Banco de México

Documentos de Investigación

Banco de México

Working Papers

N° 2007-01

A Time Series Approach to Test a Change in Inflation Persistence: The Mexican Experience

Daniel Chiquiar
Banco de México

Antonio E. Noriega
Banco de México

Manuel Ramos-Francia
Banco de México

January 2007

Documento de Investigación 2007-01

Working Paper 2007-01

A Time Series Approach to Test a Change in Inflation Persistence: The Mexican Experience*

Daniel Chiquiar†
Banco de México

Antonio E. Noriega‡
Banco de México

Manuel Ramos-Francia§
Banco de México

Abstract

When monetary policy has an explicit inflation target, observed inflation should be a stationary process. In countries where, for a variety of reasons, the determinants of inflation could lead it to follow a non-stationary process, the adoption of an inflation targeting framework should therefore induce a fundamental change in the stochastic process governing inflation. This paper studies the time series properties of Mexican inflation during 1995-2006, using recently developed techniques to detect a change in the persistence of economic time series. Consistent with the adoption of an inflation-targeting framework, the results suggest that inflation in Mexico seems to have switched from a nonstationary to a stationary process around the end of year 2000 or the beginning of 2001.
Keywords: Inflation, Persistence change, Stationarity, Unit root tests, Unknown direction of change.
JEL Classification: C12, C22, E31, E52, E58

Resumen

Cuando la política monetaria tiene un objetivo explícito de inflación, la inflación observada debería ser un proceso estacionario. En países donde, por diversas razones, los determinantes de la inflación pudiesen conducir a que ésta presente un comportamiento no estacionario, la adopción de un régimen de objetivos de inflación debiese en consecuencia inducir un cambio fundamental en el proceso estocástico que la caracteriza. Este documento estudia las propiedades estocásticas de la inflación en México durante 1995-2006. Se utilizan técnicas recientemente desarrolladas para detectar cambios en la persistencia de series de tiempo. De manera congruente con la adopción de un régimen de objetivos de inflación, los resultados sugieren que la inflación en México pasó de ser un proceso no estacionario a ser un proceso estacionario alrededor de finales del año 2000 o de principios del 2001.
Palabras Clave: Inflación, Cambio en persistencia, Estacionareidad, Pruebas de raíz unitaria, Dirección desconocida del cambio.

*We thank Carlos Capistrán and seminar participants at Banco de México for helpful comments, and to Mario Alberto Oliva for excellent research assistance.
† Dirección General de Investigación Económica. Email: dchiquiar@banxico.org.mx.
‡ Dirección General de Investigación Económica. Email: anoriega@banxico.org.mx.
§ Dirección General de Investigación Económica. Email: mrfran@banxico.org.mx.

1 Introduction

Whenever monetary policy actions are based on a loss function in which deviations of inflation with respect to some target have a positive weight, we should expect observed inflation to be a stationary process. That is, monetary policy actions would ensure that shocks to inflation have only temporary effects and, as a consequence, inflation would tend to fluctuate randomly around the target.[1] This result should hold in countries where the monetary authority follows the so called "inflation targeting" regime, although it is clearly not exclusive to this kind of policy framework.[2]

In general, however, the deviations of observed inflation from its target may exhibit persistence. The degree of inflation persistence may reflect the extent to which the shocks affecting it are themselves persistent, or diverse structural factors in the economy, such as the presence of fiscal dominance, the formation of inflation expectations, the exchange rate regime in place, the degree of price indexation and the monetary regime followed by the central bank. In some cases, the confluence of these kinds of factors may be such that, during a specific time period, inflation may behave as a non-stationary process. That is, diverse mechanisms could, in some cases, lead to an absence of mean-reverting behavior in observed inflation.

In light of the above discussion, and in order to better understand the determinants of the behavior of the nominal component of an economy, it should be relevant to be able to identify whether inflation follows a stationary process allowing for the possibility of changes in the degree of persistence, especially when changes in the structure of the economy or in the monetary policy framework have taken place. This topic has attracted the attention of researchers around the world (see e.g. Fuhrer and Moore, 1995; Dittmar et.al., 2005; Musy, 2006; Angeloni et al., 2003; Coenen, 2007; Hondroyiannis and Lazaretou, 2004). Empirical evidence on changes in inflation persistence seems to be mixed. For instance, Cogley and Sargent (2001), Benati (2002), Levin and Piger (2003), Harvey, et. al. (2006), among others, find evidence against stability of inflation persistence and suggest that, in recent years, inflation persistence has apparently diminished along with its overall levels.[3] This contrasts with the findings of O'Reilly and Whelan (2004), Gadea and Mayoral (2006), and Pivetta and

[1] Formally, this is the result under adaptive expectations. The condition for the price level to be determinate under rational expectations is that the monetary authority should have a nominal anchor (See Blanchard and Fischer, 1989). The existence of this anchor would imply that inflation cannot wander away from some value indefinitely, thus ensuring stationarity. Also note that the discussion has as a maintained assumption that nominal rigidities are present, so that monetary policy can have real effects in the short run.

[2] See Bernanke et. al. (1999), Clarida et. al. (1999), Svensson (1997, 2000). Under the inflation targeting framework, first round effects of supply shocks are accommodated by monetary policy, while demand shocks and second-round effects of cost push shocks are not accommodated. On the other hand, given initial conditions, the nominal anchor could become determined by the inflation target, if the central bank enjoys credibility.

[3] There is already an important body of evidence suggesting a significant reduction on both the level and persistence of inflation around the world. Borio et.al. (2003) documents the disinflation process as a global phenomenon; see also Cecchetti and Debelle (2005).

Reis (2006), who present evidence of unchanging inflation persistence.

Most of these studies, however, have analyzed inflation in industrial countries. Only a few exceptions (Borio et.al., 2003; Capistrán and Ramos-Francia, 2006) have studied the degree of inflation persistence in less developed economies, even when one could expect it is precisely in some of these countries that the most significant changes in persistence may have taken place. Indeed, while many of these countries exhibited episodes of high and persistent levels of inflation in the past, they have made important strides towards avoiding the occurrence of fiscal dominance, liberalizing exchange rates and financial markets and adopting independent monetary policy regimes, in many cases under an inflation targeting framework.

Mexico is an excellent case to analyze this issue. By the first half of the nineties, this country seemed to have left behind the inflationary process that characterized its economy during most of the eighties. This reflected the application of a sequence of income-based stabilization programs and the successful renegotiation of the external debt. These two factors, in particular, seemed to have contributed to break down the price indexation mechanisms and the fiscal dominance situation that kept inflation high during most of the previous decade.[4] The sudden devaluation of December 1994, however, not only triggered a new burst of inflation, but also raised the risk of a renewed situation of fiscal dominance. These events proved to be temporary, however, as a result of the fiscal adjustment undertaken, the immediate monetary response and the support package obtained from the international financial community in 1995.[5]

An important consequence of these events was that Mexico adopted a flexible exchange rate. Moreover, in the following years it gradually converged to a monetary policy framework based on inflation targeting principles, in terms of the rules governing the responses of monetary policy to inflationary shocks and of the transparency in its implementation. The adoption of this monetary policy framework, along with a prudent fiscal policy and favorable global inflationary conditions, contributed to decrease inflation from 52% in 1995 to the lowest levels in three decades. Indeed, from 2000 on, annual inflation has been below 10% and, since 2005, it has tended to be situated within the $\pm 1\%$ variability interval around the 3% inflation target established in 2002. In this context, even if inflation may have exhibited high persistence, or even a non-stationary behavior in the past, it seems to be currently behaving as a stationary process.

The main objective of this paper is precisely to test if the inflationary process in Mexico has exhibited a structural change and, in particular, if it may be assumed to currently be a stationary I(0) process. In order to analyze this possibility, we formally test for a change in persistence in both headline and core inflation in Mexico, using a time series approach based on statistical tests recently developed by Harvey, Leybourne and Taylor (2006). This approach

[4] Capistrán and Ramos-Francia (2006) suggest that, during the eighties, inflation in Mexico may have indeed exhibited a non-stationary behavior.

[5] For a detailed discussion on the actions undertaken after the crisis, the disinflation process and the adoption of an inflation targeting framework in Mexico, see Ramos-Francia and Torres (2005).

is particularly useful in that it tests the null hypothesis of constant persistence against an alternative of a change in persistence, allowing for the endogenous estimation of the time of change. This contrasts with more traditional approaches used recently to test for a change of persistence of inflation, in which there is no specific alternative hypothesis, nor there is a formal statistical procedure for estimating the timing of the change.[6]

The results suggest that, in effect, the inflation process in Mexico may be assumed to have undergone a structural change around the end of 2000 or the beginning of 2001, having switched from a non-stationary into a stationary process. That is, it seems reasonable to assume that inflation in Mexico currently follows an I(0) process, whence inflation randomly fluctuates around a well-defined mean. As mentioned before, this result gives broad support to the validity of discussing issues related to Mexico's monetary policy under an inflation targeting framework as is done, for example, in Ramos-Francia and Torres (2005), and in diverse official documents of Banco de México (2006).

The paper is organized as follows. The next section presents in some detail the statistical tools used to test for changes in the persistence of Mexico's inflation. Section 3 reports the empirical findings. Section 4 concludes.

2 Tests for a change in inflation persistence

Testing for the presence of a unit root is now routine practice among practitioners analyzing the stochastic properties of macroeconomic time series. This practice is oriented towards the classification of series as stationary or nonstationary. Establishing this distinction is meaningful for several reasons. For the purposes of the present paper, the most important one is that it helps understanding the effect of shocks to macro variables; while the impact of such shocks will be transitory for a stationary series, for a nonstationary one any random shock may have persistent effects. In other words, while an $I(0)$ time series will display mean-reverting behavior, an $I(1)$ variable will be persistent, i.e., shocks to it will have long lasting effects, thus preventing the series from returning to any defined level.

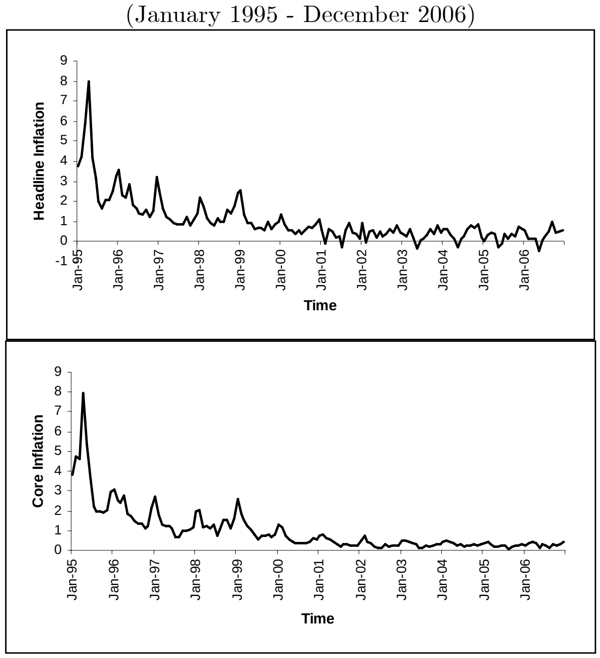
It has been observed in recent years, however, that macroeconomic variables -such as the inflation rate- may display both stationary and nonstationary features within a specific period. Indeed, it seems some series could be switching from $I(0)$ to $I(1)$ behavior, or viceversa.

The data in this study consist of monthly observations on the inflation rate and on core inflation for Mexico, based on the CPI, reported by Banco de México, over the period January 1995 to December 2006. Graphs of the series are presented in Figure 1. A visual inspection suggests that, after a negative trend from 1995 to 2000, the series seem to be stationary from 2001 on. The

[6]Examples of these more traditional procedures include testing for the stability of the sum of the coefficients on the lagged dependent variable in an AR model for inflation, or testing for shifts in the unconditional mean values of inflation, using structural change models.

objective of this paper is to test formally this hypothesis.[7]

FIGURE 1
MONTHLY HEADLINE INFLATION AND CORE INFLATION
(January 1995 - December 2006)



2.1 Testing procedures

The testing procedure in this paper is carried out in two stages. First, unit root tests will be applied to the data, in order to establish the apparent degree of integration of the series. Then, in order to uncover any possible change in this degree of integration, in the second stage we implement tests for a change in persistence.

2.1.1 Unit root tests

Two features of many economic time series tend to affect the size and power of usual unit root tests. In particular, a large negative moving average root may induce size distortions, while a large autoregressive root may result in low power. For our data, fitting an $MA(1)$ model yields an estimated moving average root of -0.80 for the inflation rate, and -0.81 for core inflation. On the other hand, for an $AR(1)$ model the autoregressive roots are 0.85 and 0.88, respectively. Hence,

[7] Capistrán and Ramos-Francia (2006), report (a) a drastic drop in the mean and standard deviation of inflation in Mexico for the period 2000-2006, compared to the previous two decades, (b) evidence of a break in january 2001, which lowered the level of inflation, and (c) a reduction in the sum of the autoregressive parameter from 0.95 in the period 1990-1999 to 0.31 in 2000-2006.

we apply the MZ_{α}, MZ_t, MSB, and the MPT tests due to Ng and Perron (2001), which are precisely designed to overcome both size distortion and low power problems when the data are characterized by these features. These tests are extensions of the M tests of Perron and Ng (1996) that use GLS detrending of the data, together with a modified information criterion for the selection of the truncation lag parameter.[8]

2.1.2 Tests for a change in persistence

To test for changes in the degree of persistence, we apply nine test statistics recently developed by Harvey, Leybourne and Taylor (2006) (HLT henceforth), which follow the work of Kim (2000), Kim et.al (2002), and Busetti and Taylor (2004). The model underlying the test statistics proposed by HLT is the following:

$$\begin{aligned} y_t &= x_t'\beta + u_t \\ u_t &= \rho_t u_{t-1} + \varepsilon_t, \qquad t = 1, ..., T \end{aligned} \tag{1}$$

where y_t is the inflation rate (headline or core), the vector x_t contains either a constant, or a constant and a linear trend, and ε_t is mean zero satisfying assumptions in Phillips and Perron (1988). Since our data seems to exhibit a negative trend, we adopt model (1) with $x_t' = (1, t)$. Accordingly, results reported below use the specification $y_t = \beta_1 + \beta_2 t + u_t$.

The null hypothesis states that the inflation rate is stationary, i.e., y_t is $I(0)$. In this setting, $\rho_t = \rho, \mid \rho \mid < 1$, $t = 1, ..., T$ in model (1). This hypothesis is denoted by H_0. In testing for a change in persistence, HLT allow for two different alternative hypotheses. The first corresponds to a change from $I(0)$ to $I(1)$, denoted H_{01}, and the second to a change from $I(1)$ to $I(0)$, denoted H_{10}. Specifically,

$$\begin{aligned} H_{01} &: \rho_t = \rho, \mid \rho \mid < 1 \text{ for } t \leq [\tau^* T] \text{ and } \rho_t = 1 - \bar{\alpha}/T, \text{ for } t > [\tau^* T], \\ H_{10} &: \rho_t = 1 - \bar{\alpha}/T \text{ for } t \leq [\tau^* T] \text{ and } \rho_t = \rho, \mid \rho \mid < 1 \text{ for } t > [\tau^* T]. \end{aligned}$$

where $\bar{\alpha} \geq 0$ allows for a local to unit root, and τ^* denotes the unknown proportion of the sample size where the change in persistence occurs. τ^* is assumed to belong to the interval $\Lambda = [\tau_l, \tau_u] \in (0, 1)$, where τ_l, τ_u stand for (arbitrary) lower and upper values for τ^*. Given the preliminary analysis presented above for our data set, the empirical applications below will concentrate in testing H_0 against H_{10}.

The various tests to be applied in the next section are based on the following ratio introduced by Kim (2000), designed to test H_0 against H_{01}:

$$K_{[\tau T]} = \frac{(T - [\tau T])^{-2} \sum_{t=[\tau T]+1}^{T} \left(\sum_{i=[\tau T]+1}^{t} \hat{u}_{i,\tau} \right)^2}{[\tau T]^{-2} \sum_{t=1}^{[\tau T]} \left(\sum_{i=1}^{t} \hat{u}_{i,\tau} \right)^2} \tag{2}$$

[8] We do not discuss further these statistics as they are well known and implemented in popular software such as E-Views. For details see Ng and Perron (2001).

where $\hat{u}_{i,\tau}$ in the numerator (denominator) is the residual from applying OLS to model (1) for $t = [\tau T] + 1, ..., T$ ($t = 1, ..., [\tau T]$). Note from (2) that, under H_0, the sums in numerator and denominator should be equal. In order to test for a change in persistence (H_0 against H_{01}), Kim (2000), Kim et. al. (2002) and Busetti and Taylor (2004) consider the following three statistics, all functions of the ratio defined above:

$$M(S) = T_*^{-1} \sum\nolimits_{[t=\tau_l T]}^{[\tau_u T]} K_t \tag{3}$$

$$M(E) = \ln T_*^{-1} \sum\nolimits_{[t=\tau_l T]}^{[\tau_u T]} \exp(0.5 K_t) \tag{4}$$

$$M(X) = \max_{\tau \in \{[\tau_l T], ..., [\tau_u T]\}} K_t \tag{5}$$

where $T_* \equiv [\tau_u T] - [\tau_l T] + 1$. These authors derive the limiting distributions of the statistics as functionals of Brownian motion processes, and show that they are pivotal (free of nuisance parameters) under the null. (3)-(5) correspond to Hansen's (1991) mean score statistic (S), Andrews and Ploberger's (1994) mean exponential statistic (E), and Andrews' (1993) maximum statistic (X), respectively. This last statistic allows estimation of the true (and unknown) change point, over the interval Λ, and is the one used in the empirical applications below for estimating the date of change.

To test H_0 against H_{10} Busetti and Taylor (2004) propose three other tests based on the *reciprocals* of K_t, namely

$$M(S)^R = T_*^{-1} \sum\nolimits_{[t=\tau_l T]}^{[\tau_u T]} K_t^{-1} \tag{6}$$

$$M(E)^R = \ln T_*^{-1} \sum\nolimits_{[t=\tau_l T]}^{[\tau_u T]} \exp(0.5 K_t^{-1}) \tag{7}$$

$$M(X)^R = \max_{\tau \in \{[\tau_l T], ..., [\tau_u T]\}} K_t^{-1} \tag{8}$$

These tests are the analogous of (3)-(5) with K_t replaced by K_t^{-1}, which we use in the empirical applications below. HLT propose six other tests, which are modified versions of (6)-(8), with the modification being such that the critical values are precisely the same under the null and alternative hypotheses, and at the same time equal to the unmodified statistics asymptotically. These modified statistics are the following

$$M(Z)_m^R = \exp(-b J_{1,T}) M(Z)^R \tag{9}$$

$$M(Z)_{m \text{ min}}^R = \exp(-b J_{\text{min}}^R) M(Z)^R \tag{10}$$

for $Z = S, E, X$. In the statistics implied by (9) and (10), b is a finite constant, chosen so that the modified tests are asymptotically correctly sized under H_0

(values for b are provided in Table 2 of HLT for all nine reciprocal statistics), and $J_{1,T}$ is T^{-1} times the Wald statistic (W) for testing the joint hypothesis $\gamma_{k+1} = ... = \gamma_9 = 0$ in the regression

$$y_t = x_t'\beta + \sum\nolimits_{i=k+1}^{9} \gamma_i t^i + error \tag{11}$$

for $t = 1, ..., T$. For the three statistics in (10), $J^R_{\min} = \min_{\tau\in\Lambda} J_{[\tau T],T}$ and $J_{[\tau T],T}$ is $T^{-1}W$ for testing $\gamma_{k+1} = ... = \gamma_9 = 0$ in (11), for $t = [\tau T] + 1, ..., T$. Critical values (both finite samples and asymptotic) for all nine statistics (6)-(10) to be applied in the next section for testing H_0 against H_{10}, are reported in Table 1 of HLT.

3 Empirical results

Results from the application of the unit root tests of Ng and Perron (2001) are reported in Table 1. In performing the tests, a constant and a linear trend were included. With a maximum lag length of 12 for both series, the modified AIC selected 12 lags for headline and for core inflation. As can be seen, for the full sample, it is not possible to reject the null hypothesis of a unit root for headline and for core inflation with any of the four test statistics.

Table 1. Unit Root Tests
(January 1995 - December 2006)

	$\mathbf{MZ}_\alpha$	$\mathbf{MZ}_t$	**MSB**	**MPT**
Headline Inflation	-1.395	-0.678	0.486	47.94
Core Inflation	-0.967	-0.529	0.547	60.63

.

Critical values at the 10%: -14.2, -2.62, 0.185 and 6.67 for the MZ_α, MZ_t, MSB and MPT, respectively. The tests include constant and trend.

These results suggest either that a nonstationary behavior characterizes the series over the whole sample, or that the persistence apparently observed in the first half of the sample is dominating the results. To discriminate between these two possibilities, we apply the tests for a change in persistence discussed above. Results are presented in Table 2.

Table 2. Tests for change in persistence Jan 1995 - Dec. 2006 (T=144)

Headline Inflation			**Core Inflation**		
MS^R	ME^R	MX^R	MS^R	ME^R	MX^R
MS^R_M	ME^R_M	MX^R_M	MS^R_M	ME^R_M	MX^R_M
$\mathrm{MS}^R_{M_{\min}}$	$\mathrm{ME}^R_{M_{\min}}$	$\mathrm{MX}^R_{M_{\min}}$	$\mathrm{MS}^R_{M_{\min}}$	$\mathrm{ME}^R_{M_{\min}}$	$\mathrm{MX}^R_{M\ \min}$
52.9***	44.8***	97.1***	259.4***	330.6***	669.4***
51.0***	41.6***	91.9***	249.7***	305.5***	630.5***
35.2***	21.9***	55.5***	175.2***	165.6***	389.7***

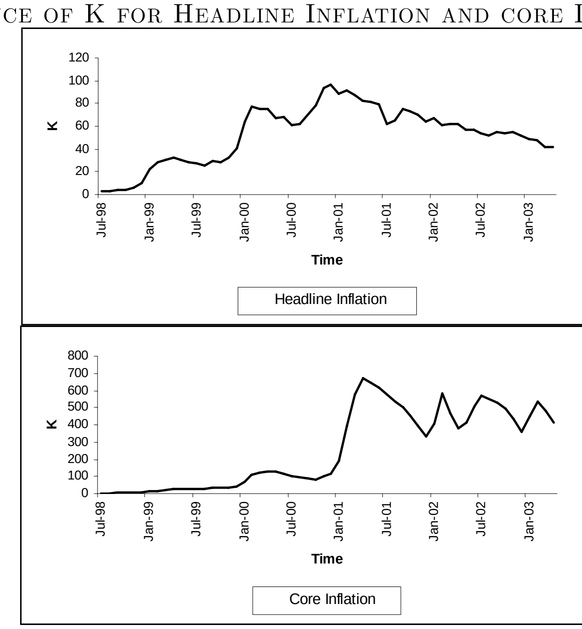
*** denote rejection at the 1% level. Calculations were carried out in Matlab 7.1.

For both headline and core inflation, all nine test statistics concur in rejecting (at the 1% level) the null hypothesis of stationarity over the entire sample, against a change in persistence from $I(1)$ to $I(0)$. Table 3 summarizes the results in terms of both the direction and the timing of the change in persistence.[9] As can be seen, the results suggest that headline (core) inflation switched from a non-stationary to an I(0) process around December 2000 (April 2001).

Table 3. Summary of Results		
	Headline Inflation	**Core Inflation**
Change	I(1) $\rightarrow$ I(0)	I(1) $\rightarrow$ I(0)
Date	December 2000	April 2001

Note that the estimated dates of change for both variables tend to be consistent with Capistrán and Ramos-Francia's (2006) findings. Figure 2 depicts values for the sequence $\left\{K_{[\tau T]}, \quad \tau \in \Lambda = [.3, .7]\right\}$, from which the timing of the change was obtained. The graphs show peaks at December 2000 for headline inflation, and at April 2001 for core inflation.

FIGURE 2
SEQUENCE OF K FOR HEADLINE INFLATION AND CORE INFLATION



In order to verify the robustness of the above break dates' estimates, Tables 4 and 5 report recursive estimates of the date of persistence change for headline and core inflation, respectively. Note from Table 4 that the estimated change point reported above is slightly sensitive to the starting date of the estimation period for the inflation rate, although in most cases the December 2000 date is

[9] Recall that the estimation of the change point is based on the $M(X)^R$ statistic.

robustly detected as the break point. It is interesting to note that this break date coincides with the end of the U-shape pattern followed by the inflation rate from the beginning of the sample up to the end of 2000; i.e., from the beginning of 2001 onwards, this seasonal pattern seems to disappear from the data, as can be inferred from Figure 1. For core inflation, on the other hand, moving the starting date a full year does not change the results in terms of the date when, according to our empirical findings, it switched from a non-stationary to a stationary process.

Table 4. Results of recursive test of change in persistence
Headline Inflation

sample					Detection	break date
January	1995	-	December	2006	yes[a]	December 2000
February	1995	-	December	2006	yes[a]	December 2000
March	1995	-	December	2006	yes[a]	December 2000
April	1995	-	December	2006	yes[a]	December 2000
May	1995	-	December	2006	yes[b]	December 2000
June	1995	-	December	2006	yes[b]	December 2000
July	1995	-	December	2006	yes[b]	December 2000
August	1995	-	December	2006	yes[b]	December 2000
September	1995	-	December	2006	yes[b]	December 2000
October	1995	-	December	2006	yes[b]	December 2000
November	1995	-	December	2006	yes[b]	February 2000
December	1995	-	December	2006	yes[b]	February 2000

[a]denotes change detected by all tests
[b]denotes change detected for modified test and non modified test

Table 5. Results of recursive test of change in persistence
Core Inflation

sample					Detection	break date
January	1995	-	December	2006	yes[a]	April 2001
February	1995	-	December	2006	yes[a]	April 2001
March	1995	-	December	2006	yes[a]	April 2001
April	1995	-	December	2006	yes[a]	April 2001
May	1995	-	December	2006	yes[a]	April 2001
June	1995	-	December	2006	yes[a]	April 2001
July	1995	-	December	2006	yes[a]	April 2001
August	1995	-	December	2006	yes[a]	April 2001
September	1995	-	December	2006	yes[a]	April 2001
October	1995	-	December	2006	yes[a]	April 2001
November	1995	-	December	2006	yes[a]	April 2001
December	1995	-	December	2006	yes[a]	April 2001

[a]denotes change detected by all tests

As a final check of our results, Tables 6 and 7 report Ng and Perron (2001) unit root test to each of the two subsamples for each series.

Table 6. Unit Root tests for the two Inflation subsamples

Sub sample	MZ_α	MZ_t	MSB	MPT
January 1995 - December 2000[a]	-3.13	-1.17	0.37	27.3
January 2001 - December 2006[b]	-29.1*	-3.81*	0.13*	0.85*

[a] includes constant and trend, lag length = 12 using MAIC, Kmax=12
[b] includes a constant, lag length = 0 using MAIC with Kmax=12
* denotes rejection of H_0 at the 1% level

Table 7. Unit Root tests for the two Core Inflation subsamples

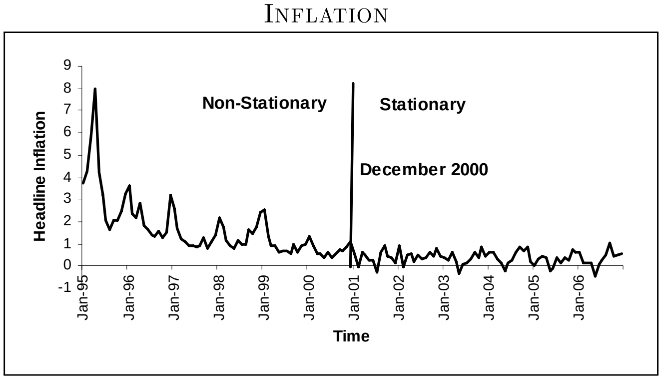
Sub sample	MZ_α	MZ_t	MSB	MPT
January 1995 - April 2001[a]	-2.056	-0.971	0.473	41.863
May 2001 - December 2006[b]	-17.30*	-2.93*	0.169*	1.455*

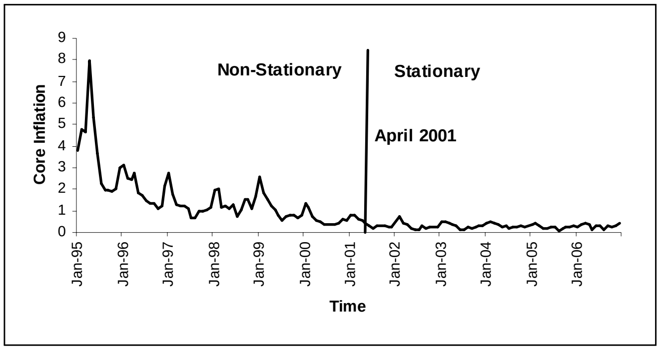
[a] includes constant and trend, lag length = 12 using MAIC, Kmax=12
[b] includes a constant, lag length = 0 using MAIC, Kmax=12
* denotes rejection of H_0 at the 1% level

Note from Table 6 that the null of a unit root in headline inflation is not rejected for the first subsample, while it is rejected at the 1% level for the second subsample. The same applies to core inflation, as shown in Table 7. Hence, unit root tests are consistent with our previous results, regarding the change in persistence for both series at the estimated change date.

The above results are summarized in the following figure, which depicts the inflation data, together with the estimated change dates and the corresponding direction of the change in persistence.

Figure 3
Estimated change dates for Monthly Headline Inflation and core Inflation





4 Conclusion

The results of this paper suggest that inflation in Mexico seems to have switched from a non-stationary process to a stationary I(0) process around the end of 2000 or the beginning of year 2001. While the purely statistical approach undertaken in the paper does not allow identifying the economic factors that may be behind this apparent structural change, it does suggest that it seems reasonable to assume that non-stationarities are currently absent in the stochastic process characterizing inflation in Mexico.

As mentioned, this is a relevant condition on which current monetary policy actions rest, and may be partly a result of the monetary policy framework that has been adopted in Mexico in the last years. A more structural analysis of the factors that have contributed to the disinflation process and the apparent eventual stabilization of inflation in Mexico at low levels is a relevant agenda for future research.

5 References

Andrews, D.W.K (1993), "Tests for Parameter Instability and Structural Change with Unknown Change Point", *Econometrica* 61, 821-856.

Andrews, D.W.K. and W. Ploberger (1994), "Optimal Tests when a Nuisance Parameter is Present Only Under the Alternative", *Econometrica* 62, 1383-1414.

Angeloni, I., G. Coenen and F. Smets (2003), "Persistence, the Transmission Mechanism and Robust Monetary Policy", Working Paper 250, European Central Bank.

Banco de Mexico (1996), Informe Anual. Banco de Mexico, Mexico.

___________ (1999), Informe Anual. Banco de Mexico, Mexico.

___________ (1999), Política Monetaria. Informe sobre el Primer Semestre de 1999. Banco de Mexico, Mexico.

___________ (2000), Informe sobre Inflación Enero-Marzo 2000. Banco de Mexico, Mexico.

___________ (2002), Informe sobre Inflación Abril-Junio 2002. Banco de Mexico, Mexico.

___________ (2006), Informe sobre Inflación Octubre-Diciembre 2005 y Programa Monetario para 2006. Banco de Mexico, Mexico.

Benati, L. (2002), "Investigating Inflation Persistence Across Monetary Regimes I: Empirical Evidence", Working Paper, Bank of England.

Bernanke, B. S., T. Laubach, F. S. Mishkin and A. S. Posen (1999), *Inflation Targeting*. Princeton University Press, New Jersey, USA.

Blanchard, O. J. and S. Fisher (1989) *Lectures on Macroeconomics*. MIT Press.

Borio, C., W. English and A. Filardo (2003), "A Tale of Two Perspectives: Old or New Challenges for Monetary Policy?", Bank for International Settlements Papers No. 19.

Bussetti, F. and A.M.R. Taylor (2004), "Tests of Stationary Against a Change in Persistence", *Journal of Econometrics* 123, 33-66.

Capistrán, C. and M. Ramos-Francia (2006), "Inflation Dynamics in Latin America", Workin Paper 2006-11, Banco de Mexico.

Cecchetti, S. and G. Debelle (2005), "Has the Inflation Process Changed?", Bank for International Settlements Working Papers No. 185.

Clarida, R., J. Galí and M. Gertler (1999), "The Science of Monetary Policy: A New Keynesian Perspective", Journal of Economic Literature, 37(4), 1661-1707.

Coenen, G. (2007), Inflation Persistence and Robust Monetary Policy Design", *Journal of Economic Dynamics and Control*, 31, 111-140.

Cogley, T. and T.J. Sargent (2001), "Evolving Post-World War II Inflation Dynamics", *NBER Macroeconomics Annual*, 16.

Dittmar, R., W. Gavin and F. Kydland (2005), "Inflation Persistence and Flexible Prices", *International Economic Review* 46(1), 245-61.

Fuhrer, J. and G. Moore (1995), "Inflation Persistence", *Quarterly Journal of Economics*, 110(1), 127-59.

Gadea, M.D. and L. Mayoral (2006), "The Persistence of Inflation in OECD Countries: A Fractionally Integrated Approach", *International Journal of Central Banking*, March (4), 51-104.

Hansen, B.E. (1991), "Tests for Parameter Instability in Regressions with I(1) Processes," *Journal of Business and Economic Statistics* 10, 321-335.

Harvey, D.I., S.J. Leybourne and A.M.R. Taylor (2006), "Modified Tests for a Change in Persistence", *Journal of Econometrics*, 134, 441-469.

Hondroyiannis, G. and S. Lazaretou (2004), "Inflation Persistence During Periods of Structural Change: An Assessment using Greek Data", Working Paper No. 370, European Central Bank.

Kim, J. (2000), "Detection of Change in Persistence of a Linear Time Series", *Journal of Econometrics* 95, 97-116.

Kim, J., J. Belaire-Franch, and R. Badillo Amador (2002), "Corrigendum to 'Detection of Change in Persistence of a Linear Time Series'", *Journal of Econometrics* 109, 389-392.

Levin, A. and J.M. Piger (2003), "Is a Inflation Persistence Intrinsic in Industrial Economies?", Working Paper 023E, Federal Reverse Bank of St. Louis.

Musy, O. (2006), ”Inflation Persistence and the Real Costs of Disinflation in Staggered Prices and Partial Adjustment Models”, *Economics Letters* 91, 50-55.

Ng, S. and P. Perron (2001), "Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power", *Econometrica* 69(6), 1519-54.

O'Reilly, G. and K. Whelan (2004), "Has Euro-Area Inflation Persistence Changed Over Time?" Working Paper 335, European Central Bank

Perron, P. and S. Ng (1996), "Useful Modifications to Some Unit Root Tests with Dependent Errors and Their Local Asymptotic Properties", *Econometrica* 45, 463-485.

Phillips, P.C.B. and P. Perron (1988), "Testing for a Unit Root in Time Series", *Biometrika* 75, 335-346.

Pivetta, F. and R. Reis (2006), "The Persistence of Inflation in the United States" *Journal of Economic Dynamics and Control*, forthcoming.

Ramos-Francia, M. and A. Torres (2005), ”Reducing Inflation Through Inflation Targeting”, Working Paper 2005-01, Banco de Mexico.

Svensson, L. (1997), "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets. *European Economic Review*, 4(6), 1111-1146.

Svensson, L. (2000), "Open-Economy Inflation Targeting", *Journal of International Economics*, 50(1), 155-183.