Has Monetary Policy Become More Efficient in Mexico?

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Abstract

Mexico has experienced a lower variability of inflation and industrial production during the 1990s as compared to the previous decade. This paper directly examines the role that monetary policy has played in achieving this higher macroeconomic stability.

We estimate the efficiency frontier for monetary policy resulting from the inflation and output variability trade-off faced by the monetary authority. The frontier is obtained for two subperiods and used to develop measures of efficiency gain (or loss) in monetary policy.

We find that the efficiency of monetary policy in Mexico has in fact increased. Its contribution to the higher macroeconomic stability amounts to 48% or 93%, depending on the assumptions made about the policy goals of the Bank of Mexico.

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1 Introduction

Over the last years most industrialized countries and some developing countries have experienced a decrease in both inflation and output variability.[1] Particularly, in the case of Mexico, the variance of inflation has dropped from 7.02% during 1982 to 1988 to 1.76% during 1991 to 1997. Similarly, the variance of the detrended natural log of industrial production has fallen from 0.40% to 0.19% for the same subperiods.

This increase in macroeconomic stability can result from the combination of two factors: 1) a reduction in the variance of the aggregate supply shocks (see below); and 2) a more efficient policy by the Mexican monetary authority. The purpose of this paper is to identify the relative contribution of each of these explanations.

The performance of monetary policy can be evaluated using the inflation and output variability trade-off that the monetary authority faces. The economy is affected by two general types of disturbances that require policy responses: aggregate demand shocks –which move output and inflation in the same direction– and aggregate supply shocks –which move output and inflation in opposite directions. Since monetary policy can move output and inflation in the same direction, it can completely offset aggregate demand shocks, while aggregate supply shocks will force the monetary authority to face a trade-off between the variability of output and that of inflation.

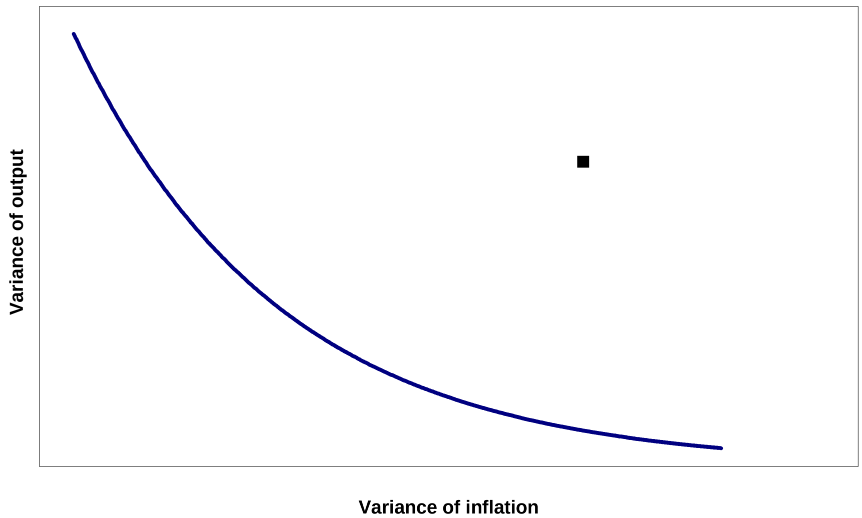
Given this trade-off, an efficiency frontier for monetary policy, which minimizes the variances of inflation and output, can be constructed (see Figure 1).[2] If monetary policy is optimal, the authority will choose a point on this curve, depending on its preferences. The location of the efficiency frontier depends on the variance of aggregate supply shocks; the smaller such variance, the closer the efficiency frontier will be to the origin. If monetary policy is not optimal, it will be more efficient the closer the performance point of the economy

[1] See Cecchetti and Ehrmann (1999), among others.

[2] This frontier is known in the literature as the Taylor Curve (Taylor, 1979).

is to the efficiency frontier.

Figure 1: Inflation-output variability frontier and performance point



By simply looking at the decrease in inflation and output variability we are unable to identify the relative contributions of a reduction in the variance of aggregate supply shocks and a more efficient monetary policy. Therefore, our strategy consists on developing measures of efficiency gain (or loss) net of the change in the variance of aggregate supply shocks, by comparing the performance point of the economy and the efficiency frontier for two subperiods.

The paper is organized as follows: Section 2 presents a structural model for the Mexican economy. Section 3 describes the procedure to obtain the efficiency frontier for monetary policy from the estimated structural model, while Section 4 introduces our measures to identify the change in efficiency of monetary policy. Section 5 presents the main results, while Section 6 concludes.

2 The Structural Model

The construction of the efficiency frontier requires knowledge about the dynamics of the economy and the assumptions about the objectives of the monetary authority. In this section we are concerned with estimating a model of the economy that resembles closely enough the structure of the Mexican economy.

We consider a simple two-variable model for the Mexican economy, similar to the one used by Rudebusch & Svensson (1999) for the US. This linear model is tractable and yields a good fit to the data for the entire period, as well as for each subperiod.[3] The model consists of the following two equations:

$$\pi_{t+1} = \sum_{l=0}^{2} \alpha_{1l}\pi_{t-l} + \alpha_{13}y_t + \alpha_{14}y_{t-1} + \alpha_{15}px_t + \alpha_{16}w_t + \alpha_{17}cr_{t+1} + \varepsilon_{1t+1} \quad (1)$$

$$y_{t+1} = \sum_{l=0}^{2} \alpha_{2l}y_{t-l} + \alpha_{23}(i_t - \pi_t) + \varepsilon_{2t+1} \quad (2)$$

The first equation represents an aggregate supply curve or augmented Phillips Curve, where the demeaned inflation rate (π) is modeled as a function of three of its lags which represent inflation expectations and the demeaned and detrended output, which is measured as the log of industrial production. The other explanatory variables are external prices (px), measured by the sum of the devaluation rate and the US inflation rate, the growth rate of a wage index (w) and a dummy variable (cr) that captures the exchange rate crisis undergone by the Mexican economy during 1983 and 1995. The variables px and w were included to increase the goodness of fit of the aggregate supply equation, following Garcés Díaz (1999). The second equation represents an aggregate demand curve or IS curve, relating output with three own lags and the *ex-post* real interest rate ($i_t - \pi_t$).

Finally, ε_1 and ε_2 are errors with mean zero and constant variance. They can be interpreted as linear combinations of aggregate supply and demand shocks to the economy. Assuming there is no correlation between the aggregate demand and supply shocks, ε_1 and ε_2 can be represented as:

$$\varepsilon_{1t+1} = \beta_{11}d_{t+1} + \beta_{12}s_{t+1} \quad (3)$$

[3] Rudebusch and Svensson (1999) explain the main features of this type of model and method of estimation with respect to a couple of models used by the Federal Reserve for the US economy. In addition, they justify the model from a practical point of view for the monetary authority. The reader is referred to their paper for the details.

$$\varepsilon_{2t+1} = \beta_{21} d_{t+1} + \beta_{22} s_{t+1} \quad (4)$$

where d is an aggregate demand shock and s is an aggregate supply shock, both with mean zero and constant variance. An efficient monetary policy would move the nominal interest rate (the instrument of monetary policy) to completely offset the aggregate demand shocks. Since the interest rate only appears in the second equation of the structural model, ε_{2t+1} will only contain the aggregate supply shock (thus, $\beta_{21} = 0$).

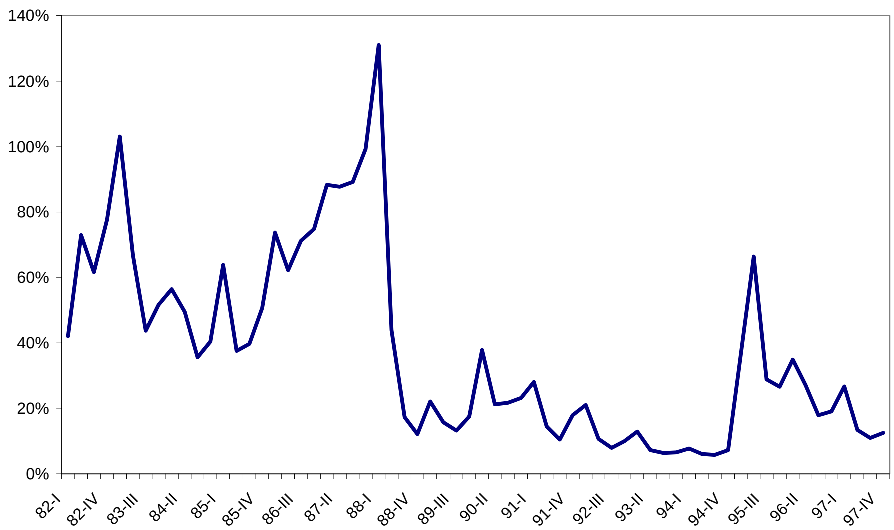
Equations (1) and (2) are estimated separately by OLS with data from the OECD Main Economic Indicators and the Bank of Mexico. In order to obtain statistical evidence to support the division of the entire period into two subperiods we applied one of Andrews' (1993) tests for structural change. The test used is based on computing the supremum of the likelihood ratio test (LR) for all possible breakpoints in the middle 70% of the entire period. For the inflation equation the maximum value of the LR statistic is 28.74 for the first quarter of 1988, which rejects the null hypothesis of no structural change at the 1% significance level (critical value of 23.63). For the output equation the test statistic is 9.60 for the first quarter of 1995, not being able to reject the null hypothesis at the 10% significance level (critical value of 13.82).

There is, therefore, statistical evidence supporting the division of the entire period into the following subperiods: 1982:I-1988:IV and 1991:I-1997:IV.[4] Figure 2 also supports this division of the entire sample, where it becomes evident that annualized quarterly inflation drops after the second quarter of 1988. This evidence is consistent with the structural change of the economy undertaken by the Mexican government at the end of the 1980s, which included a greater degree of openness and trade and economic deregulation. The division of the sample also coincides with the *Pacto de Solidaridad Económica* undertaken

[4] Andrews' test was also applied to each of the subperiods. The test does not reject the null hypothesis of no structural change for the industrial production equation, while rejects it for the inflation equation in the first subperiod. However, we note that for this last equation we have few degrees of freedom to estimate the 8 parameters required by the test.

by the government in 1988.[5]

Figure 2: Annualized quarterly Inflation



One of the key properties our structural model needs to satisfy is to yield plausible impulse response functions (IRFs), particularly in what concerns to the effects on inflation and output of an increase of 100 basis points in the nominal interest rate. The theory establishes that the IRFs of both inflation and output resulting from a nominal interest rate increase should be "U" shaped, reflecting a decrease at first in the corresponding variable and an eventual return to its initial level. As shown in Figures 3.1-3.3, our model yields acceptable IRFs for the entire period, as well as for both subperiods.[6]

[5] The estimated equations for the entire period and each of the subperiods are shown in Table A.1 in the appendix. We undertook tests for no cointegration on the entire sample and both subperiods, rejecting the null hypothesis at the 1% significance level. Finally, we found no statistical evidence of autocorrelation.

[6] For the entire sample and the first subperiod the IRFs do not show the "U" shape mentioned above. However, both inflation and output exhibit an initial reduction as a response to an increase in the interest rate, which is consistent with the theory and stands in contrast with those of the VAR model, as we discuss in the next pages.

Figure 3.1. Impulse Response Functions (1st period)

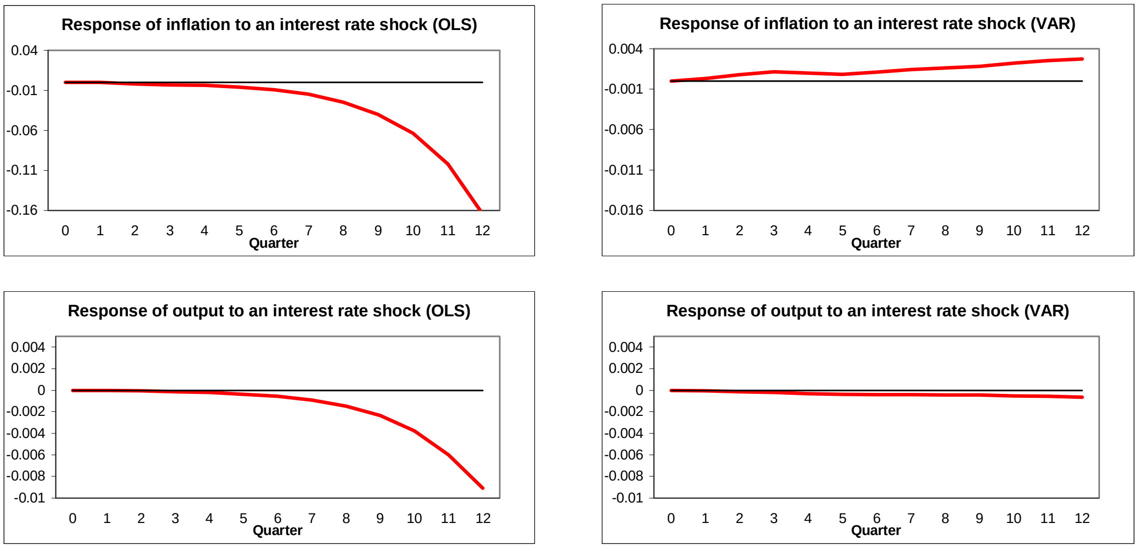


Figure 3.2. Impulse Response Functions (2nd period)

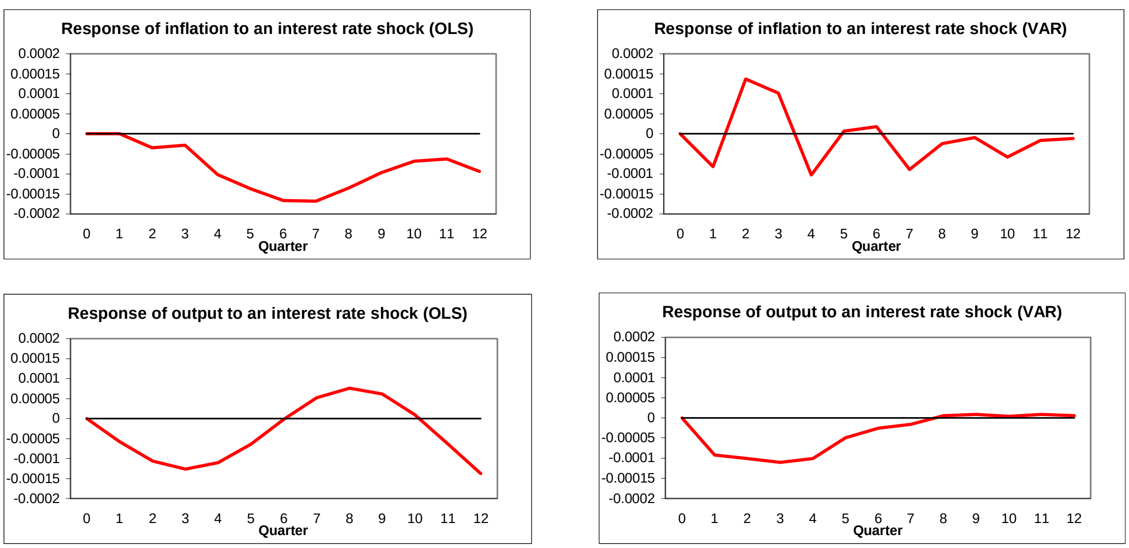
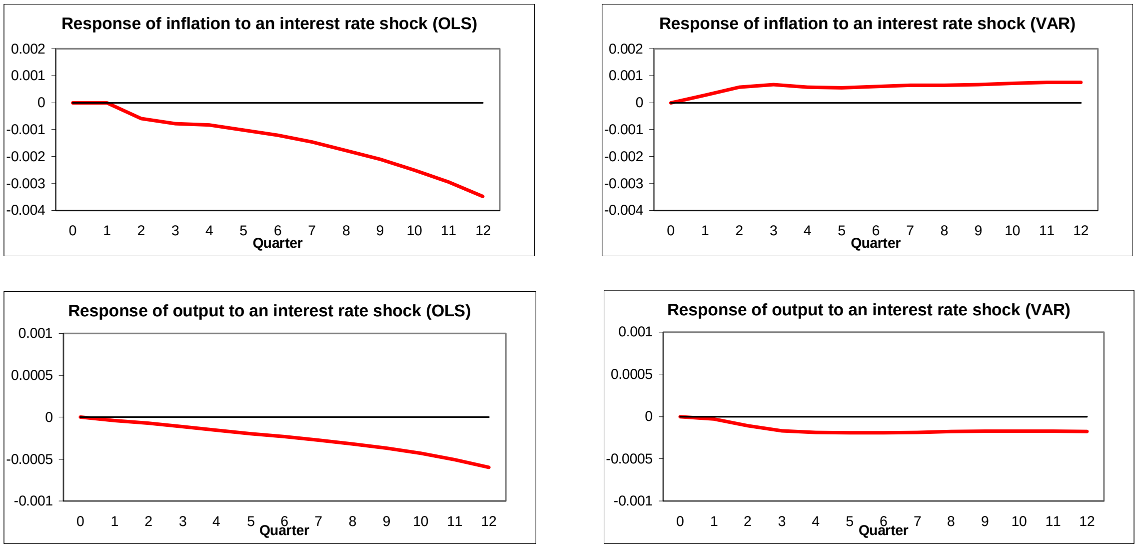


Figure 3.3. Impulse Response Functions (Entire period)



The performance of the structural model is compared to a Vector Autoregressive (VAR) model, which is commonly used in this type of analysis. This comparison is useful since VAR models are usually interpreted as atheoretical summaries of the data dynamics. For the comparison we use an unrestricted VAR where the three variables of interest (nominal interest rate, industrial production and inflation) are regressed against three of their own lags, and three exogenous variables given by px, w and cr, for a total of 12 coefficients to estimate for the equation of each dependent variable. The structural model can be interpreted as a restricted version of the VAR model, where the coefficients of the variables that do not appear on the structural model are restricted to be zero, while for the case of the interest rate equation we include one in the structural model identical to that on the VAR specification.

One way of comparing the two models is through the information criteria of Akaike (AIC) and Schwarz (SIC), which are functions of the error sum of squares and commonly used for model selection purposes.[7] In the first subperiod both criteria favor the structural model. In the second subperiod and the entire period the evidence is mixed, with the SIC favoring the structural model and the AIC favoring the VAR. A crucial difference between the AIC and

[7] The values of AIC and SIC are summarized in Table A.2 in the appendix.

the SIC is that the SIC penalizes more heavily the number of parameters estimated. Given the small number of degrees of freedom allowed by the subperiods the SIC might be a better criterion for comparing these two models.

Another point of comparison between the two models is based on the IRFs yielded by each model. As noted by Rudebusch and Svensson (1999), given that the interest rate equation in both models is the same, any discrepancy in the IRFs will be due to the restrictions imposed on the coefficients of the inflation and output equations. As mentioned above, the IRFs of the structural model are consistent with the theory while, as shown in Figures 3.1-3.3, the IRFs for the unrestricted VAR are not. In particular, for the case of the inflation equation, we observe the *price puzzle* (Sims, 1992); that is, a rise in inflation following an increase in the nominal interest rate. This phenomenon occurs frequently in VAR models and is usually solved by including a leading indicator variable for inflation, such as a commodity price index. However, including this variable for the case of Mexico does not solve the problem.[8] Hence, judging by the IRFs, the structural model appears superior to the VAR model.

3 Estimation of the Efficiency Frontier

In this section we show the details for constructing the efficiency frontier needed to evaluate the performance of monetary policy. The efficiency frontier is derived from the dynamics of the economy (given by the estimated coefficients of the structural model presented in the previous section) and an optimal policy rule that minimizes a loss function which embodies the objectives of the Central Bank.

The objective of an optimal policy rule is to minimize inflation and output variability around the inflation and output targets established by the monetary authority. The efficiency frontier is then useful in measuring the performance of monetary policy since it incorporates

[8] We also tried to revert the price puzzle by including, in addition to the commodity price index, the spread between the domestic and foreign short-term interest rate and the devaluation rate of the peso. None of these variables considered either individually or in combination with others allowed us to correct the puzzle.

the goals of monetary policy embodied in the optimal rule, together with the structure of the economy.

If the monetary policy rule is not optimal –for instance because the monetary authority does not react appropriately to the realized shocks in the economy– there is room for an efficiency gain in monetary policy. A reduction in the variability of output and inflation can then result from a more efficient monetary policy; nevertheless, such a reduction can also be due to a lower variance of the aggregate shocks.

In order to identify the relative contribution of these two possibilities we measure the minimum distance between the corresponding efficiency frontier and the actual performance point for two different subperiods. To estimate this frontier we first rewrite the structural model in (1)-(2) in its state-space representation, i.e.:

$$Y_{t+1} = BY_t + ci_t + \delta X_t + \upsilon_{t+1} \tag{5}$$

$$\text{where:} \quad Y_t = \begin{bmatrix} \pi_t \\ \pi_{t-1} \\ \pi_{t-2} \\ y_t \\ y_{t-1} \\ y_{t-2} \end{bmatrix}; \quad B = \begin{bmatrix} \alpha_{10} & \alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ -\alpha_{23} & 0 & 0 & \alpha_{20} & \alpha_{21} & \alpha_{22} \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix};$$

$$c = \begin{bmatrix} 0 \\ 0 \\ 0 \\ \alpha_{23} \\ 0 \\ 0 \end{bmatrix}; \quad \upsilon_{t+1} = \begin{bmatrix} \varepsilon_{1t+1} \\ 0 \\ 0 \\ \varepsilon_{2t+1} \\ 0 \\ 0 \end{bmatrix}; \quad \delta = \begin{bmatrix} \alpha_{15} & \alpha_{16} & \alpha_{17} \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}; \quad X_t = \begin{bmatrix} px_t \\ w_t \\ cr_{t+1} \end{bmatrix}$$

If the monetary authority's goal is to minimize the variances of inflation and output with respect to some target values, this can be summarized as minimizing the following quadratic loss function:[9]

$$E[L] = E\left[\lambda(\pi_t - \pi^*)^2 + (1-\lambda)(y_t - y^*)^2\right] \tag{6}$$

[9]This loss function does not include the exchange rate or the interest rate, since we assume that the primary concern of the Central Bank is domestic macroeconomic performance as measured by output and price stability.

where π^* and y^* are the targets of inflation and output of the monetary authority, respectively; and λ represents the relative weight that the monetary authority assigns to each of these variabilities.[10] If we assume that the target values are equal to the historic averages of each variable, the previous equation can be rewritten as follows:

$$E[L] = \lambda var(\pi_t) + (1 - \lambda) var(y_t) \tag{7}$$

or, expressed in matrix notation:

$$E\left[Y_t' \Lambda Y_t\right] \tag{8}$$

where:

$$\Lambda = \begin{bmatrix} \lambda & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1\text{-}\lambda & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{9}$$

We complete this optimal control problem with the following equation for the control variable (interest rate):

$$i_t = \Gamma Y_t. \tag{10}$$

where Γ is the vector of reaction coefficients of the monetary authority to inflation and output changes. Equation (10) is an unrestricted monetary policy rule (cf. Rudebusch and Svensson, 1999).

Formally, a solution to the optimal control problem determines an optimal path for the control variable in equation (10), that minimizes the loss function of equation (8), subject to the dynamics of the economy (equation 5). The problem is solved by finding Γ such that:[11]

$$\Gamma = -(c'Hc)^{-1} c'HB \tag{11}$$

and

$$H = \Lambda + (B + c\Gamma)' H (B + c\Gamma)$$

[10] λ can be also interpreted as the policymaker's aversion to inflation variability (cf. Cecchetti and Ehrmann, 1999).

[11] For a technical exposition of this procedure see Taylor (1979), which uses techniques by Chow (1975).

To solve for Γ, we calculate its value iteratively, using the parameters for B and c estimated in the previous section and setting Λ as the initial value for H.

The next step is to calculate the optimal variances of output and inflation for a given λ, which are obtained from the first and fourth diagonal entries of the steady-state variance-covariance matrix of Y_t. Finally, once the optimal variances are obtained, one can trace out the efficiency frontier by plotting the pairs of optimal inflation and output variances as a function of λ.

4 Efficiency Measures of Monetary Policy

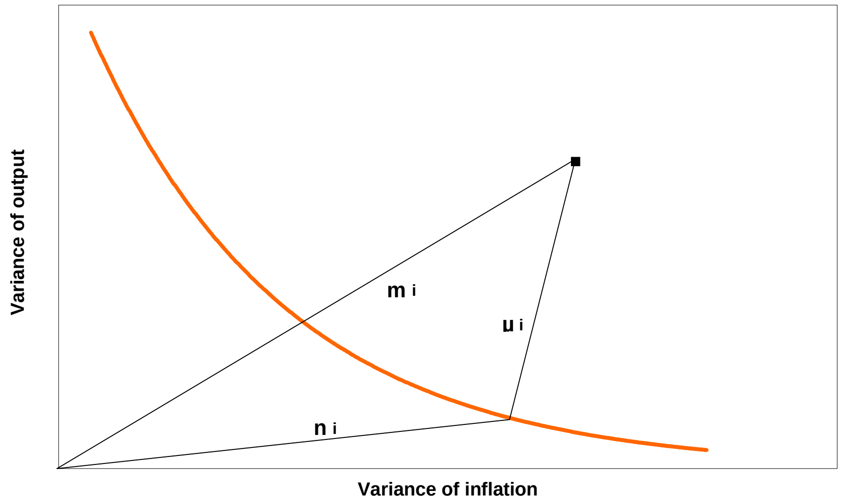
The measures we propose to determine whether monetary policy has become more efficient require the estimation of the structural model and the efficiency frontier for the two subperiods, in addition to the calculation of the observed variances of inflation and output.

The first measure computes the euclidean distance between the pair of observed variances and the efficiency frontier, which we denote by μ_i ($i = 1, 2$; subperiods) (see Figure 4). If the difference between these two distances, defined as $\mu = \mu_1 - \mu_2$, is positive, it can be interpreted as an increase in the efficiency of monetary policy from subperiod 1 to subperiod 2, whereas in case μ is negative, there would be an efficiency loss between subperiods.

The second measure determines the relative contribution of a more efficient monetary policy in the observed fall in inflation and output variability between the two subperiods. For that purpose, we initially define (see Figure 4) the metric m_i ($i = 1, 2$; subperiods) as the euclidean distance between the pair of observed variances and the origin.

We analogously define the metric n_i ($i = 1, 2$; subperiods) as the distance between the pair of optimal variances for which the distance between the efficiency frontier and the pair of observed variances is minimized, and the origin.

Figure 4: Distances



The difference $m = m_1 - m_2$ gives us a measure of how much the observed variability in output and inflation has fallen (or risen, in case it is negative) from one subperiod to the next, while the difference $n = n_1 - n_2$ indicates the amount of the inward shift (or outward shift, in case it is negative) of the efficiency frontier. Hence, the relative contribution of monetary policy in the reduction of the observed variance in the data is given by the following ratio:

$$q = \frac{(m_1 - m_2) - (n_1 - n_2)}{(m_1 - m_2)} = 1 - \frac{(n_1 - n_2)}{(m_1 - m_2)} \tag{12}$$

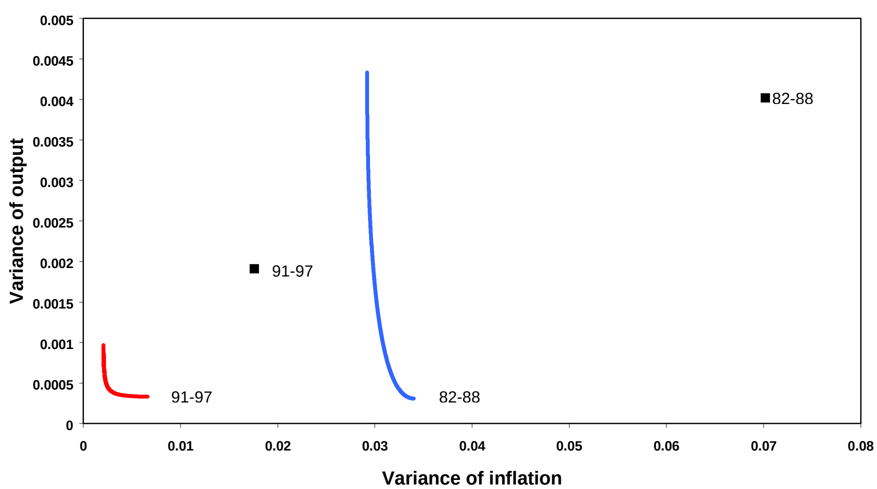
In the following section we proceed to estimate μ and q with data from the Mexican economy in order to determine if there is any contribution of a more efficient monetary policy in the observed reduction in the variability of inflation and output, and if that is the case, measure its relative importance.

5 Results

As mentioned in the introduction, the variance of the annualized quarterly inflation in Mexico fell from 7.02% in the first subperiod to 1.76% in the second, whereas the variance of (the log of) the industrial production fell from 0.40% to 0.19%.

The efficiency frontier for both subperiods and the pair of observed variances are depicted in Figure 5. Comparing the two curves, we observe that the frontier has shifted inwards for the second subperiod, which implies that the variability of the supply shocks has decreased. In addition, we observe that the shape of the frontier changes from one subperiod to the other. This is due to the different structures of the economy between subperiods. Following Cecchetti and Ehrmann (1999), the frontier for the first subperiod is related to a flat aggregate supply curve whereas the one for the second subperiod is related to a steeper aggregate supply curve. The corresponding values for the slopes of the aggregate supply curve are 0.06 and 0.43 for the first and second subperiods, respectively.[12,13]

Figure 5: Optimal Variability Frontier and Performance Point
(Comparison across subperiods)



Since the observed variance of inflation and output has fallen while at the same time the efficiency frontier has shifted inwards, we use the measures introduced in the previous section to establish whether or not this reduction is (at least partially) due to a more efficient monetary policy. Given the derivation of the efficiency frontier and the pair of observed

[12]Following Cecchetti and Ehrmann (1999), the slope of the aggregate supply curve is obtained as a 12-quarter average of the nominal interest rate impact on inflation, divided by the 12-quarter average impact on output.

[13]Table A.3 in the appendix presents the optimal values of the standard deviation of inflation and industrial production for each subperiod for some values of λ, while Table A.4 displays the values of Γ for the same values of λ.

variances (actual performance point of monetary policy) we can compute our measures. Using the first measure, $\mu_1 = 0.3064$ while $\mu_2 = 0.0205$, implying that $\mu = 0.2859$. The positive sign of μ, as mentioned in the last section, indicates that monetary policy in Mexico has become more efficient in the 1990s as compared to its performance in the 1980s.

Using the second measure we estimate the proportion of the reduction on the observed variability of output and inflation that is due to a more efficient monetary policy. Using the metrics introduced in the previous section, we observe that $(m_1; m_2; n_1; n_2) = (0.0703; 0.0177; 0.0340; 0.0066)$. Given these numbers and using equation (12) we obtain the value $q = 0.4791$, which implies that the relative contribution of a more efficient monetary policy is equal to 48%.

As we calculate the efficiency frontier and the observed standard deviations of inflation and industrial production, we implicitly assume that the objective of the Bank of Mexico is to minimize the volatility of these variables around a target given by their historic averages. For the case of inflation, the annualized quarterly average rate is 62.30% for the first subperiod and 17.93% for the second, both of which are far from reasonable targets for inflation. If we consider the medium term goal of the Bank of Mexico since 1999, which has been to reach an inflation rate comparable to that of its main trading partner (the US), the target values for inflation would be 3.58% for the first subperiod and 2.70% for the second, which are more sensible policy goals.[14]

Using these alternative target values, the variance of inflation is 42.78% for the first subperiod and 4.17% for the second. The value of μ_1 increases to 0.3938 while that of μ_2 rises to 0.0542, resulting in a value of μ equal to 0.3396. Hence, the efficiency gain of monetary policy increases in absolute value, reinforcing the evidence of a more efficient monetary policy in Mexico during the 1990s. Moreover, for the second measure the values of $(m_1; m_2; n_1; n_2)$ change to $(0.4279; 0.0417; 0.0340; 0.0066)$, resulting in an increase of the

[14] This medium term goal is cited in the official document of the Bank of Mexico "Política monetaria: Programa para 2000".

relative contribution of a more efficient monetary policy to 93%.

6 Conclusions

Compared to the 1980s, during the last decade Mexico has experienced a higher macroeconomic stability as judged by a lower variability in both inflation and industrial production. This higher stability results from a combination of a decrease in the variance of the aggregate supply shocks to the economy and a more efficient monetary policy. In order to determine their relative contribution, we obtained the efficiency frontier for monetary policy and developed measures of efficiency gain (net of the change in the variance of aggregate supply shocks) for two different subperiods.

Using a structural model for the Mexican economy to estimate the efficiency frontier, we were able to determine that the frontier has shifted inwards, indicating that the variance of the aggregate supply shocks has decreased during the 1990s. Therefore, by making use of our proposed measures, it was possible to quantify the relative contribution of a more efficient monetary policy in the reduction of the observed variances, which amounts to 48%.

We found evidence that monetary policy in Mexico has become more efficient during the 1990s. This result becomes even sharper if instead of assuming the historic averages as target values for inflation we consider that the goal of the Bank of Mexico is to keep inflation as close as possible to the average one of the US, Mexico's main trading partner. Making this alternative assumption, the relative contribution of a more efficient monetary policy in the reduction of the observed variability of inflation and output is 93%.

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7 Appendix

Table A.1: Estimated Coefficients of the Structural Model

1st Subperiod (1982-1988)

Independent variables	Dependent variables $\pi(t+1)$	Dependent variables y(t+1)
$\pi(t)$	**0.5862**	
St. Dev.	0.1811	
p-value	*0.0012*	
$\pi(t-1)$	**-0.0891**	
St. Dev.	0.2027	
p-value	*0.6605*	
$\pi(t-2)$	**0.1484**	
St. Dev.	0.1758	
p-value	*0.3986*	
y(t)	**1.5550**	**1.1450**
St. Dev.	2.0990	0.2152
p-value	*0.4589*	*0.0000*
y(t-1)	**-1.2290**	**-0.0340**
St. Dev.	1.9550	0.3488
p-value	*0.5298*	*0.9224*
y(t-2)		**-0.3476**
St. Dev.		0.2009
p-value		*0.0836*
px(t)	**0.1181**	
St. Dev.	0.0558	
p-value	*0.0344*	
w(t)	**0.0641**	
St. Dev.	*0.0168*	
p-value	*0.0001*	
$i(t)-\pi(t)$		**-0.0165**
St. Dev.		0.0263
p-value		*0.5309*
cr(t+1)	**0.0566**	
St. Dev.	0.1250	
p-value	*0.6503*	
adj. R2	**0.5809**	**0.7974**

2nd Subperiod (1991-1997)

Independent variables	Dependent variables $\pi(t+1)$	Dependent variables y(t+1)
$\pi(t)$	**0.4997**	
St. Dev.	0.1009	
p-value	*0.0000*	
$\pi(t-1)$	**0.0104**	
St. Dev.	0.1420	
p-value	*0.9419*	
$\pi(t-2)$	**0.4184**	
St. Dev.	0.1292	
p-value	*0.0012*	
y(t)	**0.8758**	**1.2840**
St. Dev.	0.6493	0.1937
p-value	*0.1774*	*0.0000*
y(t-1)	**0.2187**	**-0.3499**
St. Dev.	0.5899	0.3071
p-value	*0.7108*	*0.2546*
y(t-2)		**-0.2773**
St. Dev.		0.2065
p-value		*0.1793*
px(t)	**0.0549**	
St. Dev.	0.0091	
p-value	*0.0000*	
w(t)	**0.0201**	
St. Dev.	*0.0069*	
p-value	*0.0036*	
$i(t)-\pi(t)$		**-0.1478**
St. Dev.		0.0669
p-value		*0.0272*
cr(t+1)	**0.1344**	
St. Dev.	0.0488	
p-value	*0.0058*	
adj. R2	**0.8806**	**0.8169**

Entire Period (1982-1997)

Independent variables	Dependent variables $\pi(t+1)$	Dependent variables y(t+1)
$\pi(t)$	**0.6143**	
St. Dev.	0.0992	
p-value	*0.0000*	
$\pi(t-1)$	**-0.0934**	
St. Dev.	0.1170	
p-value	*0.9767*	
$\pi(t-2)$	**0.1159**	
St. Dev.	0.0921	
p-value	*0.2080*	
y(t)	**0.9700**	**1.1630**
St. Dev.	0.9061	0.1251
p-value	*0.2844*	*0.0000*
y(t-1)	**-0.5041**	**-0.1399**
St. Dev.	0.8330	0.1956
p-value	*0.5451*	*0.4746*
y(t)		**-0.3024**
St. Dev.		0.1232
p-value		*0.0141*
px(t)	**0.0764**	
St. Dev.	0.0152	
p-value	*0.0000*	
w(t)	**0.0517**	
St. Dev.	0.0082	
p-value	*0.0000*	
$i(t)-\pi(t)$		**-0.0365**
St. Dev.		0.0209
p-value		*0.0941*
cr(t+1)	**0.0222**	
St. Dev.	0.0543	
p-value	*0.6830*	
adj. R2	**0.8371**	**0.8236**

Table A.2: Comparison of models using AIC and SIC

1st Subperiod	**AIC**		**SIC**	
	Inflation Equation	Output Equation	Inflation Equation	Output Equation
Structural Model	-3.18	-7.77	-2.79	-7.57
VAR	-3.01	-7.76	-2.42	-7.17

2^{nd} Subperiod	**AIC**		**SIC**	
	Inflation Equation	Output Equation	Inflation Equation	Output Equation
Structural Model	-5.83	-7.69	-5.44	-7.50
VAR	-6.13	-8.07	-5.54	-7.49

Entire Period	**AIC**		**SIC**	
	Inflation Equation	Output Equation	Inflation Equation	Output Equation
Structural Model	-4.14	-7.91	-3.86	-7.77
VAR	-4.16	-8.11	-3.74	-7.69

Table A.3: Optimal variability of inflation and output

	Variance of inflation (%)		Variance of industrial production (%)	
λ	1st subperiod	2nd subperiod	1st subperiod	2nd subperiod
0.1	3.291	0.277	0.036	0.041
0.2	3.201	0.245	0.052	0.046
0.3	3.126	0.231	0.077	0.051
0.4	3.066	0.224	0.109	0.055
0.5	3.021	0.218	0.148	0.059
0.6	2.983	0.214	0.194	0.064
0.7	2.955	0.212	0.246	0.069
0.8	2.934	0.210	0.303	0.075
0.9	2.924	0.208	0.366	0.084

Table A.4: Reaction Coefficients of Optimal Policy Rule (Γ)

	(1st Subperiod)						(2nd Subperiod)					
λ	π(t)	π(t−1)	π(t−2)	y(t)	y(t-1)	y(t-2)	π(t)	π(t−1)	π(t−2)	y(t)	y(t-1)	y(t-2)
0.1	2.46	0.67	0.61	67.17	-7.10	-21.07	1.74	0.50	0.34	9.65	-2.19	-1.88
0.2	3.75	1.22	1.10	65.34	-11.18	-21.07	2.05	0.80	0.49	10.13	-2.11	-1.88
0.3	4.90	1.68	1.52	63.81	-14.61	-21.07	2.27	1.07	0.62	10.54	-2.04	-1.88
0.4	5.96	2.08	1.87	62.48	-17.59	-21.07	2.45	1.33	0.73	10.90	-1.98	-1.88
0.5	6.93	2.43	2.19	61.32	-20.21	-21.07	2.59	1.59	0.84	11.26	-1.93	-1.88
0.6	7.83	2.75	2.48	60.28	-22.56	-21.07	2.71	1.86	0.95	11.64	-1.87	-1.88
0.7	8.67	3.03	2.73	59.35	-24.70	-21.07	2.82	2.15	1.07	12.03	-1.81	-1.88
0.8	9.46	3.29	2.97	58.51	-26.65	-21.07	2.90	2.46	1.21	12.48	-1.74	-1.88
0.9	10.21	3.53	3.19	57.73	-28.46	-21.07	2.97	2.83	1.38	13.02	-1.65	-1.88