The Target of the Central Bank and Inflation Persistence in Colombia

Juan José Echavarría, Norberto Rodríguez and Luis Eduardo Rojas*

1. INTRODUCTION

A high level of inflation persistence forces the authorities to raise interest rates higher and for a more prolonged period in order to reduce inflation after a shock. This makes the process of disinflation more costly in terms of employment and GDP loss and might also lead to policy errors which, in the end, generate high levels of inflation. At the theoretical level, the existence of inflation persistence (the difference between inflation and its long term trend, when the latter is greater than zero) invalidates the so-called New Keynesian Phillips curve. Nevertheless, inflation analysis is useful for predicting its evolution.

In a recent paper, Echavarría, López, and Misas (Echavarría, López, and Misas, 2013) study the behavior of the Colombian inflation series. They find significant changes in the average and variance of the series for the periods 1991m01-2000m01 and 2000m02-2010m06, but not in a persistence indicator such as the sum of autoregressive coefficients. A similar result is found for the USA. Stock and Watson (2007) and Pivetta and Reis (2007), for example, argue that inflation persistence has not changed for decades in that country.[1]

* Banco de la República, Colombia. The points of view expressed in this document do not necessarily coincide with those of Banco de la República or its Board of Directors. Authors are grateful to Andrés González and Hernando Vargas for their comments.

[1] Stock and Watson (2007) define persistence as the major auto-regressive root and do not dismiss the possibility that the series has a unitary root, as in 1970-1983 and in 1984-2004. Based on a Bayesian model, Pivetta and Reis (2007) find that the major

How can the fact that inflation persistence has not fallen in the USA be explained when the literature shows important changes in monetary policy after 1982 under the Federal Reserve (Fed) presidencies of Volker and Greenspan (Clarida, Galí, and Gertler, 2000), and when empirical literature shows that statistical inflation persistence is reduced significantly under a credible monetary regime? Benati (2008), in effect, finds that inflation persistence has been low in countries that used the gold standard at some point, in countries who have adopted the euro as a common currency and in those countries which favor an inflation targeting regime, such as the United Kingdom, Canada and Australia.[2]

Colombia is a more paradoxical case. Mishkin (2007, pp. 299-300) suggests that during the 1990s the country did not seriously commit to reducing inflation below 20%-25% due to the fact that output stability was the central bank's primary objective. Inflation for 1991-1998 (22.7% on average) was similar to that of the 1980s (23.6%) and was systematically above the bank's target for 1991-1996 and again for 1998.

According to the author, an abrupt change occurred in October 2000 when the authorities officially adopted an inflation targeting regime. The recession of 1999 resulted in a 10% inflation rate, a level not seen since the 1970s, and the authorities took advantage of the circumstances to fundamentally reformulate monetary policy. Inflation targets for 2000, 2001 and 2002 were 10%, 8% and 6% respectively, which placed a higher emphasis on compliance with explicit targets and the transparency of the process. The interest rate was adopted as a policy instrument and a managed floating exchange rate was chosen.[3] Annualized monthly inflation was reduced from around 16% in mid-1998 to close to 2% for most of 2010.

Robalo Marques (2004) shows that an evaluation of persistence is conditional on assumptions about the behavior of long term inflation. Its value is different if long term inflation is a constant average, a stochastic

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autoregressive root is around one and is relatively constant for the period 1947-2001. However, as mentioned by Altissimo, Ehrmann, and Smets (2006), a review of the international empirical evidence suggests a high level of uncertainty about the level of persistence of the series: uncertainty about the precise value of the estimator, about the sensitivity of the periods and the methodological approach adopted, and uncertainty about the suitability of the distinct persistence measures. A review of the empirical literature for the USA and other countries is presented by Echavarría, López, and Misas (2013).

[2] Also see Levin and Piger (2004).

[3] See Hernández and Tolosa (2001); and Gómez, Uribe, and Vargas (2002).

trend or an explicit central bank target. This leads Echavarría, López, and Misas (2013) to explore an alternative path in the second part of their document. Following Cogley, Primiceri, and Sargent (2009), among others, the authors suggest that a gradual reduction of the inflation target could explain an unchanged persistence in the total inflation series. The authors estimate the persistence for the *inflation gap* $\pi_t - \pi_t^*$,[4] where π_t^* corresponds to the central bank target. However, unexpectedly, no significant changes in persistence under an inflation targeting regime are observed in this case either (even when the persistence value $\pi_t - \pi_t^*$ is low).

Vargas et al. (2009) suggests that the Banco de la República's target is an important determinant of expectatives formation by economic analysts, but this does not mean that the Bank is totally credible, and was less so in the first years of its independence. As such, this document assumes that the Banco de la República's inflation target is not entirely credible.[5]

Following Stock and Watson (2007) and Kang, Kim, and Morley (2009), an econometric model for 1979Q1-2010Q2 is estimated which breaks down the annualized quarterly inflation series among a stochastic trend (permanent component) and transitory component. In other words, transitory and permanent shocks are taken into account, the latter perhaps induced by variations in the central bank's target.

Following on from this introduction, Section 2 shows the model used, Section 3 evaluates total inflation persistence in Colombia and Section 4 the persistence of some items used by Banco de la República for its inflation forecasts.

[4] Cogley, Primiceri, and Sargent (2009) argue that the persistence for the inflation gap is relevant when trying to understand the velocity and effectiveness of central bank efforts to revert inflation to the target; whereas inflation is a relevant research subject when, for example, the impact of central bank decisions on bond prices in the market are considered.

[5] Svensson (1999) mentions the uncertainty of the model (e.g. uncertainty of the value of the natural interest rate or about the process of the smoothing of rates by the central bank) as an additional factor which creates persistence even though recent literature on the topic has concentrated on the uncertainty related to current and future central bank policies. In particular, see Erceg and Levin (2001) and Kozicky and Tinsley (2005).

2. THE MODEL

A model of unobserved inflation components which incorporates multiple regime changes is developed based on Kang, Kim, and Morley (2009).[6] The following three equations are considered:

$$\pi_t = \tau_t + C_t, \tag{1}$$

$$\tau_t = u_{S_t} + \tau_{t-1} + \eta_t, \tag{2}$$

$$C_t = \beta_{1,S_t} C_{t-1} + \beta_{2,S_t} C_{t-2} + \varepsilon_t, \tag{3}$$

$$\eta_t \sim N\left(0, \sigma^2_{\eta,S_t}\right); \varepsilon_t \sim N\left(0, \sigma^2_{\varepsilon,S_t}\right) \text{ para } s = 1, 2, 3,$$

where π_t corresponds to annualized quarterly inflation ($400*\ln(P_t/P_{t-4})$;[7] τ_t represents the permanent component of the series; and C_t the cyclical-transitory component, derived from an ARMA (p, q) process; C_t also corresponds to the inflation gap, defined as the difference between observed inflation and the permanent component.

η_t represents a permanent shock; ε_t a transitory shock; and s the current regime; $u_{S_t}, \beta_{1,S_t}, \beta_{2,S_t}$, σ^2_{η,S_t} and $\sigma^2_{\varepsilon,S_t}$ are model parameters, σ^2_{η,S_t} and $\sigma^2_{\varepsilon,S_t}$ quantify the volatility of the permanent and transitory shocks respectively. It is assumed that ε_t and η_t are independently distributed.[8]

Univariate inflation models have gained importance since, as suggested by Stock and Watson (2007), inflation is ever easier and also more difficult to predict: easier as its volatility has decreased; more difficult because of the ever lessening additional explicative power of other variables such as the output gap or international prices. In the same vein, Atkeson and Ohanian (2001) show that starting in 1984 the predictive capacity of the Phillips curve in the USA is even less than a simple forecast which equalizes expected inflation in the following 12 months with the simple average of inflation during the preceding year.

[6] The routine available in Gauss at <http://www.bepress.com/snde/vol13/iss4/art1/> was used as a base.

[7] Seasonally adjusted. The series is slightly different from that used by Echavarría, López, and Misas (2013). These authors work with annualized monthly inflation (1,200 * $\ln(P_t/P_{t-1})$) (adjusted) in the first part of the document and with annual inflation (100 * $\ln(P_t/P_{t-12})$) in the second part.

[8] This might not be entirely appropriate when the central bank revises its targets in response to changes in perceptions on the structure of the economy. (Cogley, Primiceri, and Sargent, 2009).

Stock and Watson (2007) encounter a significant reduction from 1960-1983 to 1984-2004 in the coefficient which relates the output gap with future inflation (see also Roberts, 2004). As such, while Stock and Watson (1999) affirm that the inflation projections produced by economic activity indexes have been more accurate than those based on other macroeconomic variables, including interest rates, the quantity of money or the price of primary goods. A decade later Stock (2010) only finds a relation between inflation and the output gap *in strong recessionary periods.*

The model proposed by Kang, Kim, and Morley (2009) is similar to that developed by Stock and Watson (2006) but assumes a process of unobserved components with abrupt changes (rather than stochastic volatility). This is consistent with that proposed by Levin and Piger (2004) and Benati (2008), confirmed in this document, which posits that persistence variations are associated with relatively abrupt changes to the monetary regime. Moreover, the use of a model with regime change and with the impulse-response function to measure persistence makes our results relatively comparable to those of Echavarría, López, and Misas (2013).[9]

The authors transform the unobservable component model in its ARIMA representation to calculate a scalar measurement of persistence and find the accumulated impulse-response function. The expected long term response in the presence of projection error of the distinct regimes is found in this way. Due to the structure of the unobserved components, inflation persistence depends on the relative importance of permanent and transitory shocks, as well as propagation of the ARMA model in the case of transitory shocks. The model allows for discreet changes in inflation persistence between regimes.

The impulse-response function obtained allows for the discrimination between a process with unit roots subject mostly to permanent variations and a stationary process which is mostly subject to transitory variations. Additionally, the resulting impulse-response function allows the differentiation of persistence levels in processes with unit roots (Kang, Kim, and Morley, 2009).

The number of potential regimes was arbitrarily set at three, with which the expected changes were possibly captured starting from: *1)* the Constitution of 1991 and *2)* the adoption of an inflation targeting scheme

[9] Andrews and Chen (1994), and Pivetta and Reis (2007) suggest using the sum of autoregressive coefficients or the impulse-response function as the best measures of statistical persistence.

at the end of 1999. The model parameters and change points of each regime were estimated through an adjustment maximization process. Turning points were found determining the three periods 1979Q1-1988Q4, 1989Q1-1999Q3 and 1999Q4-2010Q2, which are relatively close to those found by Echavarría, López, and Misas (2013).[10]

To make regime identification easy, it is assumed that they are *terminal* (they are never revisited once they have been abandoned) and that the last regime is *absorbent* (it is never abandoned once reached). The model is robust and open to the possibility posited by Sims (2001) that the regime change responds to the presence of heteroskedasticity and not to changes in the conditional mean.

3. PERSISTENCE OF TOTAL INFLATION

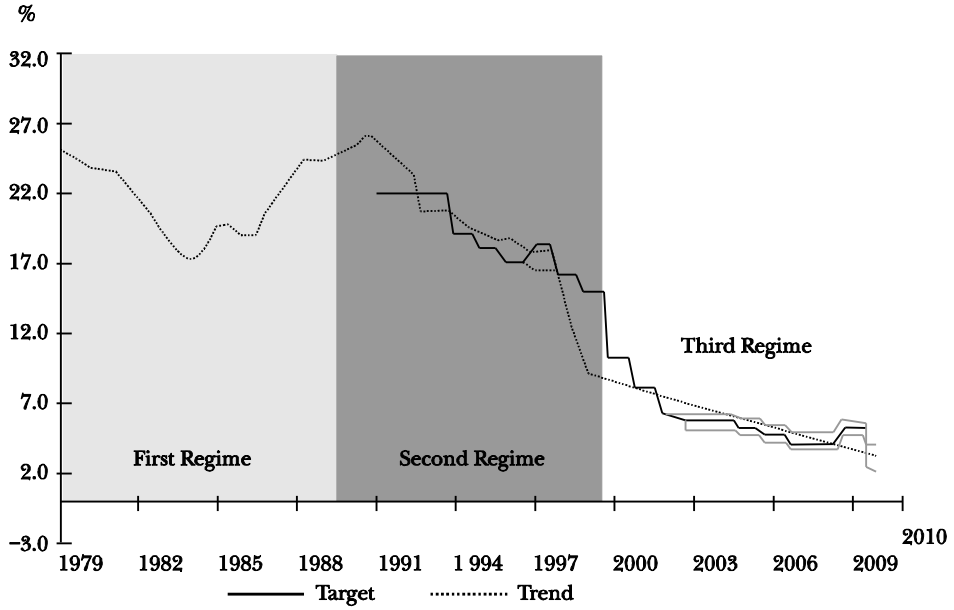
Figure 1 compares the evolution of the permanent component of inflation (τ) with the target set by the Board of Directors of Banco de la República. The Bank established *precise targets* for the period 1991-2002 and *target ranges* for later years. Additionally, a *long term target range* of 3%, plus or minus one percentage point was announced in 2001. A medium range figure, which is relevant in some minimum wage contract negotiations, was also announced. According to the bank's law, this tends to lead to meeting inflation target established in November of the previous year in December of the following year.

The long term estimated trend follows the inflation targets set by the Bank but does not coincide exactly. It was above target between 1994Q1 and 1996Q3 and below target between 1996Q4 and 2001Q1. It was close to the upper limit of the range between 2004Q1 and 2007Q2 but fell more rapidly between this time and the end of the series.

The implicit inflation *target* before 1991 is also shown. This fell from 25.3% in 1979Q1 to 17.5% in 1984Q2 and went up from a minimum of 18.6% in 1983Q1 to 26.5% in 1990Q4. As suggested by Dornbusch and Fischer (1991), no government deemed a reduction in inflation as a priority objective between 1971 and 1990, and the agents learned to live with it. The authors cite Colombia and Portugal as the only two countries where

[10] Kang, Kim, and Morley (2009) make a significant effort to determine the years which accompany regime changes. Comparison with the results of the work of Echavarría, López, and Misas (2013) was important to us and we therefore emphasised this objective less.

FIGURE 1. LONG RANGE TREND AND CENTRAL BANK TARGETS, 1979-2010 (PERCENTAGE)



moderate inflation became a *way of life* for more than 12 years. The *implicit* inflation target was high because the authorities surely considered it very costly to reduce inflation.[11] The sacrifice ratio was not observed to rise when the inflation target is high (Cogley and Sbordone, 2006).

Table 1 shows the estimated parameters for the maximum likelihood for the three regimes, taking into consideration an AR(2) process for the transitory component,[12] and Figure 2 shows the annualized quarterly inflation ($400*\ln(P_t/P_{t-4})$) and reproduces the permanent component (τ_t) again for the three regimes. Each regime can be described in general terms as follows:

– First regime (1979-1989): characterized by high volatility of permanent and transitory shocks, with transitory shocks of short duration (close to one quarter).

– Second regime (1989-1999): shows a lesser variance of shocks with respect to the first regime, with a higher reduction for the variance of

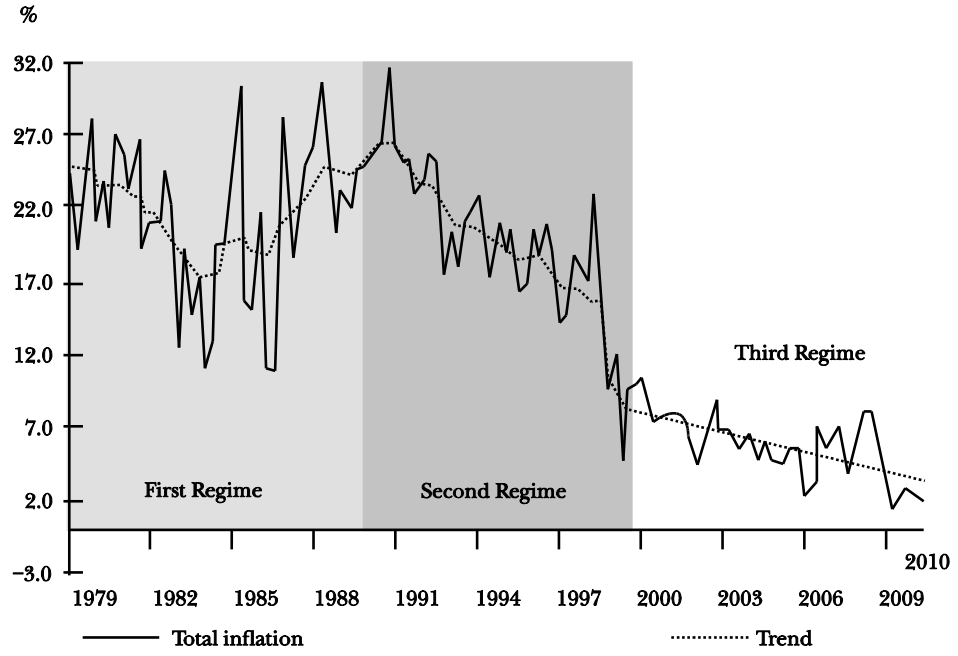
[11] Ocampo (2004), pp. 87-88.

[12] As in Kang, Kim, and Morley (2009) for the USA, an AR(2) process is sufficient to record the behavior of the transitory component.

transitory shocks. The permanent component τ_t shows a negative u_2 trend and a significant magnitude (a reduction of 28 basis points of annualized quarterly inflation each quarter).

— Third regime (1999-2010): permanent shocks show a variance close to zero, and therefore the inflation shocks are principally transitory. These transitory shocks also last longer than in the two previous regimes. The trend is practically deterministic.

FIGURE 2. LONG TERM TREND AND OBSERVED INFLATION, 1979-2010 (PERCENTAGE)



It is possible that inflation persistence could decline even further in the future because the disinflation process ended and Banco de la República has announced an inflation target for the next few years which coincides with the long term target set in 2001 (3% ± 1 basis point). Variations in the inflation target have led to highly persistent inflationary behavior in the past (Cogley, Primiceri and Sargent, 2009).

As can be seen in Table 1, the variance of permanent shocks (σ^2_{η,S_t}) was higher in 1989-1999 (2.26) than in 1979-1989 (2.02), and much higher in these two periods than in 1999-2010 (close to zero). On the other hand, the variance of transitory shocks ($\sigma^2_{\varepsilon,S_t}$) has gradually decreased from very

high levels in 1979-1989 (19.50) to intermediate levels in 1990-1999 (5.71) and even lower levels for 2000-2010 (2.57). In sum, the big *gain* in 1999-2010 was the large reduction in permanent shocks while a gradual reduction of transitory shocks began in 1989. The relation between standard deviations $\sigma^2_{\eta,S_t} / \sigma^2_{\varepsilon,S_t}$ rose from 0.32 to 0.62 between period 1 (1979-1989) and 2 (1989-1999), and fell to zero for period 3 (1999-2010).

TABLE 1. TOTAL INFLATION, MAXIMUM LIKELIHOOD ESTIMATORS (TO 90% DEGREE OF CONFIDENCE)

	S = 1 (1979Q1-1989Q4)	*S = 2 (1989Q1-1999Q3)*	*S = 3 (1999Q4-2010Q2)*
$u_{S,t}$	–0.05	–0.28	–0.13
	(–0.053, –0.036)	(–0.29, –0.27)	(–0.14, –0.12)
$\beta_{1,S}$	0.12	0.11	0.53
	(0.08, 0.15)	(–0.04, 0.19)	(0.40, 0.70)
$\beta_{2,S}$	–0.16	0.05	–0.07
	(–0.19, –0.14)	(–0.03, 0.11)	(–0.23, 0.07)
$\sigma^2_{\eta,S}$	2.02	2.26	0.00
	(1.83, 2.30)	(2.00, 2.70)	(0.00, 0.01)
$\sigma^2_{\varepsilon,S}$	19.50	5.71	2.57
	(18.60, 20.31)	(4.70, 6.44)	(2.00, 3.16)
$\sigma^2_{\eta,S} / \sigma^2_{\varepsilon,S}$	0.32	0.62	0.00

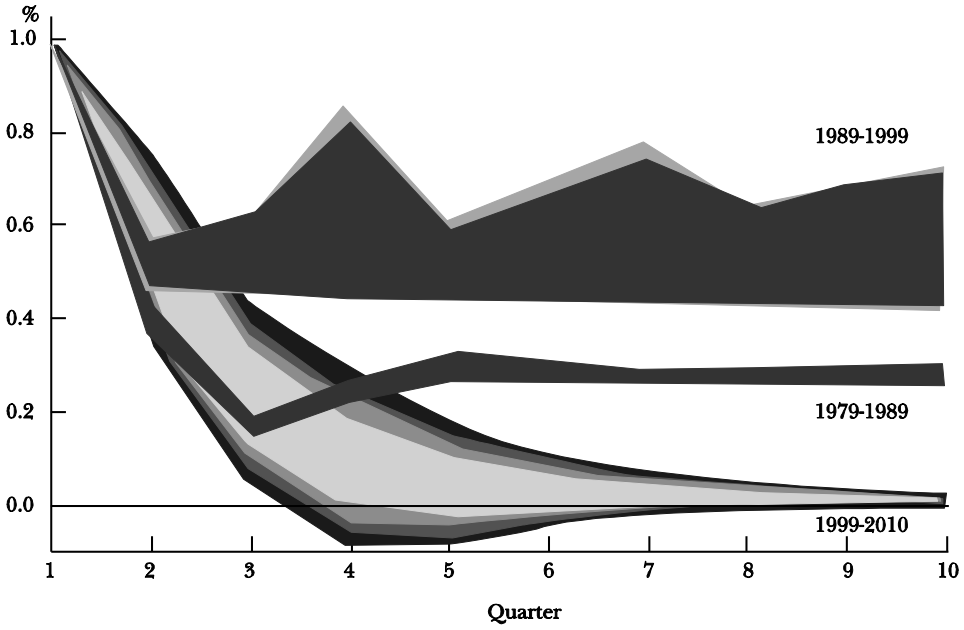
The results also shed light on the possible characteristics of the Phillips curve in Colombia. The coefficients β_1 and β_2 are associated with the variables C_{t-1} and C_{t-2} in equation (3), and show the inertia of the *gap* (cyclical or transitory component). The shock decreases to less than half during the next three quarters. In other words, the empirical evidence seems to partially confirm the validity of the New Keynesian Phillips curve where the inflation *gap* is not very persistent.[13]

Nevertheless, the enormous importance of the target (and of the credibility of the agents) in inflation determination leads to the New Keynesian Phillips curve being an adequate explanation of only a small amount of the variations in total inflation. Thus, as stated by Woodford (2005), pp. 3 "... expectations about policy matter, but at least under current conditions, very little *else* matters."

Figure 3 shows the impulse-response function for inflation and the different confidence intervals for a standardized typical shock equal to one. Intervals of 99%, 95%, 90%, 80% and 60% are shown, obtained via the so-called bootstrap re-sampling method with 2,000 repetitions (Shumway

[13] See Cogley and Sbordone (2008) and Mankiw (2001). For a review of the literature see Echavarría, López, and Misas (2013), Section 2.

FIGURE 3. IMPULSE-RESPONSE FUNCTIONS FOR THE THREE REGIMES (PERCENTAGE POINTS)



and Stoffer, 2006). The standard shock comprises a permanent shock component and another transitory one with a relative importance proportional to its variances.

Inflation persistence is defined as a function of the level observed for the impulse-response function after an initial shock, and in function of the number of quarters it takes for the shock to disappear. When these two characteristics are taken into consideration it can be concluded that inflation persistence increased in Colombia between 1979-1989 and 1989-1999, and declined to its lowest levels from 1999-2010.

If a 60% degree of confidence is used (darker area) it is observed that for the period 1979-1989 the initial shock of 1 is reduced to 0.4 after one quarter and to a little over 0.2 for the following quarters; but the shock does not entirely disappear in the 10 quarters shown on the Figure. The initial shock is only reduced to 0.5 in the period 1989-1999 and it remains at this level. The behavior is not very different for quarters 1-3 in 1979-1989 and in 1999-2010, but is for the other quarters: the average value of the series continues to fall gradually for 1999-2010, and remains at zero starting in the 5^{th} quarter.

As mentioned previously, the impulse-response function obtained allows discrimination between a process with a unit root mostly subject to permanent variations and a stationary process that mostly adheres to transitory variations. It also allows the differentiation of persistence between two processes with unit roots. Thus, the behavior of the inflation series for the period 1999-2010 is better represented by a stationary process because the shock disappears, while the other two series can be thought of as non-stationary because the shock does not disappear. The series is observed to be more persistent in 1989-1999 than in 1979-1989 because the values observed for the impulse-response function are systematically higher. Both are non-stationary because the shock does not disappear.

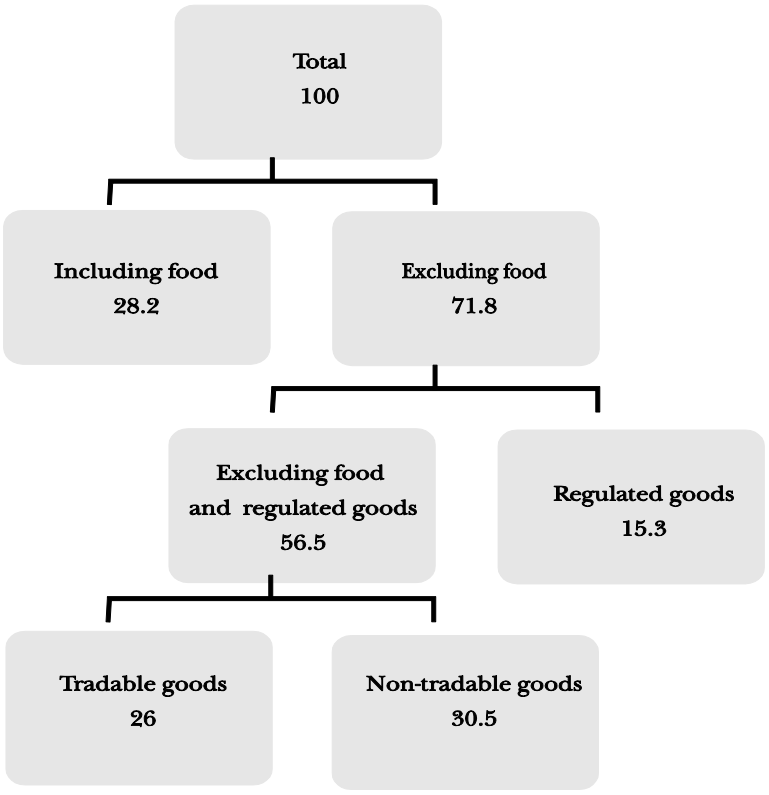
4. PERSISTENCE OF THE DIFFERENT COMPONENTS OF TOTAL INFLATION

Forecasts for inflation prepared by Banco de la República's technical team frequently consider product sub-groups. In particular, as seen in Figure 4, the so-called *transmission mechanism model* uses different behavioral equations of inflation for the total, for food and for the total excluding food. In turn, inflation excluding food can be broken down into the total excluding both food and regulated goods and the total including regulated goods. Finally, inflation excluding food and regulated goods is divided into inflation of tradable goods and non-tradable goods (Hamann, 2004). The figure shows the weight of each product group within the basket of goods. Tradable goods (26.0%), non-tradable goods (30.5%), and regulated goods (15.3%) explain the weight of the total excluding foods (71.8%), while foods represent 28.2 percent.

Figure 5 compares the behavior of the permanent and observed components of total inflation (once again), inflation excluding food, inflation of tradable goods and non-tradable goods. The shaded areas indicate periods of important change *for total inflation.* Tables 2-4 show the estimated results for each group of products.

A change in the behavior of the series can be seen in the majority of cases for 1989 and in 1999, with the exception of inflation of tradable goods, whose behavior changes only one time starting in 1989. Additionally, an almost horizontal line close to 4% is seen for non-tradable goods from 2000.

FIGURE 4. PRODUCT GROUPS IN THE TRANSMISSION MECHANISM MODEL



Tables 2-4 show that the variance in the permanent component ($\sigma^2_{\tau,S}$) falls to zero during 1999-2010 for the four groups of products, and that in 1979-1989 (specially) and in 1989-1999 it was particularly high for non-tradable goods and for the total excluding foods.

Meanwhile, the variance of the transitory component ($\sigma^2_{\varepsilon,S}$) is larger for total inflation than for its components, and only shows a continuous decline for total inflation. It does not decrease between 1989-1999 and 1999-2010 for inflation excluding foods and for non-tradable goods, and it does not exhibit a decline between 1979-1989 and 1989-1999 for tradable goods and non-tradable goods.

The coefficients β_1 and β_2 are associated with the variables C_{t-1} and C_{t-2} in equation (3), and capture the inertia of the gap (cyclical or transitory

TABLE 2. INFLATION EXCLUDING FOODS, MAXIMUM LIKELIHOOD (90% DEGREE OF CONFIDENCE)

	S = 1 (1979Q1-1989Q4)	*S = 2 (1989Q1-1999Q3)*	*S = 3 (1999Q4-2010Q2)*
$u_{s,t}$	–0.02	–0.26	–0.12
	(–0.031, –0.011)	(–0.27, –0.24)	(–0.13, –0.10)
$\beta_{1,S}$	–0.3	0.57	0.46
	(–0.77, –0.14)	(0.23, 0.82)	(0.26, 0.67)
$\beta_{2,S}$	–0.39	–0.07	–0.01
	(–0.68, –0.30)	(–0.35, 0.19)	(–0.22, 0.22)
$\sigma^2_{\eta,S}$	3.5	1.84	0.00
	(2.93, 5.89)	(1.46, 2.60)	(0.00, 0.01)
$\sigma^2_{\varepsilon,S}$	4.76	1.71	2.02
	(1.71, 6.02)	(0.69, 2.46)	(1.45,2.71)
$\sigma^2_{\eta,S} / \sigma^2_{\varepsilon,S}$	0.86	1.04	0.00

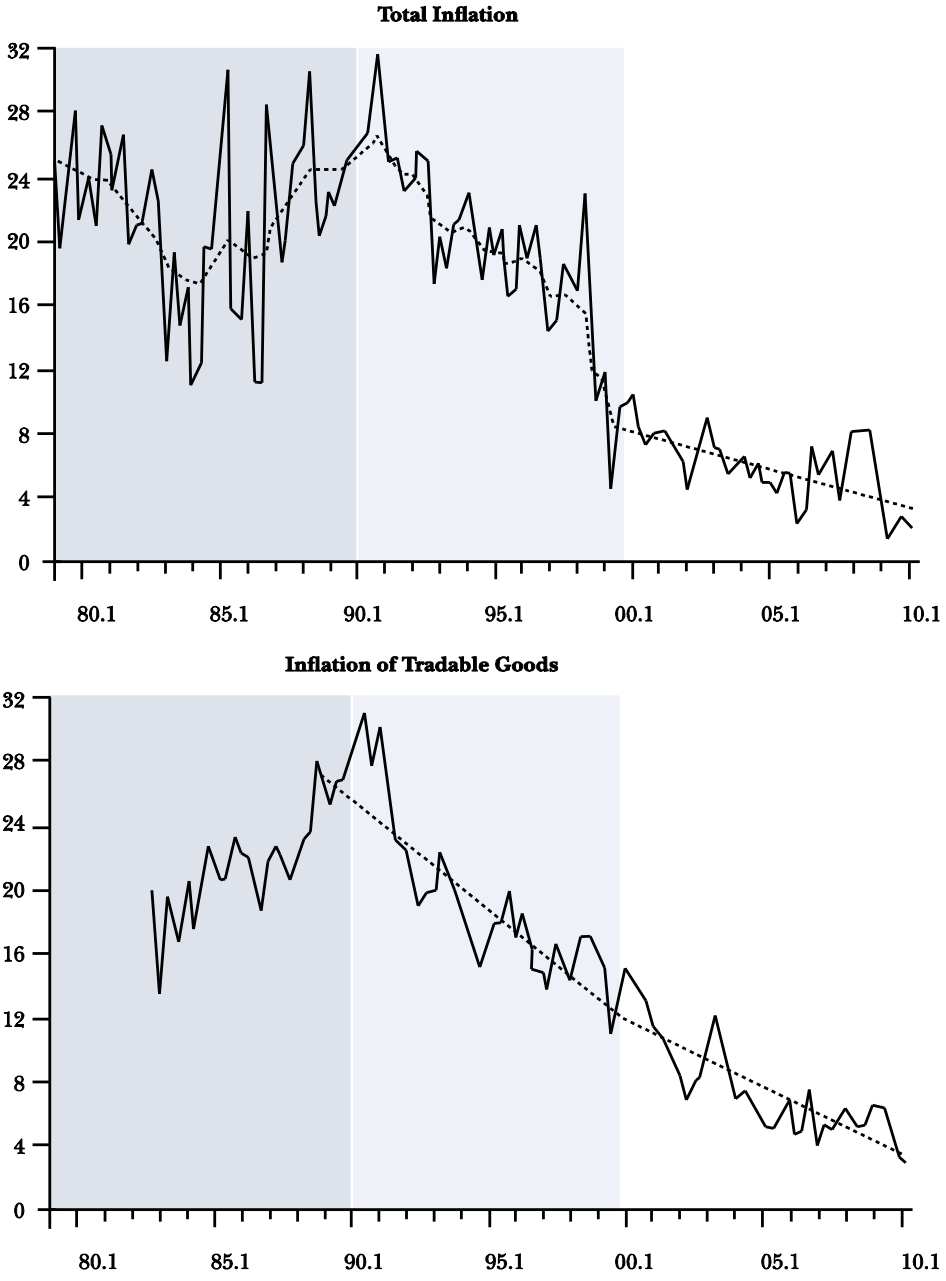
component). The shock is reduced to less than half during the first quarter in the case of the total excluding foods, in two quarters for tradable goods, and in a practically immediate fashion for non-tradable goods. This signifies that the persistence of the gap is relatively similar to that of total inflation (see above) for tradable goods, and less than that of total inflation for the total excluding foods and for non-tradable goods.

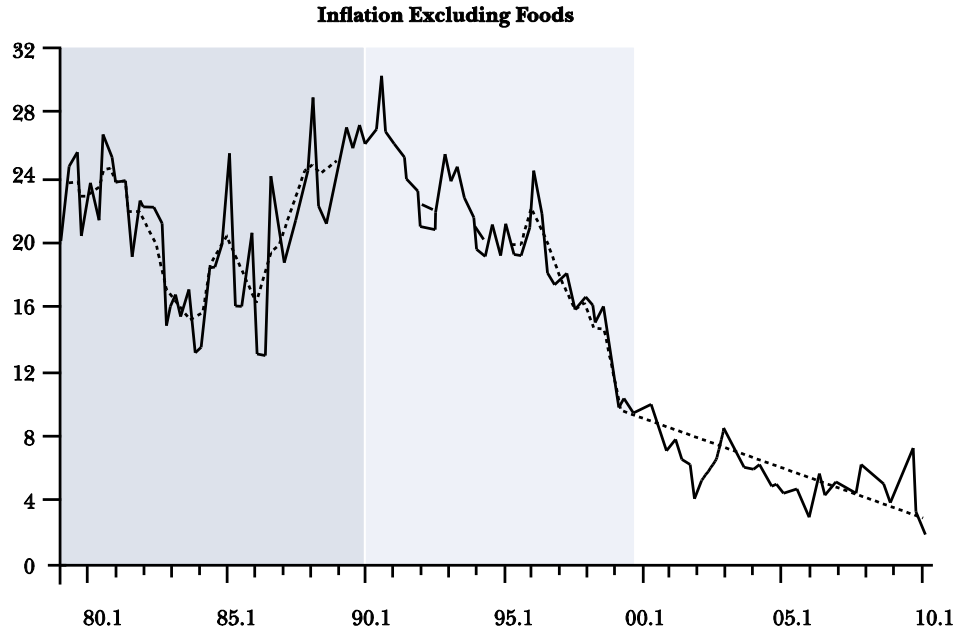
Finally, Figure 6 shows the impulse-response functions for the four product categories with 60% and 90% degrees of confidence. Only comparisons for 60% (darker area) are considered. The most noteworthy fact resides in that during 1999-2010 the shocks disappear at some time for all the product groups: toward month two for non-tradable goods, toward month four for the total, toward month five for the total excluding food and toward month ten for tradable goods.

TABLE 3. INFLATION OF TRADABLE GOODS, MAXIMUM LIKELIHOOD (90% DEGREE OF CONFIDENCE)

	S = 1 (1979Q1-1989Q4)	*S = 2 (1989Q1-1999Q3)*	*S = 3 (1999Q4-2010Q2)*
$u_{s,t}$	0.27	–0.41	–0.25
	(0.25,0.29)	(–0.42, –0.40)	(–0.27, –0.24)
$\beta_{1,S}$	–1.33	0.68	0.65
	(–1.38, –1.28)	(0.56, 0.82)	(0.50, 0.84)
$\beta_{2,S}$	–0.72	0.04	0.03
	(–0.75, –0.68)	(–0.10, 0.15)	(–0.17, 0.20)
$\sigma^2_{\eta,S}$	2.68	0.00	0.00
	(2.16, 3.24)	(0.00, 0.01)	(0.00, 0.01)
$\sigma^2_{\varepsilon,S}$	0.00	3.79	2.49
	(0.00,0.01)	(3.18, 4.37)	(1.95,3.09)
$\sigma^2_{\eta,S} / \sigma^2_{\varepsilon,S}$	0.00	0.00	0.00

FIGURE 5. INFLATION AND TREND FOR DIFFERENT PRODUCT GROUPS




Inflation Excluding Foods
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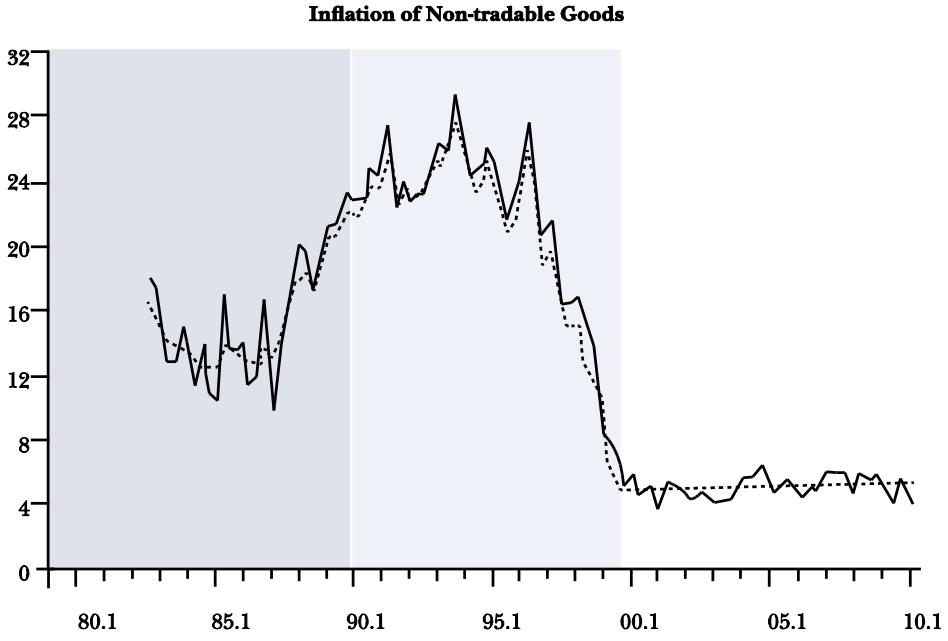
Inflation of Non-tradable Goods
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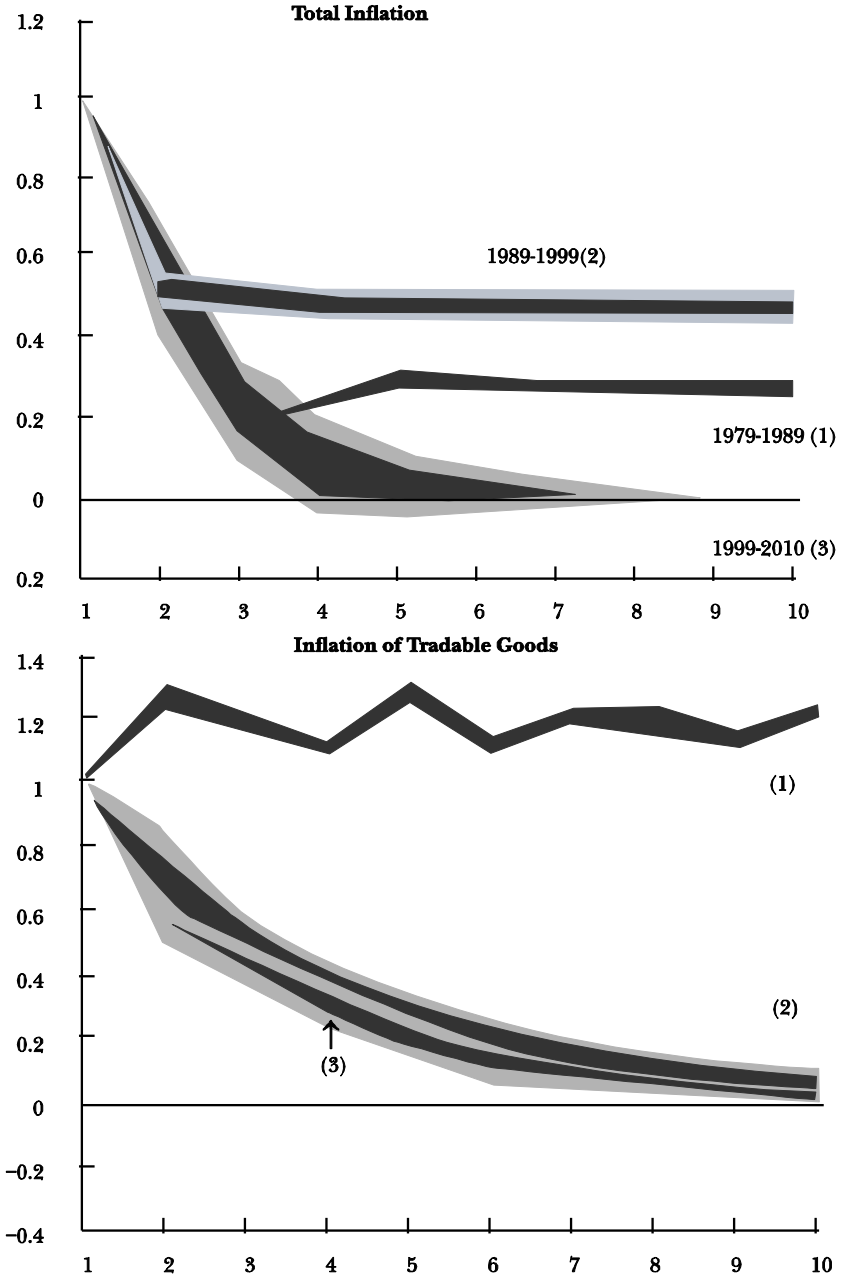
FIGURE 6. IMPULSE-RESPONDE FUNCTION FOR DIFFERENT PRODUCT GROUPS,



NOTE: The different colors correspond to 60% (dark) and 90% degree of confidence.

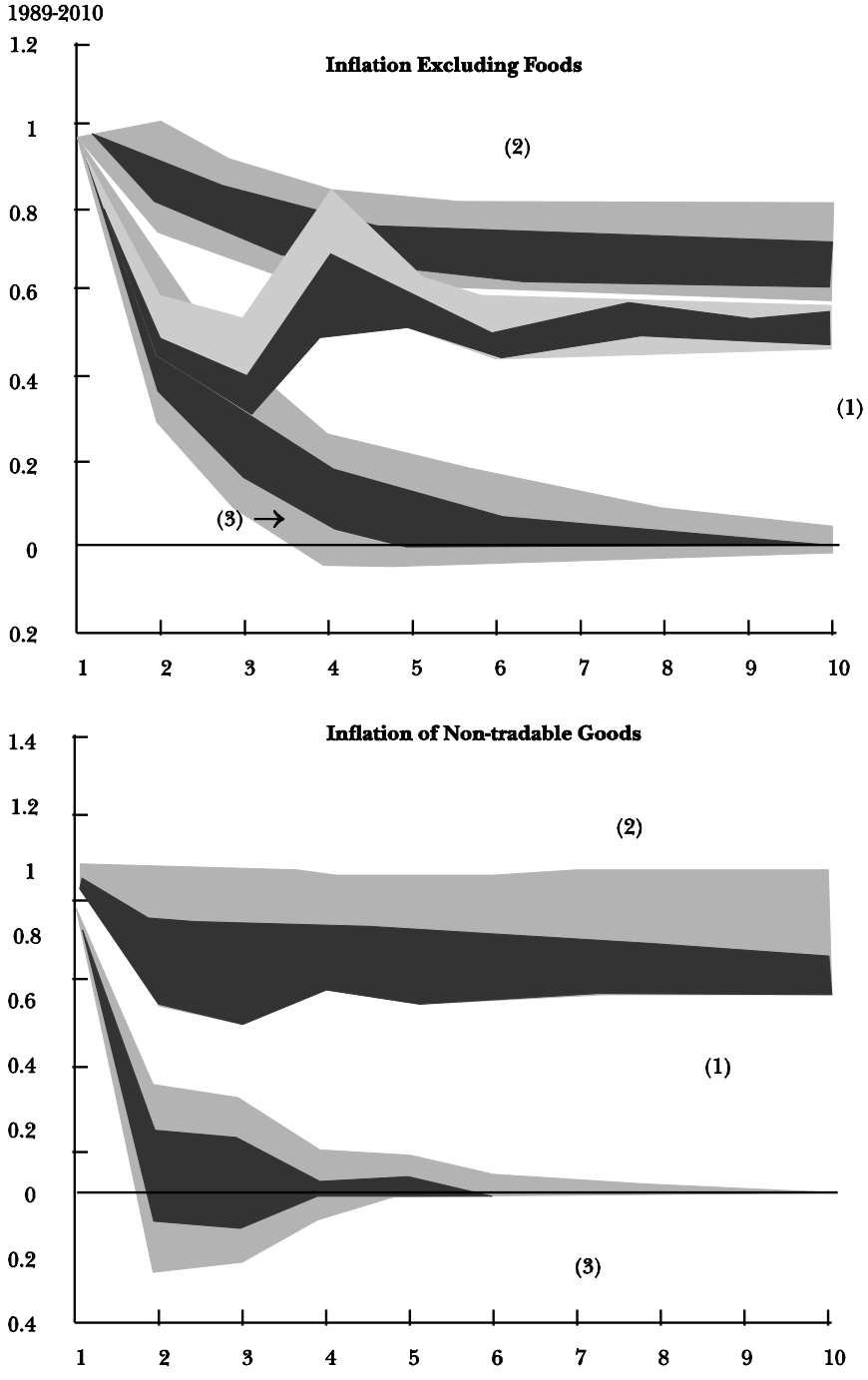

1989-2010
Inflation Excluding Foods
(1)
(2)
(3)
1.2
1
0.8
0.6
0.4
0.2
0
0.2
1 2 3 4 5 6 7 8 9 10
Inflation of Non-tradable Goods
(1)
(2)
(3)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.2
0.4
1 2 3 4 5 6 7 8 9 10

TABLE 4. INFLATION OF NON-TRADABLE GOODS, MAXIMUM PROBABILITY (90% DEGREE OF CONFIDENCE)

	S = 1 (1979Q1-1989Q4)	*S = 2 (1989Q1-1999Q3)*	*S = 3 (1999Q4-2010Q2)*
$u_{s,t}$	0.05	–0.20	0.00
	(0.02,0.08)	(–0.70, –0.14)	(–0.03, –0.02)
$\beta_{1,S}$	–1.01	0.94	0.04
	(–1.18, –0.26)	(0.60, 1.9)	(–0.26, 0.31)
$\beta_{2,S}$	–0.78	–0.01	–0.01
	(–0.98, –0.30)	(–0.98, 0.20)	(–0.26, 0.25)
$\sigma^2_{\eta,S}$	3.91	3.31	0.00
	(2.69, 4.74)	(0.01, 4.37)	(0.00, 0.01)
$\sigma^2_{\varepsilon,S}$	0.46	0.87	2.50
	(0.01,2.27)	(0.01, 5.08)	(1.71,3.40)
$\sigma^2_{\eta,S} / \sigma^2_{\varepsilon,S}$	2.92	1.95	0.00

On the other hand, in three of the four panels greater persistence is observed in 1989-1999 than in 1979-1989 and much larger than in 2000-2010. The case of tradable goods is the exception, with an enormous level of persistence in 1979-1989, possibly due to the semi-fixed exchange rate regime that existed in that period. This suggests that the most important exchange rate modification occurred in 1989 when the *crawling-peg* was abandoned (in place since 1967) and not in 1999 when the *exchange rate band* was abandoned.

The persistence of inflation excluding foods was higher than that of total inflation in 1979-1989 and in 1989-1999, with relatively similar patterns in 1999-2010. Furthermore, no single pattern was observed when comparing persistence for tradable goods and non-tradable goods. Inflation of non-tradable goods is very persistent in 1979-1989 and in 1989-1999, but not very persistent in 1999-2010, while inflation of tradable goods was relatively persistent in the three periods (especially in 1979-1989 during the crawling-peg regime); it slowly declined to zero in 1979-1989 and in 1989-1999.

5. CONCLUSIONS

The sum of the autoregressive coefficients for the total inflation series, an indicator of persistence, did not fall in Colombia with the adoption of an inflation targeting regime (Echavarría, López, and Misas, 2013), possibly due to the influence of the Central Bank's highly persistent target. Nevertheless, the inflation target was not entirely credible, and it is because of

this that it is important to consider a model which allows estimation of the long term path of inflation anticipated byagents.

Stock and Watson (2006) proposed a model with such characteristics and the model used in this document follows their general recommendations. Following Kang, Kim, and Morley (2009), a model of the unobserved components of inflation with a change of regime is estimated for 1979Q1-2010Q2. (in place of stochastic volatility) and is more in accordance with the idea that changes in the monetary regime produce relatively abrupt variations in the pattern of inflation.

The long term estimated trend follows the inflation targets set by the Bank but does not coincide exactly with them. Inflation persistence, as defined by the terms of the impulse-response function, also grew in Colombia during 1979-1989 and 1989-1999 and diminished to its lowest levels in 1999-2010 due to the adoption of an inflation targeting regime. It is possible that inflation persistence will decline even further in the future as the disinflation process has come to an end and Banco de la República has announced an inflation target for the next few years which coincides with the long term target set in 2001 (3% ±1 point).

This work revindicates the value of the so-called New Keynesian Phillips curve because the inflation *gap* is not very persistent. Nevertheless, the enormous importance of the target (and the credibility of the agents) in the determination of inflation makes the New Keynesian Phillips curve an adequate explanation for only a small portion of the variations in total inflation.

This paper compares the behavior of inflation for different product groups. The shocks disappear at one time or another for all of them in 1999-2010: toward month two for non-tradable goods, toward month four for the total, toward month five for the total excluding foods and toward month ten for tradable goods. It also suggests that the most important exchange rate modification occurred in 1989 when the *crawling-peg* was abandoned (in place since 1967) and not in 1999 when the *exchange rate band* was abandoned.

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