate effects on the growth rate of output, the unemployment rate, the growth rate of the money supply, the exchange rate, the fiscal deficit, and the price indices for energy, food, and education. Structural shocks are normalized to have a positive contemporaneous effect on their own variable, and the public deficit row is rescaled by a factor of 10^{-5} to improve the numerical conditioning of the estimation. In the short term, shocks to the exchange rate, the fiscal deficit, the unemployment rate, and the energy, food, and education price indices exert a positive contemporaneous effect on inflation (the largest ones being those of energy and food prices), while shocks to real balances and to economic activity exert a negative effect.

3.2.2. sensitivity analysis: cumulative structural impulse response functions

This section presents one of the primary tools employed for the analysis of autoregressive vector models. According to Loría (2007), the impulse response function (FIR) is a useful tool for characterizing and understanding the dynamic sensitivity of the variables specified in the model. Furthermore, it is highly efficient for evaluating and proposing economic policies (Morán, 2014).

The cumulative structural impulse response functions (CSIRFs) are obtained from the identified short-run and long-run SVAR models, and not from a recursive ordering of the reduced-form residuals. These functions are defined as follows: they measure the cumulative effect of a given shock, as opposed to the response period by

TABLE 2

SHORT-TERM EFFECTS MATRIX

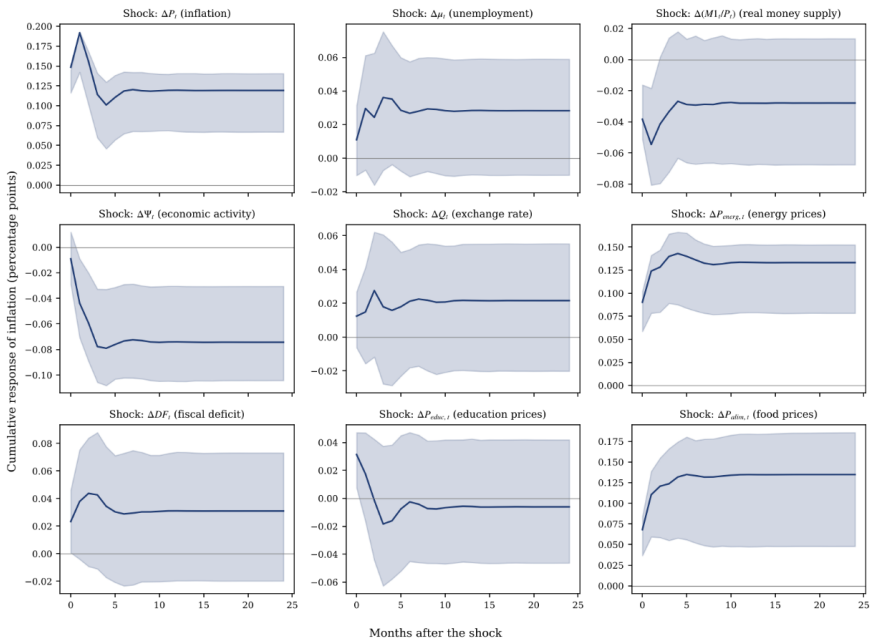
	ΔP_t	$\Delta \mu_t$	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	$\Delta \Psi_t$	ΔQ_t	ΔP_{energ_t}	ΔDF_t	ΔP_{educ_t}	ΔP_{alim_t}
ΔP_t	0.001484	0.000109	-0.000383	-0.000091	0.000124	0.000903	0.000234	0.000314	0.000680
$\Delta \mu_t$	0.000000	0.061065	0.000000	0.000000	0.000000	0.000901	-0.005202	-0.000769	0.003983
$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	0.000000	-0.002678	0.013492	-0.001040	0.000000	-0.001481	-0.000464	0.002229	0.000362
$\Delta \Psi_t$	0.000000	-0.001255	0.000000	0.009042	0.000000	0.001784	-0.000087	-0.000690	-0.000836
ΔQ_t	0.000000	-0.000288	0.001276	-0.000309	0.003163	0.000006	-0.000086	0.000074	-0.000102
ΔP_{energ_t}	0.000000	0.000000	0.000000	0.000000	0.000000	0.007478	0.000000	0.000644	0.000733
ΔDF_t	0.000000	0.000000	0.000000	0.000000	0.000000	-0.000735	0.005664	0.000605	0.000583
ΔP_{educ_t}	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005407	0.000000
ΔP_{alim_t}	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000008	0.002214

Note: Prepared by authors.

period. The estimation of impulse response functions is conducted over a 24-month timeframe, incorporating a 95% confidence interval obtained by residual bootstrap (500 replications). For this function to be deemed statistically significant, its interval must exclude zero at the end of the 24-month horizon. In this case, the objective of this analysis is to evaluate the dynamic response of inflation to shocks in economic activity, money supply, fiscal deficit, unemployment, and energy and food price indices. Figure 7 reports the responses of inflation in the short-run SVAR, and Figure 8 those in the long-run SVAR. Because inflation, economic activity, and energy prices enter the system in levels, the responses shown are cumulative responses of the corresponding levels; in the case of inflation, the cumulative response measures the effect on the price level (in percentage points) of a one-standard-deviation shock.

FIGURE 7

CUMULATIVE STRUCTURAL IMPULSE RESPONSES OF INFLATION: SHORT-RUN SVAR



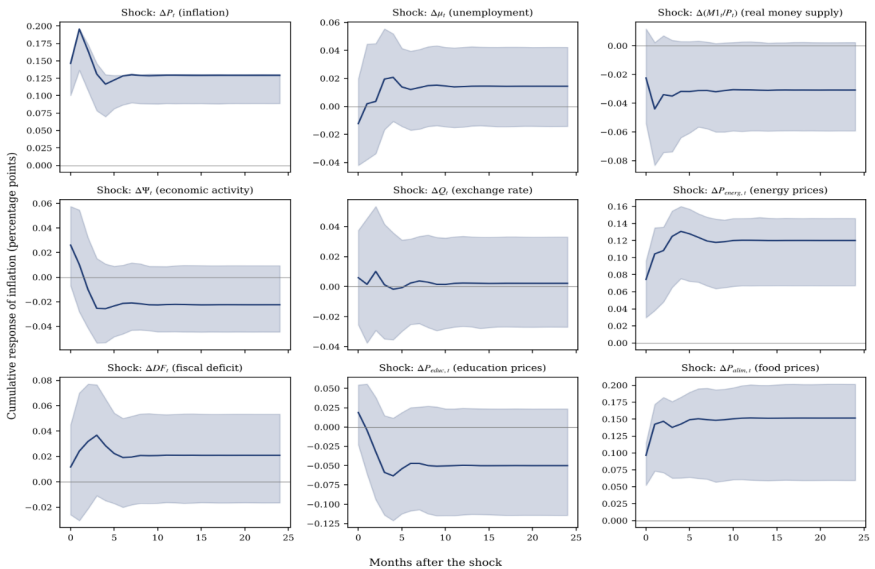
Note: Cumulative responses (percentage points) to one-standard-deviation shocks; inflation enters in levels, so its response is the effect on the price level. Prepared by authors.

Figure 7 shows that, in the short-run SVAR, energy and food price shocks leave a lasting positive mark on the price level: 24 months after a one-standard-deviation shock, cumulative inflation is about 0.13 percentage points higher in both cases, and

the intervals do not include zero. A shock to economic activity has a negative and significant cumulative effect on inflation (−0.07 percentage points), the opposite of what a demand-pull mechanism would suggest; however, a recursively identified activity shock can mix demand and supply disturbances. The responses to shocks in the exchange rate, the real money supply, unemployment, the fiscal deficit, and education prices are not statistically different from zero, since their intervals contain zero at the end of the horizon. An inflation shock, in turn, raises the price level permanently (0.12 percentage points): the cumulative response settles at a non-zero level and its interval excludes zero. Because the cumulative responses settle after a few months, the effect on the inflation rate is transitory, while the effect on the price level is permanent.

FIGURE 8

CUMULATIVE STRUCTURAL IMPULSE RESPONSES OF INFLATION: LONG-RUN SVAR



Note: Cumulative responses (percentage points) to one-standard-deviation shocks, long-run SVAR; shaded areas are 95% bootstrap bands (500 replications). Prepared by authors.

In the long-run SVAR (Figure 8), only the responses to inflation (0.13), energy prices (0.12), and food prices (0.15 percentage points) remain significant; none of the other shocks, activity included, has a significant cumulative effect on inflation.

3.2.3. Variance decomposition

According to Cuevas's perspective in 2008, a notable analytical instrument within the framework of vector autoregressive (VAR) models is the technique of variance decomposition (VD). This decomposition can be regarded as a significant complement to the analysis of impulse response functions. Variance decomposition is a statistical method that calculates the proportion of variation in a given variable that is attributable to specific shocks or influences. In other words, variance decomposition allows us to quantify the proportion of inflation fluctuations that can be attributed to shocks in different variables.

In the context of the response variable of inflation $\left(\Delta P_t\right)$, it can be observed that, within the short term (12 and 24 months), approximately 53% of the variability in inflation is attributable to the inertial shock component of the short-term SVAR models. Conversely, shocks to energy price indices $\left(\Delta P_{\mathbf{energ}_t}\right)$, food price indices $\left(\Delta P_{\mathbf{alim}_t}\right)$, and education price indices $\left(\Delta P_{\mathbf{educ}_t}\right)$ account for approximately 19%, 13%, and 4%, respectively, underscoring the notion that, in the short term, the predominant role in inflationary dynamics is attributed to shocks from inflation components (energy, education, and food). These three components jointly account for approximately 35% of the variance. Concurrently, the real and monetary transmission mechanism accounts for approximately 12% of inflation variance (see Table 3).

In the long-run structural vector autoregressive (SVAR) specification, shocks from inflation components persist after 12 and 24 months, and the food component surpasses the energy component in terms of influence, at approximately 23% and 13%, respectively, after 24 months, followed by education at approximately 5%. Concurrently, the real and monetary transmission mechanism accounts for only approximately 8% of inflation variance. No individual shock in this group exceeds 3.1% of inflation variance. It is important to note that, in the long-run specification, the inertial shock's weight remains important, at approximately 51% of inflation variance (see Table 3).

3.2.4. Robustness: an overidentified structure informed by the theoretical model

The baseline identification is recursive and, as noted in Section 2.1, is not derived from the theoretical model. To assess whether the results depend on that ordering, the structural matrix A is specified so that its zero restrictions are informed by equations (1) to (4): the prices of energy, food, and education are predetermined within the month; the public deficit responds only to economic activity (automatic stabilizers); economic activity responds to real balances, the deficit, the exchange rate, and energy prices (demand function and cost channel); real balances respond to inflation, activity, unemployment, and education prices (since they are deflated by the price index); the exchange rate responds to real balances; unemployment, as a proxy for capacity utilization, responds to activity; and inflation responds to all remaining variables

TABLE 3

DECOMPOSITION OF PRICE VARIANCE IN THE SHORT TERM AND LONG TERM

DECOMPOSITION OF PRICE VARIANCE (ΔP_t) SHORT-TERM STRUCTURAL VAR										
RESPONSE	HORIZON	ΔP_t	$\Delta \mu_t$	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	$\Delta \varphi_t$	ΔQ_t	ΔP_{energ_t}	ΔDF_t	ΔP_{educ_t}	ΔP_{alim_t}
ΔP_t	12	0.532	0.013	0.039	0.037	0.009	0.185	0.017	0.038	0.129
	24	0.532	0.013	0.039	0.037	0.009	0.185	0.017	0.038	0.129
DECOMPOSITION OF PRICE VARIANCE (ΔP_t) LONG-TERM STRUCTURAL VAR										
RESPONSE	HORIZON	ΔP_t	$\Delta \mu_t$	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	$\Delta \varphi_t$	ΔQ_t	ΔP_{energ_t}	ΔDF_t	ΔP_{educ_t}	ΔP_{alim_t}
ΔP_t	12	0.512	0.013	0.021	0.031	0.005	0.133	0.010	0.050	0.226
	24	0.512	0.013	0.021	0.031	0.005	0.133	0.010	0.050	0.226

Note. Prepared by authors.

(price equation). This structure contains 19 free contemporaneous coefficients and 9 standard deviations, against the 45 distinct elements of the residual covariance matrix, so that it imposes 17 overidentifying restrictions that can be tested (Annex 8). Panel A of Annex 8 classifies each of the 19 free coefficients according to its basis: three are implied directly by equations (1) to (4), eight are consistent with the framework or with accounting relations, two are auxiliary assumptions, and six were added after inspecting the residual correlations; the absence of free coefficients in the equations for energy, food, and education prices is also an auxiliary assumption. The structure is therefore informed by the theoretical model, but only partly derived from it.

A more restrictive version, with 13 free coefficients, which excluded any direct contemporaneous effect of real balances, the deficit, and activity on prices, and of energy prices on activity and of unemployment and education prices on real balances, is rejected by the likelihood-ratio test (LR = 70.1 with 23 degrees of freedom, $p < 0.001$). The structure retained adds six coefficients and is not rejected at the 5% level (LR = 26.1 with 17 degrees of freedom, $p = 0.073$). The six additional coefficients were specified from the residual correlations; the exercise is therefore presented as a sensitivity check on the causal ordering.

The results are similar to those of the recursive baseline (Annex 8). After 24 months, the inflation shock explains approximately 58% of the variance of inflation (95% interval of 40% to 61%), compared with 53% in the baseline; energy, food, and education prices jointly explain approximately 32% (35% in the baseline), of which energy accounts for 19% and food for 9%; and the monetary and real shocks (exchange rate, real money supply, economic activity, unemployment, and the deficit) account for approximately 10% (12% in the baseline). The cumulative responses of inflation at 24 months to energy and food prices remain positive and statistically significant (0.13 and 0.11 percentage points, respectively), whereas the response to the activity shock (−0.08 percentage points) remains negative but its interval (−0.11 to 0.00) now reaches zero, so that this result should be considered less robust than those for energy and food prices.

4. CONCLUSION

After analyzing the evolution of growth and inflation in Mexico from 2001 to 2024 in relation to monetary policy, we conclude that Banco de México has generally pursued a restrictive stabilization strategy—even before its formal adoption, a reading that draws on the descriptive evidence of the first sections rather than on the estimated model. Since the 1990s, inflation targeting has coincided with a reduction in inflation, as well as with subdued economic activity. The estimated model is consistent with the view that inflation in Mexico is not predominantly a monetary phenomenon (monetary conditions being proxied here by the real money supply) but rather associated with production costs, particularly the prices of energy and food,

which together account for approximately 31% of the variance of inflation in the short-run SVAR and 36% in the long-run SVAR (since these prices are components of the consumer price index itself, part of this share reflects the way in which they enter the aggregate index).

Our analysis has focused on the transitory effects on the Mexican economy. To that end, we performed a variety of diagnostic tests (see Annexes 1 to 7). As previously mentioned, our benchmark specification is a stable SVARX model; this specification is consistent with that of a small open economy with a flexible exchange rate and free capital mobility. This study offers several conclusions. Firstly, it is important to note that an inflation shock produces a lasting increase in the price level, even though its effect on the inflation rate is transitory. By contrast, exogenous shocks to the money supply, the exchange rate, unemployment, the fiscal deficit, and education prices have no statistically significant cumulative effect on inflation, whereas shocks to energy and food prices exert lasting positive effects on the price level and shocks to economic activity exert a negative effect (Figure 7), which should not be read as a pure demand effect, since a recursively identified activity shock may combine demand and supply disturbances.

Secondly, the variance decomposition analysis demonstrates that the share of inflation variance attributable to monetary and real shocks is small at both horizons considered. In the short term, inflation in Mexico is driven mainly by shocks to its own components (energy, education, and food), which explain approximately 35% of its variance. The inertial component is also strong: approximately 53% of the variance is attributable to the inflation shock itself, a share that should be read as the contribution of the inflation innovation and not as autoregressive persistence. By contrast, the combination of monetary and real shocks explains only 12% of the variance.

Thirdly, in the long-run SVAR specification the inertial component remains important for inflation dynamics in Mexico, accounting for 51% of the variance. The combination of monetary and real shocks, in contrast, accounts for only 8% of the fluctuations in inflation. Shocks to the components of inflation (energy, education, and food) explain 41% of the variance, with food prices gaining weight relative to the short run.

Consequently, a weak connection exists between economic activity or output growth and inflation, since shocks to economic activity account for less than 4% of inflation variance and their cumulative effect on inflation is negative, which suggests, with the caution that a recursively identified activity shock may combine demand and supply disturbances, that contractionary measures to contain aggregate demand may not be entirely warranted. Conversely, monetary shocks are associated with a negative, although statistically insignificant, cumulative response of inflation (Figure 7), which is consistent with the finding that inflation in Mexico is not predominantly a monetary phenomenon. Fiscal expansion (measured by the public deficit) has a small influence on the variance of inflation (1.7% in the short term and 1.0% in the long term) and an equally small influence on the variance of output (0.8% and 1.7%, respectively).

Therefore, in this specification fiscal shocks do not appear to be a relevant source of fluctuations in either inflation or output.

The exchange rate, for its part, has a minimal influence on the variability of inflation, both in the short term (0.9%) and in the long term (0.5%). This phenomenon is further substantiated by the limited share of output variance explained by exchange rate shocks (5.3% in the short term and 4.4% in the long term), as elucidated in Annex 7. This suggests that, in the case of Mexico, exchange rate movements may not have a significant impact on the inflationary process. Although the model does not evaluate an undervaluation policy as such, this result is compatible with the view that a competitive exchange rate would need to be complemented by a systematic formulation and implementation of a cohesive set of sectoral policies aimed at enhancing the productive capacity and efficiency of both export industries and import-substituting industries. On the basis of the descriptive evidence and of the preceding results, it can be argued that the monetary authority could explore new policy frameworks that expand Banco de México's mandate beyond inflation targeting. A multi-objective approach should not only prioritize price stability but also incorporate employment and growth targets, alongside exchange rate considerations. However, such an expansion must build upon the institutional strengths of inflation targeting (IT)—namely, its transparency, credibility, and hard-earned reputation. In our view, economic growth should now receive greater priority, given that high and volatile inflation—a defining challenge of the 1980s—has been effectively tamed.

Finally, some limitations qualify these findings. Identification relies on a recursive ordering in which the prices of energy, food, and education precede aggregate inflation, so that part of their explanatory share reflects the fact that these prices are components of the consumer price index; an overidentified structure informed by the theoretical model (Section 3.2.4) yields similar variance shares, although the negative response to activity shocks is less robust. In addition, monetary conditions are proxied by the real money supply, whereas the Bank of Mexico implements its policy under inflation targeting mainly through an interest rate. Future research could incorporate the policy rate and a measure of inflation expectations, a long-run counterpart of the overidentified structure, a vector error-correction specification for the non-stationary variables, and an assessment of the stability of the transmission mechanism before and after the formal adoption of inflation targeting.

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6. APPENDIX

ANNEX 1. LAG SELECTION

Lag	AIC	HQIC	SBIC
0	-63.797	-62.456	-60.457*
1	-64.496	-62.724*	-60.082
2	-64.659	-62.456	-59.171
3	-64.795	-62.161	-58.233
4	-64.708	-61.642	-57.072
5	-64.710	-61.213	-56.000
6	-64.724	-60.796	-54.940
7	-64.739	-60.380	-53.882
8	-64.805	-60.015	-52.874
9	-64.686	-59.465	-51.681
10	-64.772	-59.120	-50.693
11	-64.705	-58.622	-49.553
12	-65.878*	-59.364	-49.652

Note: Prepared by authors.

ANNEX 2

STRUCTURAL BREAKPOINT AND OUTLIERS' POINTS

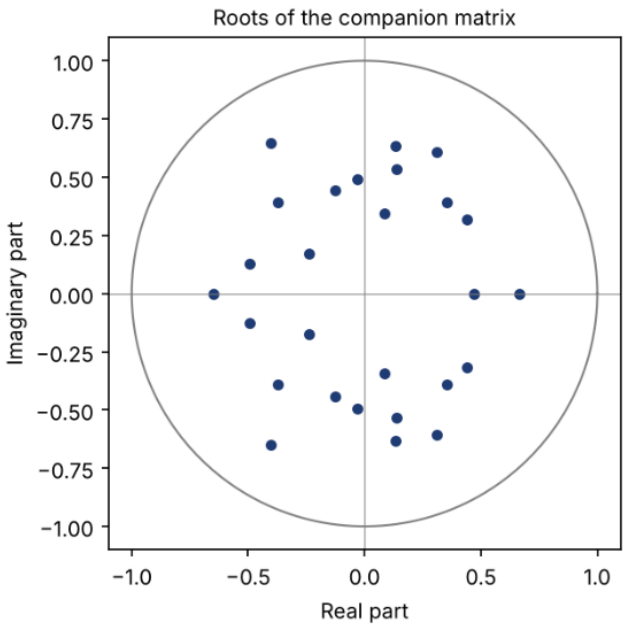
	Test Statistic	1% critical Value	5% critical value	10% critical value
F (1|0)	2.66	3.22	2.7	2.46
F (2|1)	1.85	3.39	2.92	2.69
F (3|2)	1.92	3.46	3.04	2.83
F (4|3)	0.96	3.51	3.15	2.92
F (5|4)	0.79	3.61	3.21	2.99
Breaks:				
	Breakpoints		[95% Conf. Interval]	
1	2018m8		1370m12	2666m4
Outliers				
	Year		Month	
1	2002		2	
2	2004		8	

	Test Statistic	1% critical Value	5% critical value	10% critical value
3	2008		10	
4	2010		4	
5	2011		5	
6	2012		6	
7	2014		2	
8	2020		11	
9	2021		3	
10	2022		6	
11	2024		8	

Note: Prepared by authors.

ANNEX 3

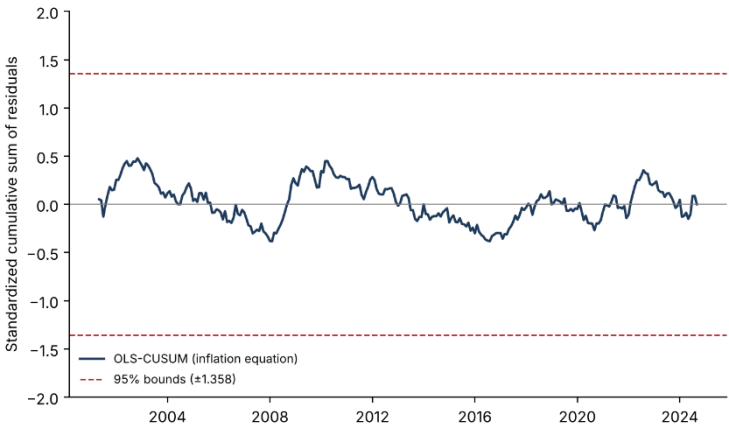
STABILITY DIAGNOSTICS: ROOTS OF THE COMPANION MATRIX AND OLS-CUSUM



Note: Prepared by authors.

ANNEX 4

STABILITY DIAGNOSTICS: OLS-CUSUM



Note: OLS-CUSUM (Ploberger and Krämer, 1992) of the inflation-equation residuals; dashed lines are the 5% bounds (±1.358). Prepared by authors.

ANNEX 5

GRANGER CAUSALITY TEST

Equation	Excluded	chi2	df	p-value
ΔP_t	Δu_t	3.872	3	0.276
ΔP_t	$\Delta\left(\frac{M1_t}{P_t}\right)$	0.262	3	0.967
ΔP_t	$\Delta \Psi_t$	14.429	3	0.002
ΔP_t	ΔQ_t	0.728	3	0.867
ΔP_t	$\Delta P_{\text{energ}_t}$	8.608	3	0.035
ΔP_t	ΔDF_t	1.062	3	0.786
ΔP_t	ΔP_{educ_t}	5.604	3	0.133
ΔP_t	ΔP_{alim_t}	2.788	3	0.425
ΔP_t	ALL	43.912	24	0.008

Note: Prepared by authors.

ANNEX 6

WHITE-NOISE AND NORMALITY TESTS (INFLATION EQUATION)

	Test	p-value
Ljung-Box	**White-noise test (Ljung-Box)** Q (24) = 20.27	0.681
Normality test		
Shapiro-Wilk Skewness-Kurtosis	W-statistic = 0.995 Chi-squared statistic = 1.42	0.527 0.493

Note: Prepared by authors.

ANNEX 7

DECOMPOSITION OF PRICE VARIANCE IN THE SHORT TERM AND LONG TERM

DECOMPOSITION OF VARIANCE SHORT-TERM STRUCTURAL VAR										
DEPENDENT	HORIZON	ΔP_t	$\Delta \mu_t$	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	$\Delta \Psi_t$	ΔQ_t	ΔP_{energ_t}	ΔDF_t	ΔP_{educ_t}	ΔP_{alim_t}
ΔP_t	12	0.532	0.013	0.039	0.037	0.009	0.185	0.017	0.038	0.129
	24	0.532	0.013	0.039	0.037	0.009	0.185	0.017	0.038	0.129
$\Delta \mu_t$	12	0.004	0.851	0.046	0.029	0.015	0.012	0.007	0.031	0.004
	24	0.004	0.851	0.046	0.029	0.015	0.012	0.007	0.031	0.004
$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	12	0.029	0.042	0.718	0.007	0.021	0.013	0.006	0.142	0.022
	24	0.029	0.042	0.718	0.007	0.021	0.013	0.006	0.142	0.022
$\Delta \Psi_t$	12	0.008	0.038	0.024	0.781	0.053	0.070	0.008	0.009	0.009
	24	0.008	0.037	0.024	0.781	0.053	0.070	0.008	0.009	0.009
ΔQ_t	12	0.006	0.018	0.140	0.014	0.757	0.003	0.021	0.022	0.019
	24	0.006	0.018	0.140	0.014	0.757	0.003	0.021	0.022	0.019
ΔDF_t	12	0.002	0.004	0.048	0.001	0.002	0.033	0.862	0.035	0.014
	24	0.002	0.004	0.048	0.001	0.002	0.033	0.862	0.035	0.014
DECOMPOSITION OF VARIANCE LONG-TERM STRUCTURAL VAR										
DEPENDENT	HORIZON	ΔP_t	$\Delta \mu_t$	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	$\Delta \Psi_t$	ΔQ_t	ΔP_{energ_t}	ΔDF_t	ΔP_{educ_t}	ΔP_{alim_t}
ΔP_t	12	0.512	0.013	0.021	0.031	0.005	0.133	0.010	0.050	0.226
	24	0.512	0.013	0.021	0.031	0.005	0.133	0.010	0.050	0.226
$\Delta \mu_t$	12	0.008	0.614	0.160	0.096	0.027	0.025	0.013	0.049	0.007
	24	0.008	0.614	0.160	0.096	0.027	0.025	0.014	0.049	0.007
$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	12	0.024	0.085	0.591	0.021	0.025	0.023	0.077	0.113	0.040
	24	0.024	0.085	0.591	0.021	0.025	0.023	0.078	0.113	0.040

DECOMPOSITION OF VARIANCE SHORT-TERM STRUCTURAL VAR										
DEPENDENT	HORIZON	ΔP_t	Δu_t	$\Delta\left(\frac{M1_t}{P_t}\right)$	$\Delta \Psi_t$	ΔQ_t	ΔP_{energ_t}	ΔDF_t	ΔP_{educ_t}	ΔP_{alim_t}
$\Delta \Psi_t$	12	0.016	0.143	0.056	0.632	0.044	0.039	0.016	0.013	0.040
	24	0.016	0.143	0.056	0.632	0.044	0.039	0.016	0.013	0.040
ΔQ_t	12	0.005	0.011	0.146	0.056	0.672	0.010	0.032	0.028	0.040
	24	0.005	0.011	0.146	0.056	0.672	0.010	0.032	0.028	0.040
ΔDF_t	12	0.002	0.014	0.072	0.005	0.004	0.047	0.740	0.051	0.066
	24	0.002	0.014	0.072	0.005	0.004	0.047	0.740	0.051	0.066

Note: Prepared by authors.

ANNEX 8

OVERIDENTIFIED STRUCTURE INFORMED BY THE THEORETICAL MODEL

Panel A. Contemporaneous coefficients (matrix A) and their basis in the theoretical model

Equation (innovation of)	Responds to	Coefficient	Std. error	z	Basis	Classification
ΔP_t	$\Delta \dot{\mu}_t$	-0.001	0.002	-0.46	Proxy for capacity utilization, eq. (4); also labor-market slack (Phillips-curve channel)	Consistent with the framework
	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	0.023	0.012	1.88	Not in equations (1)–(4)	Added after residual correlations
	$\Delta \Psi_t$	0.012	0.010	1.17	Not in equations (1)–(4)	Added after residual correlations
	ΔQ_t	-0.039	0.028	-1.40	Import prices; eq. (1) uses the real rate	Consistent with the framework
	$\Delta P_{\text{energ}_t}$	-0.123	0.012	-10.15	Cost channel; component of the price index	Consistent with the framework
	ΔDF_t	-0.041	0.016	-2.62	Not in equations (1)–(4)	Added after residual correlations
	ΔP_{educ_t}	-0.046	0.017	-2.69	Cost channel; component of the price index	Consistent with the framework
	ΔP_{alim_t}	-0.255	0.040	-6.36	Cost channel; component of the price index	Consistent with the framework
$\Delta \dot{\mu}_t$	$\Delta \Psi_t$	0.898	0.414	2.17	Okun-type relation; proxy for capacity utilization	Consistent with the framework
$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	ΔP_t	0.735	0.807	0.91	Real balances are deflated by the price index	Consistent with the framework
	$\Delta \dot{\mu}_t$	0.044	0.013	3.35	Not in equations (1)–(4)	Added after residual correlations
	$\Delta \Psi_t$	0.124	0.181	0.69	Money-market equilibrium behind eq. (1)	Consistent with the framework

Equation (innovation of)	Responds to	Coefficient	Std. error	z	Basis	Classification
	ΔP_{educ_t}	-0.433	0.150	-2.88	Not in equations (1)–(4)	Added after residual correlations
$\Delta \Psi_t$	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	-0.001	0.100	-0.01	Demand function, eq. (1)	Implied by equations (1)–(4)
	ΔQ_t	0.120	0.199	0.60	Demand function, eq. (1)	Implied by equations (1)–(4)
	$\Delta P_{\text{energ}_t}$	-0.286	0.097	-2.95	Cost channel; not in equations (1)–(4)	Added after residual correlations
	ΔDF_t	-0.851	0.618	-1.38	Demand function, eq. (1)	Implied by equations (1)–(4)
ΔQ_t	$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	-0.095	0.014	-6.88	Not in equations (1)–(4)	Auxiliary assumption
ΔDF_t	$\Delta \Psi_t$	0.345	0.227	1.52	Automatic stabilizers	Auxiliary assumption

Note: Maximum likelihood estimates of the free coefficients of matrix A in A u(t) = B e(t); a positive coefficient implies a negative contemporaneous effect of the column innovation on the row innovation. LR test of the 17 overidentifying restrictions: 26.07 ($p = 0.073$); the more restrictive version is rejected ($LR = 70.1$, $p < 0.001$). Prepared by authors.

Panel B. Variance decomposition and cumulative response of inflation after 24 months

Shock	FEVD (%), recursive	FEVD (%), overidentified	Cum. response, recursive	Cum. response, overidentified
ΔP_t	53.2 [38.0, 58.1]	57.5 [40.3, 61.0]	0.119 [0.067, 0.140]	0.121 [0.067, 0.139]
Δu_t	1.3 [0.6, 5.5]	0.9 [0.5, 5.1]	0.028 [−0.010, 0.059]	0.018 [−0.025, 0.055]
$\Delta\left(\frac{M_{1_t}}{P_t}\right)$	3.9 [1.3, 9.3]	2.0 [0.6, 11.8]	−0.028 [−0.068, 0.014]	−0.017 [−0.080, 0.057]
$\Delta \Psi_t$	3.7 [1.5, 8.3]	5.4 [1.4, 11.1]	−0.074 [−0.104, −0.031]	−0.084 [−0.107, 0.002]
ΔQ_t	0.9 [0.5, 4.8]	1.0 [0.5, 5.3]	0.022 [−0.020, 0.055]	0.025 [−0.019, 0.061]
$\Delta P_{\text{energ}_t}$	18.5 [10.3, 27.2]	19.2 [10.7, 28.0]	0.133 [0.078, 0.153]	0.134 [0.083, 0.163]
ΔDF_t	1.7 [0.6, 7.3]	0.9 [0.5, 6.8]	0.031 [−0.020, 0.073]	−0.008 [−0.076, 0.056]
ΔP_{educ_t}	3.8 [1.1, 11.9]	3.8 [0.9, 12.2]	−0.006 [−0.046, 0.042]	−0.027 [−0.064, 0.017]
ΔP_{alim_t}	12.9 [5.1, 21.6]	9.3 [3.9, 16.5]	0.135 [0.048, 0.186]	0.111 [0.028, 0.155]

Note: Forecast error variance of inflation (%) and cumulative response of inflation (percentage points) after 24 months; 95% bootstrap intervals (500 replications) in brackets. Prepared by authors.