Anchor authoring of Inflation Expectations after Adverse Supply Shocks

Abstract

In order to create an environment of low and stable inflation in Mexico it has been necessary to generate a framework for the conduction of monetary policy focused on preserving an environment of price stability along with fiscal discipline. In this context, this paper describes some structural achievements to control inflation that have been attained in Mexico. In addition, it shows empirical evidence in favor of the anchoring of inflation expectations, particularly those for the medium

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and long term, being recently strengthened. It presents an analysis considering three episodes in which inflation in Mexico was subject to different supply shocks, and it finds that of the episodes analyzed, which were within the period 2004-2012, it was during the episode observed in 2012 when inflation expectations showed greater stability, which suggests a strengthening of the credibility of the Bank of Mexico’s commitment to price stability.

Keywords: inflation expectations, anchoring inflation expectations, cost-push shocks, monetary policy, Mexico.

JEL classification: E52, E58, E65.

INTRODUCTION

After the episodes of high inflation during the seventies and eighties, when several advanced economies recorded double digit inflation and some emerging economies even experienced hyperinflation, a consensus emerged that monetary authorities should mainly focus on achieving and maintaining an environment of low and stable inflation. Moreover, some central banks that had not been autonomous became so, while monetary authorities also placed increasing emphasis on improving their communication strategies and improving their transparency. This framework for the conduct of monetary policy contributed to a prolonged period of low inflation in advanced economies, as well as in some emerging ones. This, in turn, strengthened the credibility of monetary policy and the anchoring of inflation expectations, leading to a positive feedback between monetary policy, low inflation and well-anchored inflation expectations.¹

In the case of Mexico it is important to point out that since 1994 the country has had an autonomous central bank whose main priority is to ensure the stability of the domestic currency’s purchasing power. Since 2001 Banco de México has conducted monetary policy under an inflation targeting regime.² In

¹ Mishkin and Schmidt-Hebbel (2007).
² The Monetary Program for 2001 published by Banco de México
particular, it was given the task of attaining an annual inflation for the consumer price index (CPI) of 3%. This framework for the conduction of monetary policy, together with prudent fiscal policy, has allowed for controlling the phenomenon of inflation in Mexico. Among the most outstanding structural achievements in controlling inflation are: i) the reduction in the level, volatility and persistence of inflation; ii) a pricing process that resembles the way prices are determined in economies with a long history of price stability; and iii) a performance of inflation expectations that is consistent with an environment of low and stable inflation. The aforementioned has also allowed for a more efficient functioning of the economy’s pricing system. The latter has been reflected in, among other things, a decrease of the pass-through effect of exchange rate fluctuations, commodity price increases and tax adjustments to inflation.

These achievements have helped to increase the credibility of Banco de México’s commitment to price stability. As will be assessed in this paper, this prevents the supply shocks which affect inflation from negatively influencing inflation expectations so that such shocks just have a transitory impact on inflation. In this respect, this paper analyzes three episodes between 2004 and 2012 when inflation in Mexico was affected by supply shocks. These episodes correspond to 2004, 2006-2008 and 2011-2012. The latter period stands out because inflation expectations exhibited greater stability.

presents the most important reasons for choosing this scheme, among which announcing an official target for inflation and continuous efforts to improve transparency and communication with the public stand out.

However, given that there is a wide range of factors that influence the behavior of inflation in the short-term, which are beyond the central bank’s control, Banco de México has set a variability interval of plus/minus one percentage point around the 3% target. On this matter, Banco de México has emphasized that said interval is not an indifference range, but a practical way of representing the uncertainty associated with the behavior of inflation.

For a more detailed explanation of supply shocks and their effect on inflation see the Monetary Program for 2012 and 2013.
The paper is organized as follows: the first section briefly describes some of the achievements that have been made in Mexico regarding price stability. The second section analyzes the performance of inflation expectations during the three periods in which different supply shocks affected inflation in Mexico. Finally, some conclusions are presented.

1. PROGRESS IN THE CONSOLIDATION OF PRICE STABILITY

A monetary policy oriented at ensuring price stability, together with fiscal discipline, has enabled inflation to be controlled in Mexico. In this regard, Ramos-Francia and Torres (2005) describe monetary policy in Mexico after the crisis of 1995, showing that once a sustainable fiscal position was reached, the inflation targeting scheme helped anchor inflation expectations and steadily reduce inflation. In this context, some of the structural achievements that have been made in controlling inflation in Mexico are described below.

1.1 Level, Volatility and Persistence of Inflation

Headline inflation in Mexico has declined gradually from levels of over 100% during the decade of the eighties to the values of around 3% observed recently (Figure 1). Inflation has therefore been converging toward the 3% target. The technical chapter “Change in the Nominal System of the Mexican Economy in the Early 2000’s,” published by Banco de México in the Quarterly Report of October-December 2010, presents empirical evidence for the fact that headline inflation has undergone some structural changes. In particular, since approximately 2001 inflation has fluctuated modestly around a value that is the lowest since CPI calculations began in Mexico. Thus, inflation has changed from being a highly volatile process into a more stable one.

Regarding the reduction in the inflation level in Mexico, a process of convergence of inflation in Mexico toward that of the United States has been observed during the last decade. The
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box “Comparison of Inflation Experience in Mexico and the U.S. during the Last Decade,” published by Banco de México in the Quarterly Report of January-March 2012, and based on Cortés et al. (2012), presents empirical evidence for such process of convergence.

Inflation persistence in Mexico has decreased. Inflation is said to be highly persistent when the shocks affecting it, such as fluctuations in certain relative prices like foodstuffs or commodities, have a prolonged impact. Chiquiar et al. (2007) study some statistical properties of inflation in Mexico during 1995 and 2006, employing techniques to identify changes in the persistence of time series. The results suggest that inflation in Mexico shifted from being a non-stationary process to a stationary one toward the end of the year 2000 or the start of 2001.

1.2 Pricing Process in the Economy

In addition to the aforementioned, progress in controlling inflation has also caused the pricing process in Mexico to become more similar to the way prices are determined in economies that managed to achieve price stability many years ago. In countries

Figure 1

HEADLINE INFLATION
(in annual percentage)

Source: Banco de México and INEGI.
that experience an environment of low and stable inflation the price formation process is characterized by three main aspects: i) prices exhibit downwards flexibility; ii) the magnitude of price adjustments is moderate; and, iii) predominance of time-dependent price revision strategies, where firms update their prices in order to make adjustments in the predetermined periods.

The technical chapter “Features of the Price Formation Process in Mexico: Evidence from CPI Micro Data,” published by Banco de México in the Quarterly Report of October-December 2011 and based on Cortés et al. (2011), uses the micro data employed for calculating the CPI to study the pricing process in Mexico. This study describes how the downward flexibility of prices has increased over the last decade and shows evidence that the proportion of price reductions in Mexico is currently similar to that observed in the United States. It has also been found that, unlike during the past, the magnitude of price changes in Mexico is moderate nowadays.

In addition to the above, evidence was found that time-dependent pricing strategies currently predominate. This as opposed to the way in which prices were formed during the past decade, when state-dependent strategies were followed, where firms updated their prices according to the circumstances faced by such firms at the macroeconomic level. Thus, the way in which prices are currently formed in the Mexican economy is in line with a stable and predictable macroeconomic environment. Moreover, the box “Relative Price Changes and Inflation Convergence toward the 3 Percent Target,” published by Banco de México in the Quarterly Report of April-June 2013, presents evidence that the aforementioned features of the price formation process were not affected by the supply shocks experienced by the Mexican economy during 2012 and at the start of 2013.

1.3 Performance of Inflation Expectations

Under this context, positive results in the fight against inflation have led to a high degree of credibility regarding Banco de México’s commitment to price stability. The latter has also
allowed the anchoring of economic agents’ inflation expectations (Figure 2).

Figure 2

HEADLINE INFLATION EXPECTATIVES
(in annual percentage)

Efforts to consolidate price stability in Mexico have been associated with a favorable evolution of inflation expectations. The aforementioned is documented in the technical chapter “Evolution of Inflation Expectations in Mexico,” published by Banco de México in the Quarterly Report of July-September 2011, and in García Verdú (2012). It is therefore possible to highlight some features of the dynamics of inflation expectations in Mexico. First, their value has gradually converged toward the inflation target. Second, their dispersion has decreased as a result of the low uncertainty conditions associated with an environment of low and stable inflation (Figure 3). Finally, the behavior of inflation expectations shows that the perception of upside risks to inflation performance has declined significantly relative to the perception of downside risks to it.

The behavior of inflation expectations is crucial for maintaining price stability. This is due to the fact that inflation expectations can influence observed inflation as price adjustments made by economic agents in each period mainly depend
on the inflation that is expected in future periods. Thus, the credibility of Banco de México’s commitment to price stability is essential in order for the institution to effectively maintain an environment of low and stable inflation.

1.4 Functioning of the Price System

Price stability has contributed to a smooth and efficient functioning of the economy’s price system. This means that relative prices efficiently transmit information on prevailing conditions in each market, particularly regarding the relative scarcity of goods and services. Prices therefore serve as signals for coordinating the production, distribution and consumption of goods and services, encouraging the efficient allocation of resources inside the economy. This can be illustrated with some examples.

First, the reduction of the pass-through of exchange rate fluctuations to domestic prices that has been observed in Mexico over the last ten years. The aforementioned has been documented in the technical chapter “Exchange Rate Pass-through
to Prices,” published by Banco de México in the Quarterly Report of January-March 2011, as well as by Capistrán et al. (2011) and Cortés (2013).

Second, the fact that increases in the relative prices of certain goods, such as commodities that usually exhibit highly volatile behavior, have transitory effects on inflation. Thus, the box “Considerations on the Impact of International Commodity Price Fluctuations on Consumer Prices in Mexico,” published by Banco de México in the Quarterly Report of April-June 2012, concludes that in the case of Mexico there is no evidence of second-round effects on the pricing process in Mexico.

Finally, tax increases, such as those corresponding to the fiscal adjustments that came into force in 2010, only lead to temporary increases in inflation (only once the impact of the taxes is included in the price of taxed goods and services, do such prices stop increasing) in the absence of other shocks. On this point, the box “Evidence on the Absence of Second-round Effects on the Pricing Process Associated with the Tax Adjustments for 2010 Approved by Congress,” published by Banco de México in the Quarterly Report of January-March 2010 did not find evidence that the fiscal adjustments which came into force in 2010 had contaminated the price formation process in the economy.

Thus, the reduced pass-through of exchange rate fluctuations, changes in commodity prices and tax adjustments to inflation is associated with the absence of second-round effects. This suggests that inflation expectations, particularly long-term expectations, have not been negatively affected by shocks such as those referred to. The following section therefore analyzes in detail the behavior exhibited by inflation expectations in Mexico upon supply shocks.

2. RESPONSE OF INFLATION EXPECTATIONS TO SUPPLY SHOCKS

As described above, variations in the relative prices of goods and services have only a transitory impact on inflation in Mexico, which tends to dissipate rapidly. The anchoring of inflation
expectations has been crucial to this process because, as mentioned previously, their evolution affects the performance of inflation. In general terms, inflation expectations are said to be anchored when they are relatively insensitive to inflation shocks. On this point, it is worth pointing out that the performance of medium and long-term inflation expectations is most relevant, given that short-term ones naturally increase to some extent as a result of such shocks.\(^5\)

The degree to which inflation expectations are anchored does not necessarily remain constant over time. Both timing and magnitude of its variations can be the result of different factors, among which the central bank’s conduction of monetary policy stands out. Thus, a monetary policy oriented at procuring price stability, while generating an environment of low and stable inflation, can contribute to the anchoring of inflation expectations (Figure 4).

In this sense, several empirical works have explored the relation between the framework for the conduction of monetary policy and the behavior of inflation expectations. In the case of advanced economies, Gürkaynak et al. (2010) found that long-term inflation expectations were better anchored in Sweden, an economy that had had an inflation targeting regime for several years, than in the United States, where said regime had still not been formally implemented. The work also shows evidence that the anchoring of long-term inflation expectations in the UK has strengthened since the Bank of England gained legal independence in the nineties. In the case of emerging economies, Pooter et al. (2013) study the behavior of long-term inflation expectations in Brazil, Chile and México, finding that expectations have become better anchored in recent years. However, they conclude that it is still very premature to say they are well-anchored.

In addition to the above, Capistrán and Ramos-Francia (2010) examine the effect of having an inflation targeting regime on

\(^5\) In general terms, the expectation referring to an indicator formulated for the next 12 months or less is considered a short-term expectation.
the dispersion of professional analysts’ inflation forecasts using a panel of 26 countries, including 14 with inflation targets, Mexico among them. These authors find that the dispersion of long-term inflation expectations is lower in countries that have adopted inflation targeting regimes, especially in the case of emerging market economies such as Mexico.

This section analyzes the way in which inflation expectations in Mexico have responded to supply shocks that affected inflation. In particular, three episodes between 2004 and 2012 in which inflation in Mexico was affected by past supply shocks are analyzed. These correspond to 2004, 2006-2008 and 2011-2012. The periods of supply shocks were determined based on

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This paper considered the inflation expectations that were obtained from the survey Banco de México conducts among private sector specialists.
the *Quarterly Report* and the “Monetary Policy Decision Announcements.” This is due to the fact that the monetary policy actions implemented by the central bank are based on the members of the Board of Governors’ interpretation of the economic situation and the outlook for inflation. This interpretation is also communicated to participants in the market and the general public through different media, such as the *Quarterly Report* and the “Monetary Policy Decision Announcements.”

We therefore review such media, as well as the international prices of commodities (Figure 5), in order to identify the periods when concerns were raised regarding the appearance of supply shocks. For each of these periods we describe the observed shocks, their impact on inflation and its expectations, mainly long-term, as well as the monetary policy actions that were implemented. The period 2011-2012 stands out because inflation expectations exhibited greater stability, which suggests increased credibility in the monetary authority’s commitment to price stability. An econometric exercise is also presented which finds evidence that the anchoring of inflation expectations has indeed strengthened during recent years.

### 2.1 2004 Episode

The first episode of supply shocks analyzed in this paper corresponds to 2004, when the Mexican economy was subject to the following shocks: increases in the international prices of commodities.
different commodities, increments in the prices of some goods and services administered and regulated by the government and increases in the prices of certain agricultural products due to climatic factors.

In this context, during 2004 annual headline inflation recorded considerable growth, shifting from 3.98% in December 2003 to 5.43% in November 2004 (Figure 6). Inflation expectations for different horizons gathered in Banco de México’s survey were also affected (Figure 6). In particular, those corresponding to inflation for the next four years went from 3.57% in December 2003 to 3.91% in December 2004. As for monetary policy, the central bank increased the corto (the level of commercial banks’ current account balances at Banco de México) on nine occasions.

8 The inflation expectations referred to throughout this section correspond to the average of inflation expectations collected in Banco de México’s survey.
during 2004. Thus, the interbank funding rate increased from its lowest level registered in the year, 4.73% recorded on January 19, to 8.75% on December 31 (Figure 7).

2.2 2006-2008 Episode

The second supply shock episode corresponds to the period between the second half of 2006 and the third quarter of 2008, when the following events took place: increases in the international prices of commodities, increments in some agricultural products’ prices due to climatic conditions, and the approval of tax reform in September 2007 establishing new taxes.

Annual headline inflation increased from 3.06% in July 2006 to 4.21% in March 2007. In the following months, annual headline inflation remained at high levels, fluctuating around 4%. It then grew significantly throughout 2008, reaching 5.47% in September that year (Figure 8). As for the behavior of inflation...
**Figure 7**

**SUPPLY SHOCK EPISODE 1: POLICY RATE**
(percentages)

Source: Banco de México.

**Figure 8**

**SUPPLY SHOCK EPISODE 2: OBSERVED AND EXPECTED INFLATION**
(annual percentage)

Source: Banco de México and Banco de México Survey of Expectations.
expectations, those for a horizon of less than a year deteriorated insofar as inflation rebounded. Meanwhile, inflation expectations for the next four years remained close to 3.5% from mid-2006 to December 2007. However, they grew during 2008, reaching 3.66% in September that year.

Banco de México tightened monetary conditions in April and October 2007. Thus, the target bank funding rate went from 7% to 7.25% in April and, subsequently, located at 7.5% from October onwards. It also decided to raise the target for the target overnight interbank interest rate by 25 basis points consecutively in June, July and August 2008. Thus, the referred interest rate shifted from 7.5% to 8.25% (Figure 9).

2.3 2011-2012 Episode

The last episode corresponds to the period from the third quarter of 2011 to the third quarter of 2012. During this period, the Mexican economy was affected by supply shocks, mainly domestic ones: the relative prices of some agricultural goods increased due to climatic and sanitary factors, and exchange rate depreciation episodes were observed in the period.

Headline inflation, which had been 3.14% in September 2011, surpassed the upper bound of the variability interval in June 2012, recording a level of 4.34% in the referred month. Later, it continued to increase until it reached 4.77% in September (Figure 10). As for the evolution of inflation expectations, although short-term expectations increased, medium and long-term expectations remained relatively stable, unlike during the previous episodes. In particular, longer-term expectations remained anchored within the variability interval established around the inflation target. Inflation expectations for the next

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9 It is important to mention that during the period analyzed in this section, Banco de México changed the operational target for monetary policy. In particular, on January 21, 2008, Banco de México adopted the overnight interbank interest rate as an operational target instead of the current account balance that commercial banks maintain at the central bank (the corto).
Figure 9

**SUPPLY SHOCK EPISODE 2: POLICY RATE**

(percentages)

Source: Banco de México.

Figure 10

**SUPPLY SHOCK EPISODE 3: OBSERVED AND EXPECTED INFLATION**

(annual percentage)

Source: Banco de México and Banco de México Survey of Expectations.
four years changed from 3.56% in September 2011 to 3.60% in September 2012. In this context, during the period in question the target for the overnight interbank interest rate remained unchanged.

Table 1 in Appendix A shows the performance of inflation expectations during the third episode of supply shocks as compared to the two previous episodes. Inflation expectations for the next four years increased less during the third episode than in the previous ones. The comparison between the first and third episodes is particularly relevant given that, even though the rise in inflation was greater in the third episode with respect to the first one, the growth of inflation expectations was lower. This would suggest that inflation expectations are currently better anchored.

Regarding the comparison between the second and third episodes, it is important to point out that the latter was shorter and that both inflation and its expectations increased less. As a consequence, based on this descriptive analysis, it is unclear whether the lower response of inflation expectations was the result of a more solid anchoring or the smaller impact of shocks on inflation. Therefore, a more formal analysis is required. The following section therefore presents an econometric exercise analyzing the evolution of the anchoring of inflation expectation during recent years.

2.4 Econometric Exercise

This section presents an econometric exercise to analyze how inflation shocks have affected short and long-term inflation expectations in Mexico. This is done using the methodology of Mariscal, Powell y Tavella (2013) as a reference. The data employed corresponds to inflation expectations for the next 12 months and for the next four years taken from the monthly survey on this topic that Banco de México conducts among private sector analysts. Meanwhile, observed annual inflation corresponds to that published on a monthly basis by the National Institute of Statistics and Geography (Instituto Nacional
de Estadística y Geografía, INEGI). The period of analysis corresponds to 2004-2012. Based on the referred sample, the following regression was estimated:

\[ E_t(\pi_{t+i}) = \alpha + \gamma E_{t-1}(\pi_{t+i}) + \delta \max\{\pi_{t-1} - \pi^*, 0\} + \epsilon_t, \]

where \( \pi \) is the annual inflation rate, \( \pi^* \) is Banco de México’s permanent inflation target. The subindex \( t \) refers to the month in which the inflation survey was conducted and \( E_t \) refers to the expectation at the moment \( t \). For instance, \( E_t(\pi_{t+12}) \) considers the inflation expectation at the moment \( t \) for the following 12 months.

The calculations were made with a 36-month moving window. Thus, the specification presented above is estimated employing information available on inflation expectations for the next 12 months and for the next four years.

The result this exercise attempts to identify corresponds to the response of inflation expectations to inflation shocks throughout time, i.e., the main interest is on the evolution of parameter \( \delta \). In the regression equation, such parameter corresponds to the coefficient of a variable that takes the maximum value between zero and the difference between observed inflation in the previous period and the 3% inflation target. Thus, said variable measures how far observed inflation is above the 3% permanent target. A higher value of parameter \( \delta \) suggests increases in inflation expectations associated to the occurrence of inflation shocks. Thus, a more solid anchoring of expectations would be related to the reduction of the value of this parameter.

In line with the aforementioned, the estimated regression can have the following interpretation.\(^{10}\) Rewriting the regression gives the expression:

\[ E_t(\pi_{t+i}) - \gamma E_{t-1}(\pi_{t+i}) = \alpha + \delta \max\{\pi_{t-1} - \pi^*, 0\} + \epsilon_t. \]

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\(^{10}\) This interpretation was proposed by an assessor in the editorial process for this journal.
The left hand term can be interpreted as a quasi-revision of inflation expectations. Thus, when parameter $\delta$ takes a value equal to zero it means that deviations of observed inflation from the target do not lead to a revision in inflation expectations. In such case it can be said that inflation expectations are well-anchored. Lower values of parameter $\delta$ would generally be associated with a better anchoring of inflation expectations.

The results obtained after considering the average of inflation expectations for the next 12 months and for the next four years, show that the parameter $\delta$ has been decreasing over time, to become close to values not statistically different from zero in the recent period (Figures 11 and 12).

Furthermore, as short-term expectations correspond to those for the next 12 months, higher values were obtained when these were used in the regression as compared to longer-term ones.

It is worth mentioning that for the estimation that considered the average of inflation expectations for the next 12 months, it was found that after the second episode of supply shocks, when inflation remained under control despite the magnitude of the shocks, a decrease in the parameter in question was registered. Thus, it shifted from positive values to values not statistically different from zero, except for a brief period in the middle of 2012.

As for the estimation that considered expectations for the next four years, a downward trend in this parameter was observed after the second episode of shocks, which went from positive values to values not statistically different from zero. Nevertheless, the referred parameter exhibited positive values in some months of the last episode, it subsequently decreased to values not statistically different from zero.

Although, as has been mentioned, this work is primarily interested in the evolution of parameter $\delta$, it also describes the behavior of parameters $\alpha$ and $\gamma$, which correspond to the constant and coefficient of lagged inflation expectations in the regression equation. Figures 13 and 14 show the evolution of these parameters for the estimation that considered the average of inflation expectations for the next 12 months, while Figures 15 and 16 illustrate the behavior of said parameters
Figure 11
AVERAGE INFLATION EXPECTATIONS OVER THE NEXT 12 MONTHS
COEFFICIENT ($\delta_E$)\textsuperscript{1}
(36-month moving window)

Source: Banco de México and Banco de México Survey of Expectations.
\textsuperscript{1}Confidence interval at 90 percent.

Figure 12
AVERAGE INFLATION EXPECTATIONS OVER THE NEXT FOUR YEARS
COEFFICIENT ($\delta_E$)\textsuperscript{1}
(36-month moving window)

Source: Banco de México and Banco de México Survey of Expectations.
\textsuperscript{1}Confidence intervals at 90 percent.
Figure 13

**Inflation Expectations over the Next 12 Months**

**Constant Term ($\alpha$)**

(36-month moving window)

![Figure 13](image-url)

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence intervals at 90 percent.

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Figure 14

**Inflation Expectations over the Next 12 Months**

**Lag Coefficient ($\gamma$)**

(36-month moving average)

![Figure 14](image-url)

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence intervals at 90 percent.

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Figure 15

INFLATION EXPECTATIONS OVER THE NEXT FOUR YEARS
CONSTANT TERM (\(\alpha\))^1
(36-month moving window)

Source: Banco de México and Banco de México Survey of Expectations.
^1 Confidence intervals at 90 percent.

Figure 16

INFLATION EXPECTATIONS OVER THE NEXT FOUR YEARS LAG
COEFFICIENT (\(\gamma\))^1
(36-month moving average)

Source: Banco de México and Banco de México Survey of Expectations.
^1 Confidence intervals at 90 percent.
when the average of inflation expectations for the next four years was employed.

As can be seen, parameter takes positive values which, except in some periods, are generally statistically different from zero. Meanwhile, parameter always exhibits positive values, less than one and statistically different from zero. Moreover, when inflation expectations for the next four years are considered, the referred parameter tends to take values less than those corresponding to the calculation that considers expectations for the next 12 months. This seems to suggest that the persistence of inflation expectations tends to be lower when expectations for longer terms are considered. It is important to point out that a value of between zero and one for this parameter can be interpreted as additional evidence of the anchoring of inflation expectations. The latter is due to the fact that in presence of an inflation shock, the behavior of expectations exhibits mean reversion. Furthermore, although values of these parameters fluctuate throughout the sample period, no upward or downward trend is observed.

### 2.5 Robustness Tests

In order to verify the robustness of the results of the econometric exercise, this section presents three additional exercises: i) recursive estimation of the regression; ii) including deviations of inflation with respect to the variability interval instead of the precise target in the specification; and iii) estimating the original specification controlling for the phase of the economic cycle.

First, the same Equation presented previously is estimated but with a recursive regression, i.e., considering the available data regarding the expectations from September 2003 onwards, starting with a sample of 24 months and amplifying it by adding data throughout time until November 2013. As can be seen in Figures 17 and 18, the response of inflation expectations to deviations in inflation from its target has decreased over time.
Figure 17

**Average Inflation Expectations over the Next 12 Months**

**Coefficient ($\delta_E$)**

(36-month moving average)

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence intervals at 90 percent.

Figure 18

**Average Inflation Expectations over the Next Four Years**

**Coefficient ($\delta_E$)**

(36-month moving average)

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence intervals at 90 percent.
Second, using the same sample as in the previous exercise, the following regression was estimated:

\[ E_t (\pi_{t+i}) = \alpha + \gamma E_{t-1} (\pi_{t+i}) + \delta \text{Max}\{\pi_{t-1} - \pi^*, 1\} + \epsilon_t. \]

In this Equation, parameter \( \delta \) corresponds to the coefficient of a variable that takes the maximum value between the unit and the difference between the observed inflation in the previous period and the 3% inflation target. Thus, this variable captures the periods when inflation was above the upper bound of the variability interval around the 3% permanent target. When inflation expectations for the next 12 months and for the next four years are considered, the results show that parameter \( \delta \) has decreased to values in the recent period that are not statistically different from zero, although it did exhibit positive values in some months during the middle of 2012 (Figures 19 and 20). This is in line with results obtained in the previous exercises.

Third, the original specification was estimated controlling for the phase of the cycle that the economy was undergoing. In this case the regression is as follows:

\[ E_t (\pi_{t+i}) = \alpha + \gamma E_{t-1} (\pi_{t+i}) + \delta \text{Max}\{\pi_{t-1} - \pi^*, 0\} + \beta X_{t-1} + \epsilon_t, \]

where parameter \( \beta \) corresponds to the coefficient associated to the lagged output gap \( (X_{t-1}) \). This variable is controlled by the phase of the cycle the economy is undergoing because it could be argued that inflation expectations are affected not only by the performance of inflation itself, but also by the degree of slack in the economy. For instance, if the output gap is negative firms will find it more difficult to make upward adjustments in their prices in the event of a supply shock, meaning economic agents’ inflation expectations would tend to be less affected by the same shock. However, after considering the average of inflation expectations for the next 12 months and for the next four years, the results show that, even when controlling for the output gap, parameter \( \delta \) continues to decrease.
Source: Banco de México and Banco de México Expectations Survey.

1 Confidence intervals at 90 percent.

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence intervals at 90 percent.
over time to get to values that are not statistically different from zero in the recent period (Figures 21 and 22). This is in line with the previous results.

In general, the results would seem to suggest that the fact that the pricing process of the economy was not contaminated during the second episode of supply shocks helped to strengthen the anchoring of inflation expectations. They were therefore relatively less affected in the third episode of supply shocks. In light of such conditions, unlike in previous periods of supply shocks, when Banco de México responded by tightening the monetary policy stance in order to reinforce its commitment to price stability, during the last period analyzed, given the anchoring of inflation expectations, it was not necessary to raise the reference interest rate.

CONCLUSIONS

A framework for the conduction of monetary policy focused on procuring and maintaining an environment of price stability, along with sound public finances, has contributed to creating a stable macroeconomic environment in Mexico. Under this context, after describing the structural achievements to control inflation in Mexico, this paper shows empirical evidence in favor of the fact that the anchoring of inflation expectations has strengthened recently. A descriptive analysis was presented, in which three episodes when the Mexican economy was subject to different supply shocks were considered. It was shown that during the episode corresponding to 2011-2012 inflation expectations increased considerably less than in the other episodes analyzed. Moreover, the econometric results suggest that inflation expectations respond increasingly less to inflationary shocks. This could be attributed, to a great extent, to the credibility of monetary policy and to improvements in Banco de México’s communication strategy with market participants and the public in general. The results of this paper therefore lend support to the idea that a virtuous cycle has been created between the environment of price stability achieved in Mexico,
Figure 21

**COEFFICIENT (\(\delta_E\)) CONTROLLING FOR OUTPUT GAP (INFLATION EXPECTATIONS OVER THE NEXT 12 MONTHS)**

(36-month moving window)

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence interval at 90 percent.

Figure 22

**COEFFICIENT (\(\delta_E\)) CONTROLLING FOR OUTPUT GAP (INFLATION EXPECTATIONS OVER THE NEXT FOUR YEARS)**

(36-month moving window)

Source: Banco de México and Banco de México Survey of Expectations.

1 Confidence interval at 90 percent.
the anchoring of inflation expectations and a monetary policy conduction focused on procuring the stability of the domestic currency's purchasing power.

APPENDIX A
Table 1

PERFORMANCE OF INFLATION AND ITS EXPECTATIONS
DURING THE EPISODES OF SUPPLY SHOCKS

(Percent)

<table>
<thead>
<tr>
<th></th>
<th>Episode 3</th>
<th>Episode 2</th>
<th>Episode 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(B−A)</td>
</tr>
<tr>
<td>Headline</td>
<td>3.14</td>
<td>4.77</td>
<td>1.63</td>
</tr>
<tr>
<td>Headline inflation expectations</td>
<td></td>
<td></td>
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<tr>
<td>Next four years</td>
<td>3.56</td>
<td>3.60</td>
<td>0.04</td>
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<tr>
<td>End of 2004</td>
<td></td>
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<td></td>
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<tr>
<td>End of 2005</td>
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<td></td>
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<tr>
<td>End of 2007</td>
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<td></td>
<td></td>
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<tr>
<td>End of 2008</td>
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<td></td>
</tr>
<tr>
<td>End of 2009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of 2012</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>End of 2013</td>
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</table>

Source: Banco de México.

* E−(D).
References

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