The transmission mechanism of monetary policy in Colombia: major changes and current features

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Introduction

The Colombian economy underwent substantial changes over the last decade that affected the transmission mechanism of monetary policy in significant ways. After a protracted recession and a financial crisis, the economy, characterized by moderate, slowly declining inflation, a complex monetary regime, incipient financial asset markets and a credit surge, as depicted by Carrasquilla (1998), transformed into a low inflation economy with an inflation targeting regime and a relatively deep public bond market. This paper seeks to describe the main elements of this process. In the first part, an account of some of the major changes experienced by the Colombian economy is presented. In the second part, these changes are linked to the current features of the transmission mechanism.

1.   Main changes in the Colombian economy affecting the transmission mechanism

In 1997 CPI inflation in Colombia was 17.7% and had come down from 25.1% in 1992 (Graph 1). The monetary policy strategy consisted of a system of "bands" for the exchange rate, the monetary aggregates and the interbank interest rate that were supposed to be consistent with an inflation target announced for the year. Since there could be conflict between the bands, an ordering of priorities was established, but it was not always followed in the face of some of the shocks that hit the economy later on.

Aggregate expenditure had risen fast since 1992, following large capital inflows and low real interest rates between 1992 and the first half 1994. As a result, the current account deficit was 4.7% of GDP on average between 1993 and 1997, while financial system credit growth was above 16% in real terms between 1992 and 1995. The increase in mortgage credit was a considerable part of total credit growth and real estate real values climbed between 1992 and 1995. Non-interest public expenditure also rose as a percentage of GDP from 17.4% in 1990 to 30.6% in 1997.

As a consequence, the Colombian economy was highly vulnerable to external shocks in terms of both income/expenditure flows and domestic/external stocks of debt. Private external debt went up from 6.6% of GDP in 1992 to 18.4% of GDP in 1997, while the ratio of financial system loans to GDP reached 43.1% in 1997, a large number when compared to an average of 30.5% between 1980 and 2006.

In these circumstances, the terms of trade deteriorated in 1998 and private capital flowed out of the country between 1998 and 1999. There were strong pressures for currency depreciation. The exchange rate target zone was defended in 1998, but was finally devalued

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in August of that year, following the Russian crisis. Renewed pressures on the currency occurred in mid 1999. The target zone was devalued again and widened. Finally, in September 1999 the currency was allowed to float and the monetary policy regime converged to a full fledged inflation targeting strategy. A program was agreed with the IMF to stabilize the public debt ratios and to grant access to the scarce external funding.

The external shock to such a vulnerable economy also produced a sharp drop in output and employment. GDP fell by more than 4% in 1999 and growth did not recover significantly until 2003. Given the high degree of indebtedness of the private sector and the fragility of some segments of the financial system, a financial crisis ensued. All these events changed the transmission mechanism in substantial ways. In the remainder of this section, three key events will be described in some detail to provide an understanding of their influence on the current transmission mechanism.

(a)   The fall of inflation

Graph 1 shows that CPI inflation fell rapidly in 1999. It went from 16.7% in December 1998 to 9.2% in December 1999, decreasing more in that year alone than in all the five previous years. This abrupt disinflation came as a surprise for the markets and the public (Table 1) and was associated with the recession that occurred in 1999 (Graph 2). In that year, investment fell by 38.6%, consumption decreased by 3.2% and the unemployment rate rose by 4.2 percentage points. Short term real interest rates had increased since early 1998, reaching record levels (17.3%) in November 1998, as a result of the rise in the country risk premia, as well as the efforts by the central bank to defend the exchange rate target zone.

Since a real depreciation of the currency was required by the changing external conditions, non-tradable price annual inflation fell by 8.8 percentage points in 1999, while the price increases of the tradable sub-basket fell by 6 percentage points in that year. Rents, a large component of the non-tradable sub-basket, were particularly hard hit, with real decreases of 5.1, 7.4 and 5.6 percentage points in 1999, 2000 and 2001, respectively. The financial crisis and the burst of a real estate bubble were behind such a drop in real rents.

Between January 1998 and December 2000 the currency depreciated by 44.5% and 28.9% in nominal and real terms, respectively. As mentioned, inflation fell throughout the period, so the impact of depreciation on headline CPI inflation was insignificant. This reflected the need for a real depreciation, the reaction of the central bank and the response of the economy to increased external and domestic interest rates in the context of large imbalances.

After 1999 the Central Bank followed a policy of gradual disinflation, setting decreasing annual targets that have been met most of the time (Graph 1). Some authors have argued that the disinflation of 1999 and beyond was "fortuitous" because the Central Bank took advantage of the considerable negative output gap that has prevailed throughout most of the present decade (Graph 2) (Clavijo, 2000). However, the very fact that the Central Bank did not try to set low interest rates in the midst of the crisis (with rising sovereign risk premia) or to increase inflation afterwards to stimulate the depressed economy sent a strong signal about the preferences and the long run targets of the policymakers. In particular, they showed the Central Bank's willingness to achieve and keep low levels of inflation, indicating that the disinflation had been permanent. This was an important message, given Colombia's long history of moderate inflation and the timid pace of disinflation before 1999.

(b)   The adoption of an inflation targeting strategy

Some elements of an inflation targeting (IT) regime were present in Colombia before 1999. Quantitative inflation targets had had to be announced by law since 1992. An internal Inflation Report was produced to guide the decisions of the Board of Directors. This report included several statistical and single-equation models to forecast inflation, and some effort

was made in order to understand the short run determinants of inflation. The Inflation Report started to be published in December 1998.

After the currency was allowed to float in September 1999, the decision was made to follow an IT strategy. Nevertheless, the limited knowledge of the transmission mechanism and the lack of instruments to predict or simulate the behavior of the economy over horizons longer than one year represented serious restrictions on the application of IT. In addition, money demand seemed to be stable, so initially, the IT strategy was accompanied by "reference paths" for M3 and the monetary base, like the ones used in the ECB. The idea was that the signals about the future course of inflation were to come from both the IT analysis and forecasts, and the deviations of the monetary aggregates from their "reference paths".

With time, however, the relationship between money growth and inflation changed (as illustrated below) and some demand functions turned unstable. Simultaneously, knowledge of the transmission mechanism was developed (Gómez et al, 2002), as well as instruments to forecast and simulate the behavior of the economy over longer horizons, conditional on monetary policy. Hence, the deviations of monetary aggregates from their "reference paths" were abandoned as a strong criterion for policy action and the monetary policy strategy converged to a full fledged IT regime.

Within the IT framework, the main instrument of the Central Bank is its overnight repo interest rate. At the policy rate, the Central Bank provides (withdraws) all the liquidity demanded (supplied) by the financial system. The aim is to guide the overnight interbank rates and the banks' deposit and loan interest rates toward levels deemed as consistent with the achievement of the inflation target 18–24 months ahead. The immediate effect of this change was the stabilization of the overnight interbank interest rates (Graph 3) and the production of a clear signal on the stance of monetary policy. Before, the interbank rates fluctuated widely because the Central Bank tried to set paths for the monetary aggregates or defended the exchange rate at the ends of the target zone.

Up until 2002 the Central Bank set annual point inflation targets. Since 2003, it has set a ±0.5% range target for the year ahead and has announced a wider range for the mid-point of the target two years ahead. This is consistent with the estimated horizon in which monetary policy has the largest effect on inflation (18–24 months). Also, the Central Bank announced a long term target of inflation between 2% and 4%. The successive announced ranges have been decreasing toward the long run target, as the Bank has explained to the public that it intends to gradually converge to it. As long as the credibility of the Central Bank's inflation targets is enhanced, the policy described above may have implications on formation of prices and wages, altering the persistence of inflation, anchoring inflation expectations and making the accomplishment of the targets less costly.

(c)   The financial crisis

Some sectors of the financial system presented fragilities during the 1990s (Uribe and Vargas, 2003). Regulation and supervision of public owned banks and some financial cooperatives were weak. Risk management practices at those institutions were poor and many of them eventually failed when interest rates increased, unemployment rose and income fell.

The mortgage banks were not sufficiently capitalized to reflect the credit risk associated with large increases in unemployment or falls in the real value of collateral (real estate). There was a mismatch between long run loans (partially indexed to the short run interest rate) and short term liabilities (interbank loans and CDs). Thus, mortgage banks' profits were vulnerable to sharp shifts in short run interest rates. In addition, even though it was partial, the indexation of mortgage loans to the short run interest rate made the disposable income of indebted households quite sensitive to movements in interest rates.

In this context, the external shocks that led to skyrocketing foreign and domestic interest rates produced a marked deterioration of the financial situation of households and mortgage banks. All the abovementioned risks were realized, collateral values plummeted and many households stopped paying their debts. One large mortgage bank went bankrupt and required intervention by the Government.

The financial crisis was to have important consequences for the transmission mechanism:

- The credit channel of transmission of monetary policy was severed, as the demand for credit was cut by highly indebted individuals and firms, while credit supply was restricted by a financial system that had an increased risk perception of the economy and whose capital had been hit by large losses (Echeverry and Salazar, 1999, and Barajas and Steiner, 2002, among others). In this situation, the expansive monetary policy that followed the crisis had a limited impact on aggregate demand. At some point, its effect may have been restricted to the income effect on borrowers. This may be one of the reasons for the protracted recession of the Colombian economy (Graph 2).

- Given the increased credit risk perception and the deterioration of their capital, banks and other financial institutions turned to domestic public bonds as an alternative investment. The rapid growth of the private pension funds portfolios also contributed to the increase in the demand for public bonds. At the same time, the Government's rising financial requirements, the restrictions in access to external funding and the need to reduce the Government's foreign exchange exposure induced an increasing supply of public domestic bonds throughout the decade. The development of the public bond market has allowed the formation of a zero coupon curve, a key element for the pricing of financial assets. The importance of this change will probably be greater in the future, as the fixed rate, long run, private loan and bond markets expand (especially the mortgage loan market). More recently, the upsurge of public bond holdings by financial intermediaries has exacerbated their exposure to market risk (Vargas et al (2006)), making their asset portfolio adjustment an important element of the transmission mechanism in the short run.[2]

- Securitization of mortgage loans emerged, encouraged by income tax exemptions on earned interest. There was a deliberate policy to develop this market, with the idea of better diversifying credit risk. Today the size of mortgage backed securities is around 38% of non-securitized mortgage loans. Most of these securities are held by banks.

- Mortgage loans were de-linked from short run interest rates, so a strong and fast connection between policy rates and household expenditure was broken. Today, mortgage loans are made at fixed rates or indexed to CPI inflation. Their importance in the transmission mechanism is still subdued, because of the process of debt reduction started by households after the crisis.

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[2] For example, after some turbulence in April–July 2006, banks reduced their holdings of public bonds and shifted to loans (especially consumer loans). This implied a reduction in lending rates at a time when the Central Bank was raising its interest rates.

2.   Main features of the transmission mechanism

The events described in the foregoing section had some effects on the responses of inflation to its macroeconomic determinants, the behavior of aggregate demand and the reaction of market interest rates to shifts in monetary policy.

(a)   Determinants of inflation

The permanent fall of inflation and the adoption of an IT regime had some consequences for the determination of inflation over short term horizons (two years or less):

- Expectations of sustained single-digit inflation and improvements in the credibility of the Central Bank's targets have partially reduced inflation persistence and helped to anchor expectations.

- Falling inflation expectations and supply shocks have shifted the short-run Phillips curve. At the same time, lower and more stable inflation may have changed the sensitivity of the short-run aggregate supply to inflation surprises.

- Exchange rate flexibility and the credibility of a low inflation regime could have decreased pass-through from imported goods prices to CPI inflation. However, an increased degree of competition in the economy may have raised the pass-through from the exchange rate and foreign prices to imported good prices.

- Finally, the fall of inflation, some exogenous shocks and the new policy regime have blurred the short and medium term relationship between money growth and inflation.

(i)   Inflation persistence and anchoring of expectations

The literature on IT argues that one of the main advantages of this regime is the reduction of inflation persistence and the anchoring of expectations. If the inflation target is credible, indexation mechanisms and adaptive expectations should be weakened, as agents put more weight on the inflation target in the formation of prices and wages. Hence, shocks do not have permanent effects of inflation (Capistrán and Ramos-Francia (2006a)).

Inspection of the Colombian survey data indicates that the credibility of the inflation targets and the anchoring of expectations gradually improved after the fall of inflation and the adoption of IT (Table 2). Capistrán and Ramos-Francia (2006b) also show that the consensus inflation expectations for 18–24 months ahead inflation have become closer to the inflation target since 2003, even though current inflation may have been higher than the future target.

With respect to inflation persistence, typically two methods are used to assess its changes (Bergljot et al (2006)):

- Changes in the sum of the coefficients of past inflation in a simple autoregressive specification:

$$\pi_t = a + \sum_{j=0}^{p} b_j \pi_{t-j} + \varepsilon_t$$

- Changes in the coefficients of "backward" and "forward" looking components of a Hybrid New Keynesian Phillips Curve (HNKPC) (γ_b and γ_f):

$$\pi_t = \gamma_f E_t \pi_{t+1} + \gamma_b \pi_{t-1} + \lambda mc_t + \mu_t$$

Here, persistence is attributed to inertia ("intrinsic persistence"), expectations ("expectation-based persistence") or the persistence of the deviations of marginal costs from their steady state value ("extrinsic persistence").

Regarding the first method, three studies find mixed results, depending on the price index used (Table 3). According to these estimates, after 1999 persistence declined for the GDP deflator and CPI food and non-tradable inflation. Persistence remained high for CPI headline inflation as well as for tradable and regulated price inflation.[3] González and Hamann (2006) argue that the apparently still large degree of persistence in CPI inflation might be due to imperfect credibility and information, and a slow process of learning by the public about the "permanent component" of the inflation target.[4] They link this interpretation to the gradual pace of disinflation that has taken place in Colombia.

On the other hand, estimates of the HNKPC coefficients seem to support the hypothesis that intrinsic persistence lost importance in favor of expectations-based persistence after 1999 (Table 4).

In sum, there is some evidence that the permanent fall of inflation and the adoption of an IT regime may have helped to anchor inflation expectations. The latter seem to have become more important in price formation, but persistence remains high for some price indices. It is worth recalling that inflation is not at its long run target yet, and that disinflation has been slow. Thus, obtaining all the benefits of low inflation and IT in terms of low "sacrifice ratios" will take more time in Colombia.

(ii)   Shifts and "slope" of the short-run aggregate supply

Decreasing inflation has led to decreasing inflation expectations and this has shifted the short-run Phillips curve in Colombia since 2000 (Graph 4).[5] More recently, supply shocks and the increased degree of competition in some sectors have also contributed to this movement. This is confirmed by the behavior of non-tradable prices inflation, presumably the component of the CPI that is most sensitive to the output gap. Graph 5 shows that the relationship between non-tradable inflation and the output gap breaks after 2000, as the output gap closes and inflation remains stable. However, when the relationship is corrected for inflation expectations,[6] the association becomes apparent (Graph 6).

The "slope" of the short run aggregate supply (the response of inflation to the output gap) seems to have declined with the fall of inflation, although the evidence is less conclusive in this regard:

- Recursive OLS estimation of an aggregate supply equation points to a reduction of the output gap coefficient since the start of the disinflation process (1991), with an additional downward shift after 1997 (Graph 7).

- The estimations of the HNKPC presented above indicate a greater sensitivity of inflation to deviations of marginal costs from their steady state values after 1999

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[3]   González and Hamann (2006) use a Kalman filter to estimate a structure in which a smooth trend and persistence of inflation are modeled simultaneously. In this case, persistence is understood as the speed of reversion to the trend. Their results show that for the 1990–2005 sample, persistence is high for the core inflation measures and tradable goods inflation. Persistence is low (negative in some cases) for non-tradable and regulated price inflation, as well as for headline inflation.

[4]   The evidence found by González and Hamann (2006) favors this explanation over a simple ad-hoc indexation hypothesis.

[5]   Some studies suggest that the long run component of the unemployment rate rose in the first part of the nineties due to increasing non-wage labor costs (eg Arango and Posada (2006)). This would have implied an upward shift in the Phillips curve presented in Graph 4. Slowly falling inflation expectations at that time could have (partially) offset this movement.

[6]   Inflation expectations are taken from the core simulation/forecast model of Banco de la República and correspond to a weighted average of future and past inflation.

(Table 5). Since a positive relationship is expected between the output and the marginal cost gaps,[7] this result does not seem consistent with the previous one.

Several stories can be told around both results. On the one hand, the opening of the Colombian economy during the early 1990s and the effects of globalization may explain the first finding (reduced sensitivity of inflation to the output gap), in line with the interpretation given to similar results in industrialized countries (Helbling et al (2006)). The idea is that with increased integration, domestic factors have become less important in explaining domestic prices, relative to global or external factors. On the other hand, the larger response of inflation to the marginal cost gap may indicate greater price flexibility in Colombia after 1999 (among other things). This could be the result of a higher degree of competition in several sectors. However, this hypothesis would have to be validated by microeconomic data.

An alternative, more "classical" interpretation of the diminished reaction of inflation to changes in the output gap has to do with the reduction of inflation and inflation volatility. The classic paper by Lucas (1973) suggests that the response of aggregate supply to nominal shocks depends on the ratio of the volatilities of individual relative prices and aggregate prices.[8] Table 6 shows that the ratio of the volatility of relative price changes to the volatility of inflation has increased for several sectors, as inflation and inflation volatility decreased in Colombia.

(iii)   Exchange rate pass-through

Graph 8 shows a decreasing recursive OLS coefficient of PPI imported goods price inflation in a core CPI inflation (aggregate supply) equation, suggesting a declining pass-through since 1991. Similar results are obtained from a Kalman filter estimation of a system comprising an equation for core CPI inflation and an equation for imported good prices (Graph 9, second panel). In contrast, the pass-through from exchange rate depreciation and foreign prices to imported good prices has apparently increased in the same period (Graph 9, first panel).

The decreasing size of pass-through to CPI has been observed in many economies (eg Baqueiro et al (2003)) and has been attributed to a credible, low inflation environment (Taylor (2000)), among other things. Graph 8 suggests that it started to fall in Colombia with the beginning of the disinflation process (1991). However, given the slow speed of this process, a more plausible explanation of the decaying pass-through could be the adoption of a more flexible exchange rate arrangement.[9] In this context, shifts in the exchange rate are transferred to prices only if they are perceived to be persistent. A floating regime introduces uncertainty about the duration of a shock, hence moderating the pass-through.

Curiously enough, according to Graph 8, the pass-through coefficient did not experience significant changes after 1999, when the currency floated, IT was adopted and inflation fell. Nonetheless, Graph 9 indicates that the pass-through has continued to fall throughout the past ten years.

In contrast to the previous result, Graph 9 (upper panel) shows that the pass-through from the exchange rate and foreign prices to imported good prices has almost continually increased since 1991. Using sectoral data, Rincón et al (2005) find evidence of incomplete

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[7]   This relationship holds with fixed prices and flexible wages.

[8]   Intuitively, in the context of imperfect information, the smaller the volatility of the money supply and aggregate prices, the more informative are the individual price changes about shifts in relative prices.

[9]   Before 1991, a crawling-peg regime with capital controls had been in place for about 25 years. From 1991, an "implicit" target zone allowed the currency to fluctuate within a rather wide band. Between 1994 and 1999 the bands were explicitly set and announced. After September 1999, the currency was allowed to float.

pass-through from the exchange rate to manufactured imported goods, supporting the existence of non-competitive market structures. They also find unstable and non-decreasing pass-through coefficients for most of the sectors considered between 1995 and 2002. Interestingly, these coefficients rise after 1999 (some revert later, other do not), when a persistent depreciation of the currency took place.

Non-decreasing pass-through coefficients to imported prices in a falling inflation, flexible exchange rate environment may signal an increasing degree of participation of imported goods suppliers in the manufactured goods markets. This is consistent with the opening of the economy in the 1990s.

(iv)   *Money and inflation in the short run*

The short-run relationship between money and inflation weakened in Colombia after the disinflation (Graph 10). Non linear effects of the reduction of inflation and nominal interest rates, as well as exogenous shocks (like an increasing debit tax) may help explain the real expansion of the monetary base. The dramatic increase of the real money demand has been accommodated by the Central Bank, given the policy regime. At the policy interest rate, all the money demanded is supplied, so the changes in the demand for money show up in the observed quantity of money.

In addition, some money demand functions have turned unstable in their parameters. The effect of these events has been a reduced usefulness of money to understand or predict inflation developments.[10] More recently, however, González et al (2006) have found evidence of a greater contribution of money gaps (relative to the output gap) in the explanation of the deviation of inflation from its targets.

(b)   Behavior of aggregate demand

(i)   *Sensitivity of aggregate demand to the interest rate*

The debt build-up and the ensuing financial crisis of the 1990s had some consequences for the behavior of aggregate demand. Interest rate sensitivity of aggregate expenditure rose with the increase in debt and was apparent during the recession of 1999. Graphs 11 and 12 show that the debt ratios of households and firms reached their peaks around 1998. This made the private sector highly sensitive to interest rate shocks.

When external conditions changed in 1998–1999 and interest rates went up, the effect on private demand was relatively large. In addition to the increased debt burden, real estate relative prices had been falling since 1996. Private consumption and investment fell sharply as interest rates climbed (Graphs 13 and 14). The recursive OLS coefficient of the real interest rate deviation from trend in an "IS curve" equation illustrates the enlarged sensitivity of aggregate demand to interest rate changes after 1999 (Graph 15).

After 1999 real interest rates came down fast, while expenditure recovered slowly (Graphs 13 and 14), reflecting the fragile financial situation of the financial and private sectors. As

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[10]   For example, when the Central Bank sets the interest rate, an interpretation of a negative correlation between money growth and inflation, like the one shown in Graph 10, could be the succession of exogenous money demand shocks and the presence of a negative output gap that reduces inflation. Alternatively, higher demand for domestic assets could simultaneously raise money demand and appreciate the currency, putting downward pressure on inflation. Yet a third interpretation could be an expansion of productivity that explains both the decline of inflation and the rise of money demand. So, difficulties arise when interpreting the money-inflation relationship in the same way that understanding the inflation-output relationship may be complicated at times.

mentioned in the previous section, firms and households entered in a process of debt reduction, while banks turned to public debt bonds as an alternative investment. Today, private sector indebtedness is lower and the recent expansion in investment has been financed mostly with internal savings (Table 7).[11] Since 2002, banks' profits have recovered. Macroeconomic conditions and the stronger financial situation of both the private sector and financial intermediaries have allowed an acceleration of credit growth (especially consumer loans). Thus, a change in the trend of the private sector's debt indicator has been observed (eg Graph 11).

(ii)   Sensitivity of aggregate demand to the exchange rate

Throughout the 1990s there were some changes that could have affected the "reduced form" relationship between output and the exchange rate (the "IS curve"):

- Capital controls were relaxed and the exchange rate regime was made more flexible. As a result, the short-run reaction of the economy after a shock could have changed, as well as the relevant types of shocks facing the economy. For example, an improvement in the terms of trade would no longer imply an expanding economy and pressures on inflation. Or deliberate policies to increase net exports through devaluations could have become less relevant in explaining the output-exchange rate relationship, as other shocks (eg capital account shocks) happen to be more important in the determination of the exchange rate and output dynamics.

- The upsurge of private external debt in the 1990s (Graph 16) made the balance-sheet effects more relevant. Thus, a positive response of output to a (real) depreciation of the currency could have been weakened, as the expenditure-switching channel could have been (partially) offset by the balance sheet effects.

Graph 17 shows that the recursive OLS coefficient of the real exchange rate gap in an "IS curve" decreases and becomes less significant with time. This may be an indication of the two factors just mentioned.[12] Beyond the inspection of the "reduced form" relationship, some studies have found mixed results on the importance of balance sheet effects.

On the one hand, using firm-level information, Echeverry et al (2003) find that investment responds negatively to a devaluation of the currency (although positively to the level of the exchange rate). Also, in their estimations larger firms and importing (more than exporting) firms are more prone to use external funding. On the other hand, Echavarría and Arbeláez (2003) also use firm-level data, but they find a positive effect of devaluations on sales, investment and profits, both in the aggregate and in different sectors of the economy. This is attributed to a competitiveness effect that is stronger than the balance-sheet effects. Moreover, according to their results, most of the firms that use external funding are currency-matched (they are either exporters or foreign-owned). Tovar (2006) uses a DSGE model to show that the expenditure-switching effect is stronger than the balance-sheet effect for Colombia, so devaluations by the Central Bank have expansionary effects. However, a sudden stop both depreciates the currency and reduces output. This highlights the importance of the source of the shocks to the economy in explaining the (general equilibrium) relationship between output and the exchange rate.

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[11] This raises the question about what interest rate is relevant for the determination of aggregate demand. It has been argued that, given the expansion of the domestic public bond market, the prices of these securities are now important as opportunity cost indicators or as measures of wealth. However, Jalil and Amaya (2006) show that public bond rates are positively related to economic activity variables.

[12] For example, in the first half of the nineties there were large capital inflows. Some real appreciation occurred in the context of higher exchange rate flexibility, but Central Bank purchases of reserves were important. The observed outcome was an appreciation of the currency, lower interest rates and an expansion of output.

The reduction in the levels of private foreign debt (Graph 16) suggests that balance-sheet effects are now less important than before. Further, there is evidence in the sense that larger firms with foreign indebtedness tend to use the forward market to hedge exchange rate risk (Kamil et al (2006)).

(c)   Reaction of market interest rates to shifts in monetary policy

The adoption of IT implied a dramatic smoothing of the overnight interbank rate (Graph 3). In principle, this enhanced the signals about the monetary policy stance and objectives. Given the financial structure of households and firms, and the development of the securities markets in Colombia, the financial system is still a particularly important component of the transmission mechanism. Hence, interest rate pass-through is a key issue. Graph 18 shows that financial market interest rates generally follow the policy rate.

Studies for Colombia have found that, although there is a long-term relationship between policy and bank interest rates, interest rate pass-through is incomplete. Using descriptive statistics, Huertas et al (2005) estimate that a 1% change in the monetary policy rate produces a change of 0.26% in the 90-day CD rate in one week and a change of 0.6% over longer horizons. Further, using VAR models they found that commercial short term lending rates react one-for-one to the deposit rate, while the short-run pass-through is just 42% for the "preferential" short term lending rate. The authors suggest that the low transmission of the monetary policy interest rate to market interest rates can be explained by the weakening of the credit channel discussed above. Betancourt et al (2006) argue that, under imperfect substitution between foreign and domestic loans and deposits, interest rate pass-through may vary depending on macroeconomic conditions (external interest rates, risk premia, expectations of depreciation and output). They find some evidence that supports this hypothesis in Colombia.

3.   Summary

The Colombian economy experienced several shocks in the past ten years. The permanent fall of inflation, the adoption of inflation targeting (IT) and a financial crisis altered the transmission mechanism of monetary policy. Low inflation and IT reduced inflation persistence and helped to anchor inflation expectations, although the full effects in this regard are still to be observed. The evidence is less conclusive with respect to the changes of the responsiveness of inflation to domestic conditions (output or marginal cost gaps). Increased competition may have encouraged a higher degree of price flexibility, but a more stable inflation environment may have raised the sensitivity of aggregate supply to inflation surprises. Exchange rate pass-through to imported good prices rose, possibly due to a higher degree of trade openness. In contrast, imported good prices pass-through to CPI fell in response to exchange rate flexibility and a low inflation environment. The short-run money-inflation relationship was broken in the presence of low inflation, exogenous shocks to the demand for money and a policy regime that stabilized short-run interest rates

The sensitivity of aggregate demand to the interest rate varied with the indebtedness of private agents and the credit channel was severed after the financial crisis. The development of the domestic public bond market is expected to have important consequences for the transmission mechanism, as the use of long term financial instruments expands in the context of a low inflation environment. The private external debt build-up of the 1990s could have raised the importance of balance-sheet effects in the relationship between the exchange rate and economic activity variables. However, the reduction of external indebtedness and the increasing use of derivatives markets by real sector corporations have probably reduced the relevance of balance-sheet effects in recent years.

Finally, the IT regime implied a stabilization of short-run interest rates, making the monetary policy stance and objectives clearer to the public. Interest rate pass-through appears to be incomplete and seems to respond to the varying importance of the credit channel and the general state of the macro economy.

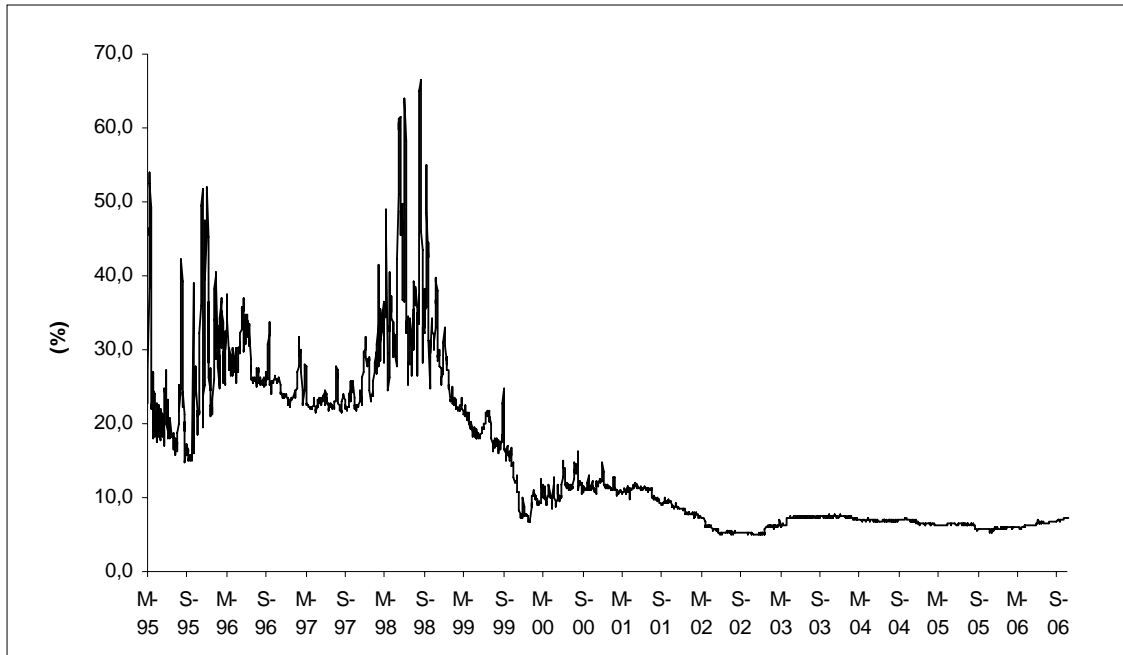Graph 1

Total CPI inflation and inflation targets
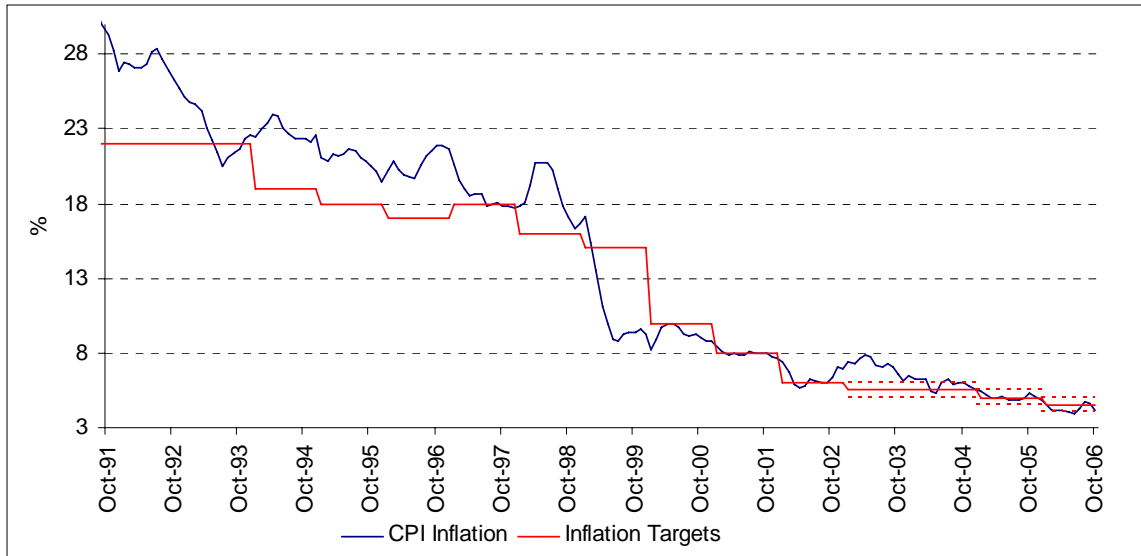
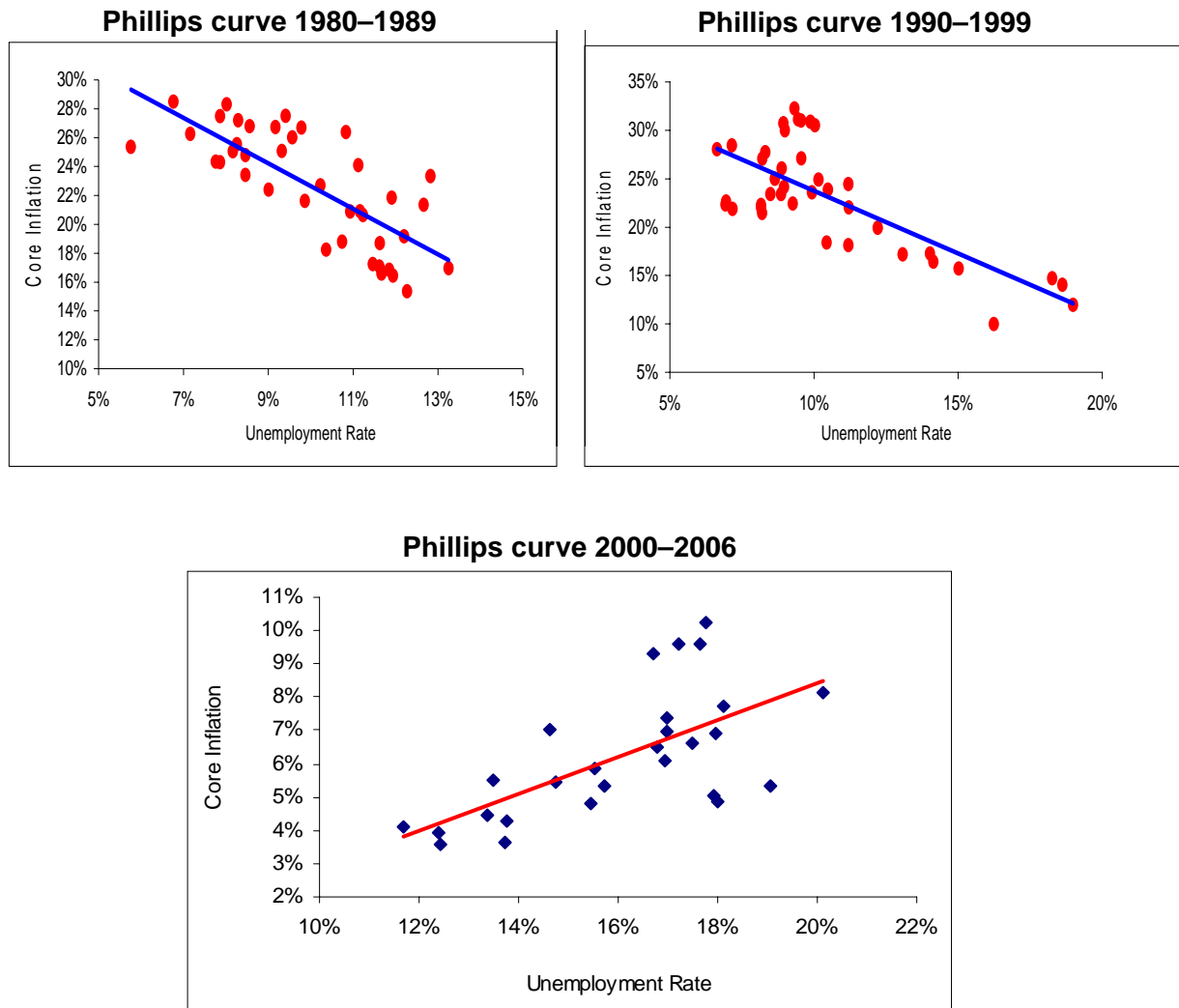Sources: DANE; Banco de la República.

Graph 2

Colombia – output gap
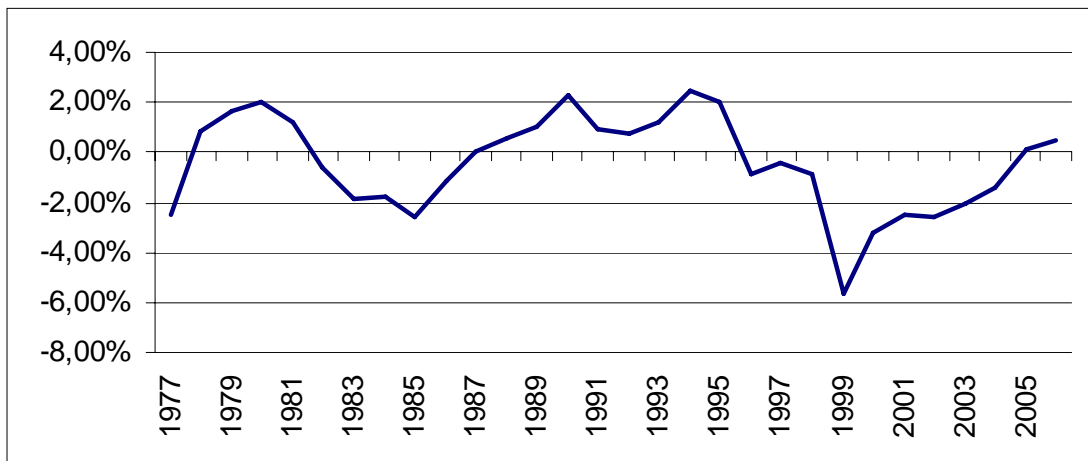
Source: Banco de la República.

Graph 3

Interbank interest rate

Source: Banco de la República.

Graph 4

Phillips curve 1980–1989

Phillips curve 1990–1999

Phillips curve 2000–2006

Sources: DANE; Banco de la República.
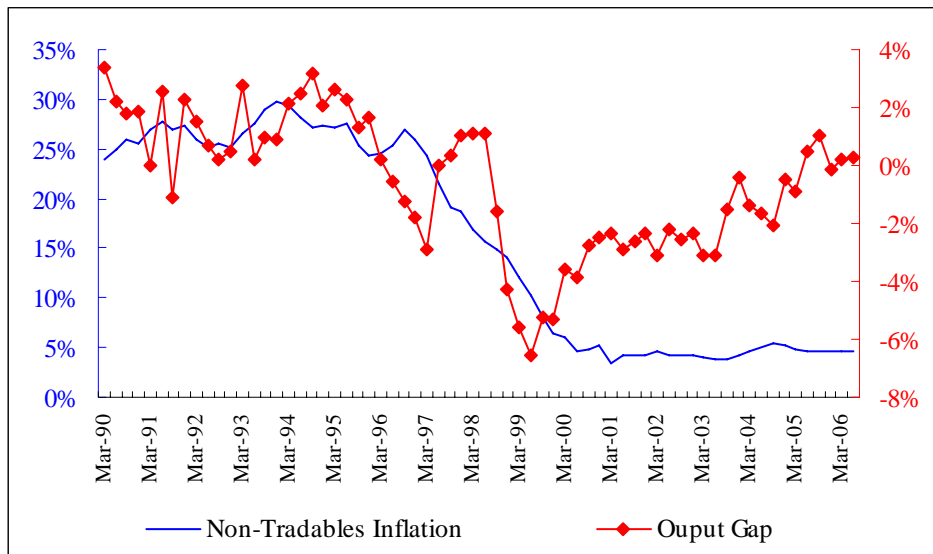
Graph 5

Source: Banco de la República.
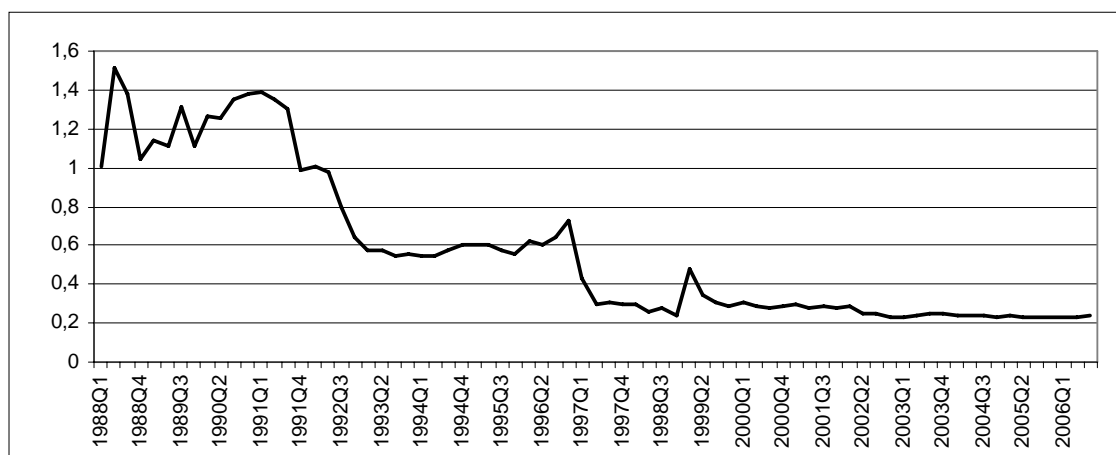
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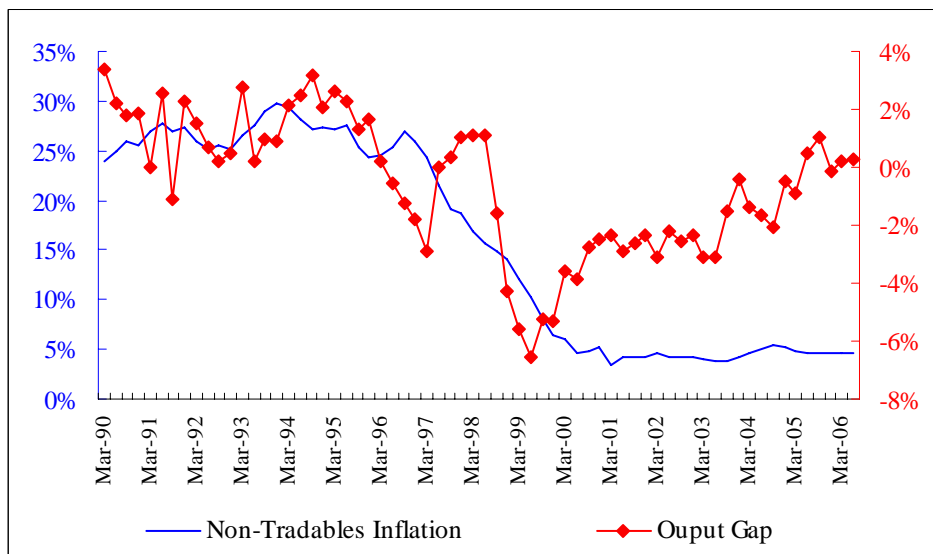
Source: Banco de la República.

Graph 7

Output gap coefficient
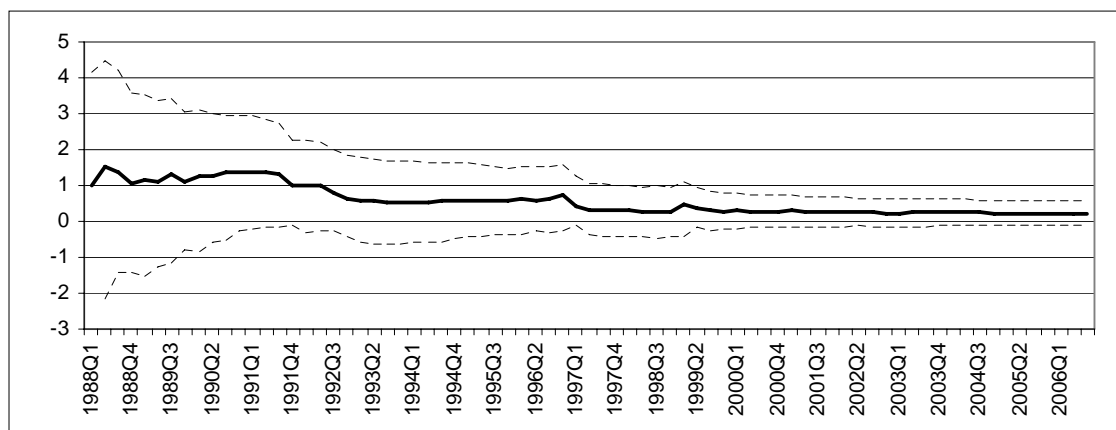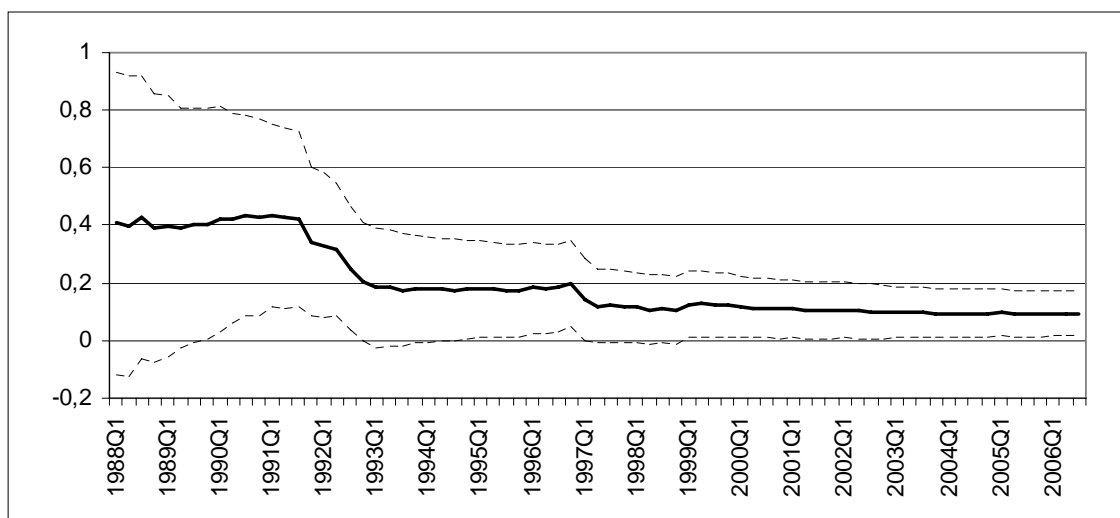

Output gap coefficient (enlargement)

Recursive OLS output gap coefficient of the equation $\pi_t = c_1\pi_{t-1} + c_2\pi_{t-2}^M + c_3\hat{y}_{t-1} + \varepsilon_t$

$\hat{y}_t$ is the output gap (Hodrick and Prescott with priors), π_t is annualized quarterly CPI inflation (excluding food items) and π_t^M is annualized quarterly PPI imported goods inflation. Sample: 1981Q1–2006Q3.

Source: Estimation by Julián Pérez, Banco de la República.

Graph 8

Imported goods prices – CPI pass-through

Recursive OLS output gap coefficient of the equation $\pi_t = c_1 \pi_{t-1} + c_2 \pi^M_{t-2} + c_3 \hat{y}_{t-1} + \varepsilon_t$

$\hat{y}_t$ is the output gap (Hodrick and Prescott with priors), π_t is annualized quarterly CPI inflation (excluding food items) and π^M_t is annualized quarterly PPI imported goods inflation. Sample: 1981Q1–2006Q3.
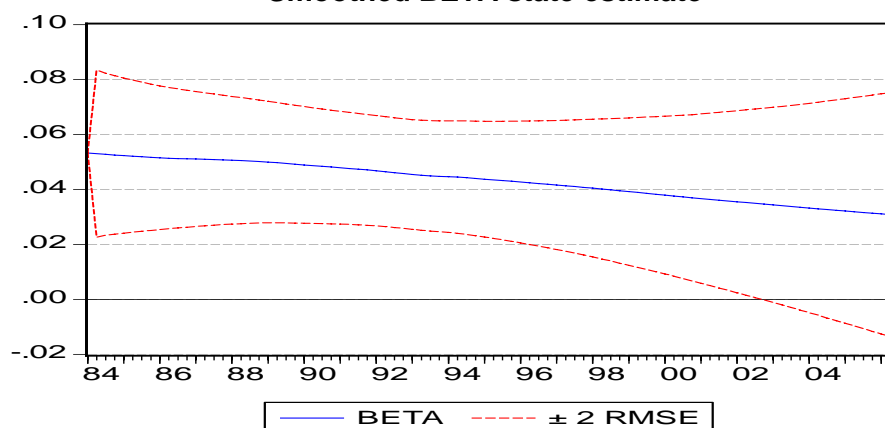
Source: Estimation by Julián Pérez, Banco de la República.

Graph 9

Smoothed ALFA state estimate

ALFA	-----	± 2 RMSE
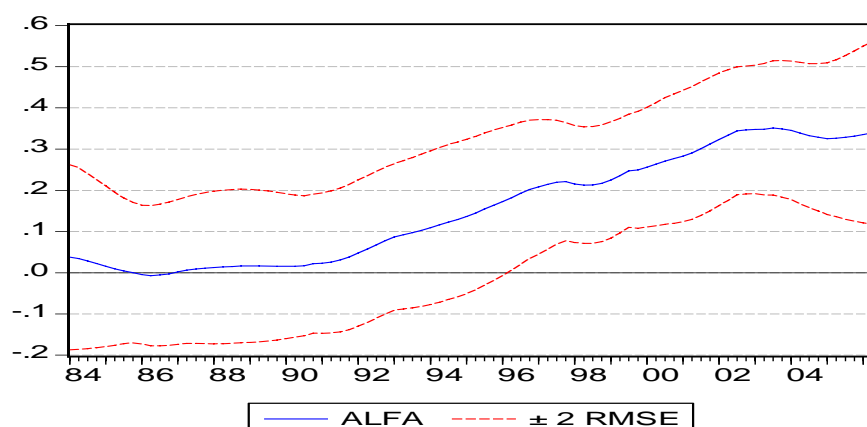
Smoothed BETA state estimate

BETA	-----	± 2 RMSE

Kalman filter estimation of:

$$\pi_t^M = (1 - \alpha_t)\pi_{t-|}^M + \alpha_t(\Delta S_{t-1} + \pi_{t-1}^*) + c_3\hat{y}_{t-1} + \varepsilon_t^M \tag{1}$$

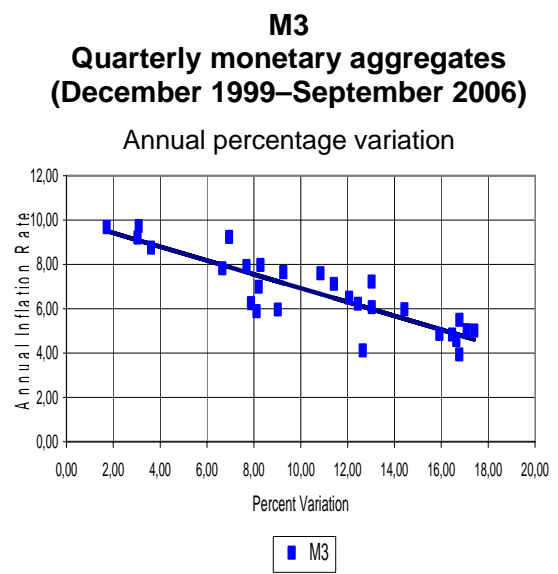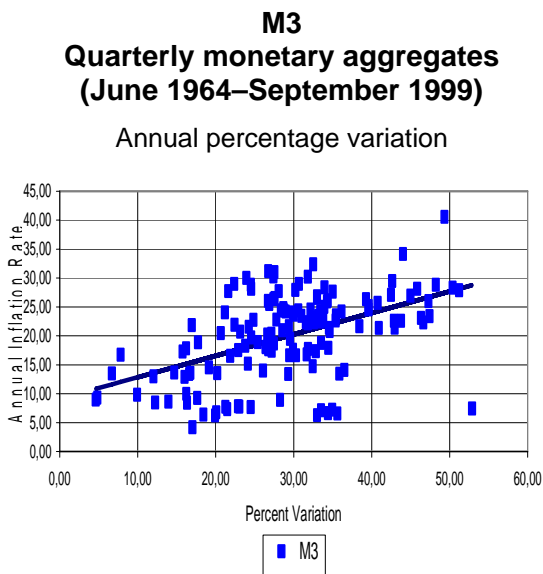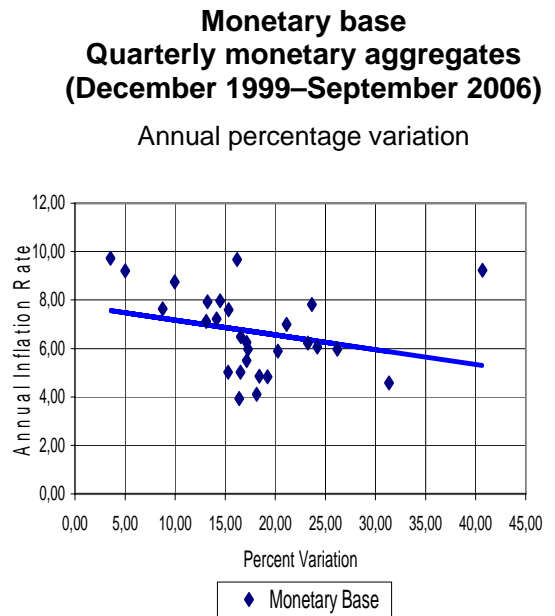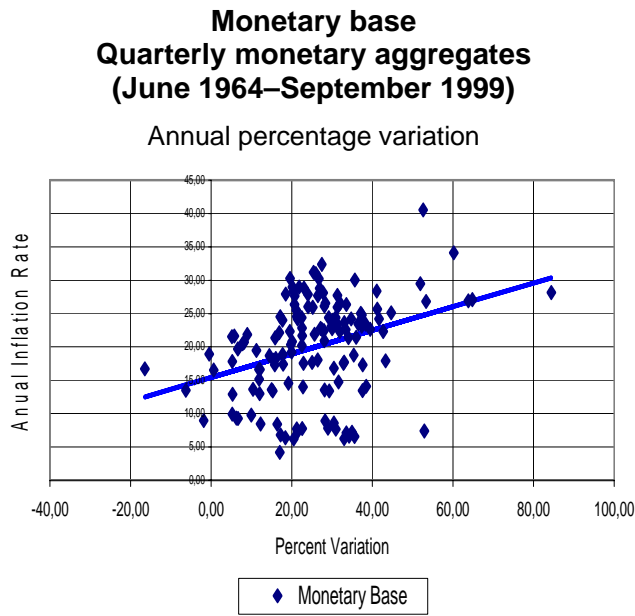$$\pi_t^B = (1 - \beta_t)\pi_{t-1}^B + \beta_t\pi_{t-2}^M + c_3\hat{y}_{t-1} + \varepsilon_t^B \tag{2}$$

$$\alpha_t = \alpha_{t-1} + \delta + \varepsilon_t^\alpha \tag{3}$$

$$\beta_t = \beta_{t-1} + \delta + \varepsilon_t^\beta \tag{4}$$

Where: π_t^M is annualized quarterly PPI imported goods inflation, π_t^* is annualized quarterly CPI US inflation, ΔS_t is the annualized quarterly depreciation rate of the Colombian peso against the US dollar, α_t is the *pass-through* from depreciation to imported goods prices, π_t^B is annualized quarterly CPI inflation (excluding food items and some services) and β_t is the *pass-through* from imported goods prices to CPI core inflation, and $\hat{y}_t$ is the output gap (Hodrick and Prescott with priors).

Source: Estimation by Julián Pérez, Banco de la República.

Graph 10

**Monetary base
Quarterly monetary aggregates
(June 1964–September 1999)**

Annual percentage variation

**Monetary base
Quarterly monetary aggregates
(December 1999–September 2006)**

Annual percentage variation

**M3
Quarterly monetary aggregates
(June 1964–September 1999)**

Annual percentage variation

**M3
Quarterly monetary aggregates
(December 1999–September 2006)**

Annual percentage variation
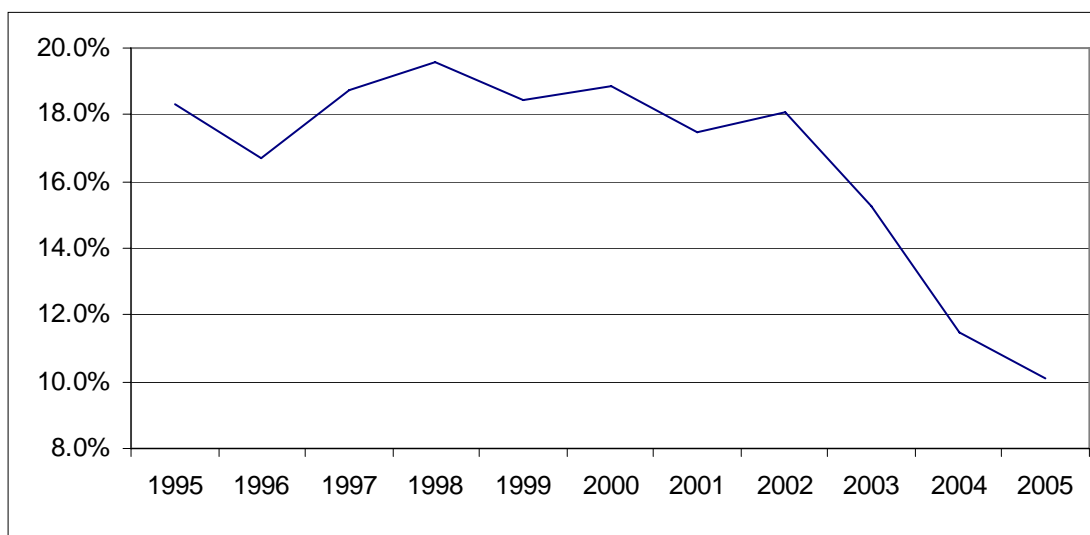

Source: Banco de la República.

Graph 11

Household financial debt/consumption
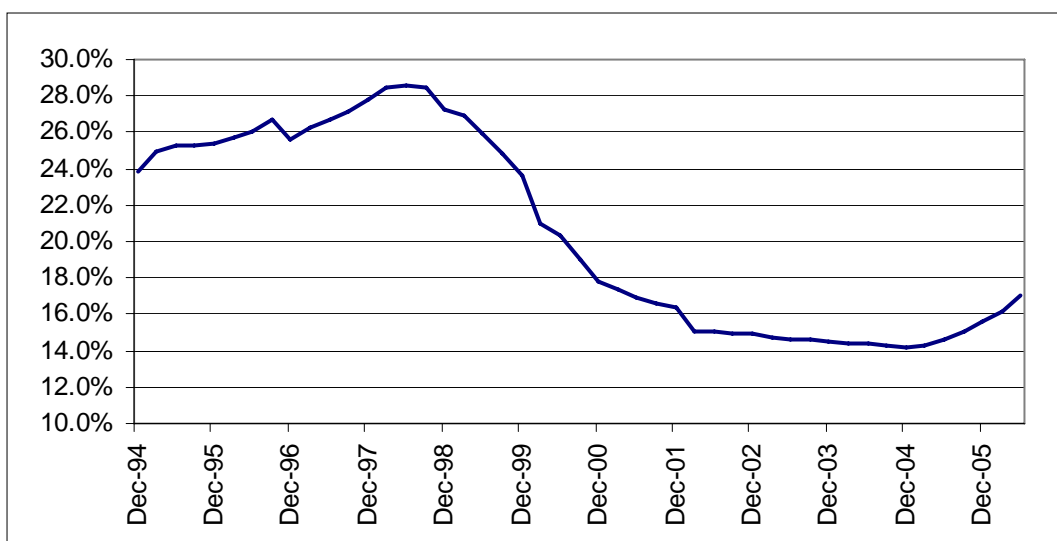
(Consumer loans + mortgage loans)/consumption

Source: Calculations of Banco de la República based on data from DANE and Superfinanciera.
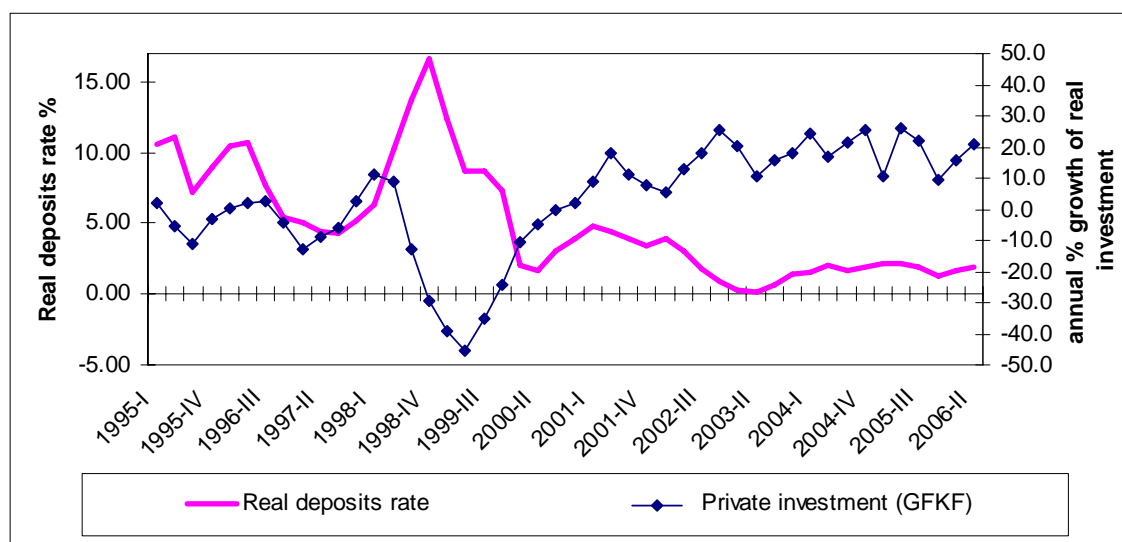

Graph 12

Firms

Debt/Assets

Source: Calculations of Banco de la República based on data from DANE and Superfinanciera.

Graph 13

Real private consumption and real deposit interest rate

%
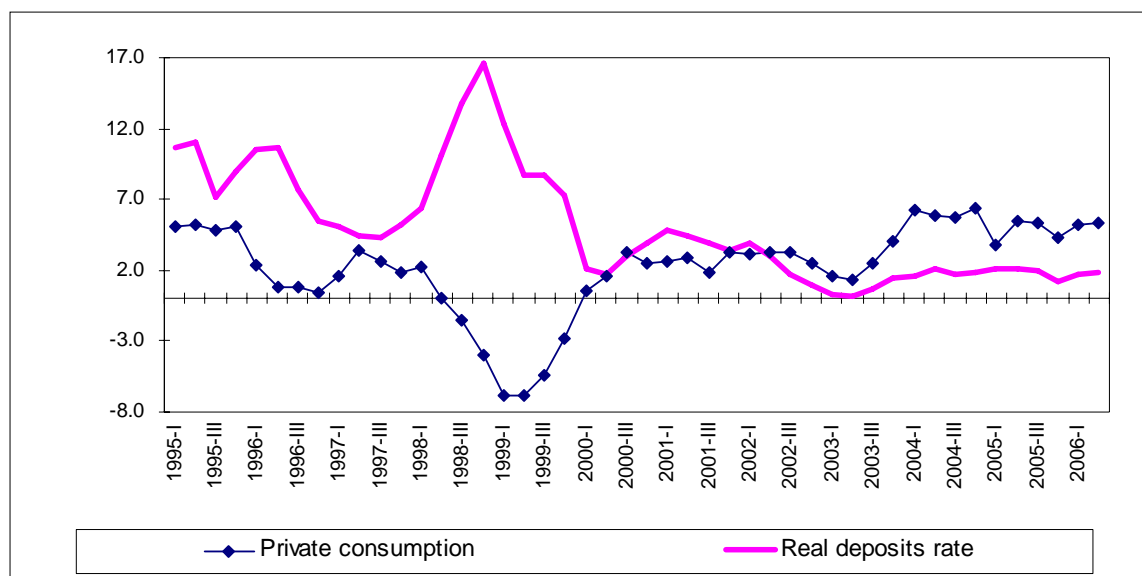
Sources: DANE; Banco de la República.

Graph 14

Real private investment and real deposit interest rate

Sources: DANE; Banco de la República.

Graph 15

Interest rate coefficient in an "IS curve"
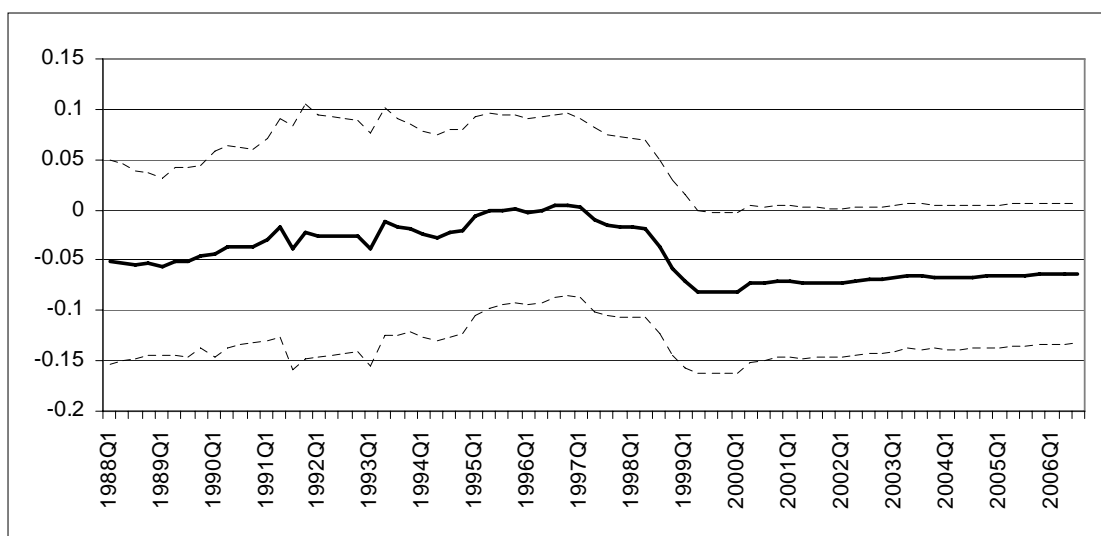
Coefficient of the real interest rate deviations from trend in: $\hat{y}_t = c_1\hat{y}_{t-1} + c_2\hat{r}_{t-1} + c_3\hat{z}_{t-1} + \varepsilon_t$

Where $\hat{y}_t$ is the output gap (Hodrick-Prescott with priors), $\hat{r}_t$ is the 90 day real interest rate gap (HP) and $\hat{z}_t$ is the bilateral (US) real exchange rate gap (HP).

Source: Estimation by Julián Pérez, Banco de la República.

Graph 16

Private external debt

US$ millions
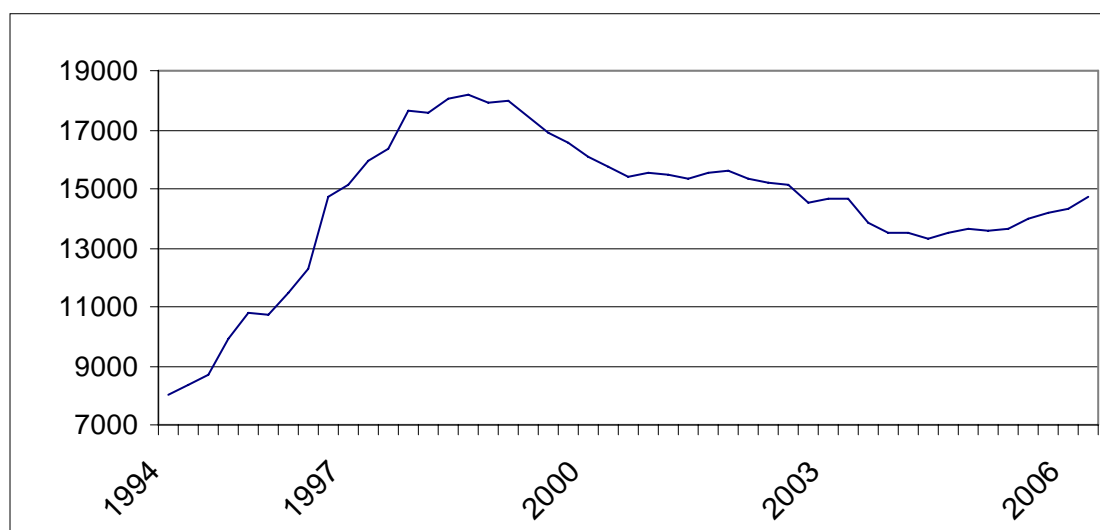
Source: Banco de la República.

Graph 17

Exchange rate coefficient in an "IS curve"
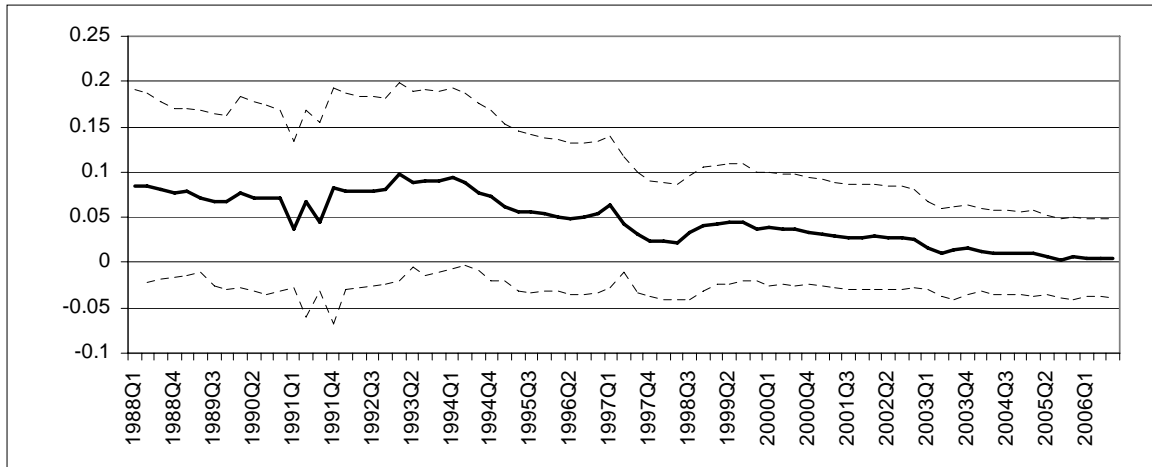
Coefficient of the real exchange rate deviations from trend in: $\hat{y}_t = c_1\hat{y}_{t-1} + c_2\hat{r}_{t-1} + c_3\hat{z}_{t-1} + \varepsilon_t$

Where $\hat{y}_t$ is the output gap (Hodrick-Prescott with priors), $\hat{r}_t$ is the 90 day real interest rate gap (HP) and $\hat{z}_t$ is the bilateral (US) real exchange rate gap (HP).

Source: Estimation by Julián Pérez, Banco de la República.

Graph 18

Nominal interest rates in Colombia
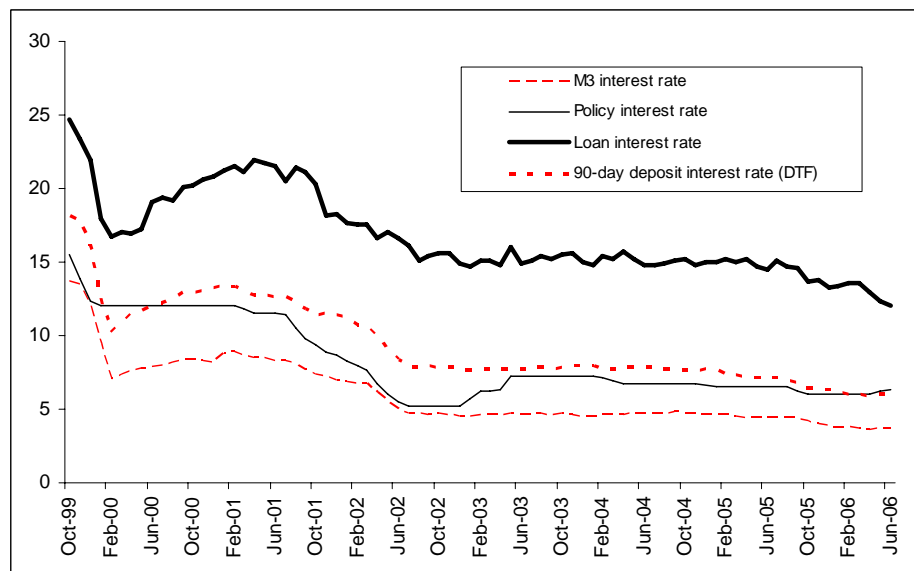
Source: Banco de la República.

Table 1

Inflation and inflation expectations 1999

|	Observed annual inflation	Inflation expectations for December 1999
December 1998	16.7%	15.9%
March 1999	13.5%	13.5%
June 1999	8.9%	12.2%
September 1999	9.3%	9.9%
December 1999	9.2%	

Memo item: Inflation target for 1999: 15%.

Sources: DANE; Banco de la República. Inflation expectations are obtained from surveys presented in the Inflation Reports.

Table 2

Inflation expectations and credibility of inflation targets in Colombia

Year	Observed (1)	Expectation (2)	Target (2)	Error (1)–(3)	Surprise (1)–(2)	Anchoring (2)–(3)	Credibility
1997	17.68	18.45	18.0	–0.3	–0.8	0.4	
1998	16.70	17.95	16.0	0.7	–1.2	2.0	
1999	9.23	15.789	15.0	–5.8	–6.6	0-8	
2000	8.75	9.89	10.0	–1.3	–1.1	–0.1	33.0
2001	7.64	8.85	8.0	–0.4	–1.2	0.8	46.9
2002	6.99	6.95	6.0	1.0	0.0	1.0	35.0
2003	6.49	6.58	5.5	1.0	–0.1	1.1	42.0
2004	5.50	6.13	5.5	0.0	–0.6	0.6	69.1
2005	4.85	5.41	5.0	–0.2	–0.6	0.4	77.8
2006	4.19	4.6	4.5	–0.3	–0.4	0.1	90.1

Expectation: refers to the expected value of the end of year inflation measured at the beginning of the year. Credibility: refers to the percentage of people who believed (at the beginning of the year) that the target would be met for that year. Inflation expectations for the year 1997 correspond to the June Survey.

Observed inflation for 2006 corresponds to annual yoy inflation until October 2006.

Source: González and Hamann (2006).

Table 3

Inflation persistence: sum of autoregressive coefficients

Study	Specifica-tion	Price index	Samples	Persistence before	Persistence after
Capistrán/Ramos-Francia (2006a)	Monthly AR (12) or modified AIC	CPI headline	Before (2 samples): 1980.01–1989.12 1990.01–1999.12 After: 2000.01–2006.06	0.58, 0.58[1]	0.67
Bergljot et al (2006)	Quarterly AR (5)	GDP deflator	Before: 1986Q1–1999Q2 After: 1999Q3–2006Q2	1.03	0.803
García-Saltos (2006)	Quarterly AR (5)	GDP deflator	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.83	0.42[2]
García-Saltos (2006)	Quarterly AR (5)	CPI headline	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.96	0.93
García-Saltos (2006)	Quarterly AR (5)	CPI non tradable	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.96	0.37
García-Saltos (2006)	Quarterly AR (5)	CPI tradable	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.92	0.97
García-Saltos (2006)	Quarterly AR (5)	CPI food	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.55	0.28[3]
García-Saltos (2006)	Quarterly AR (5)	CPI regulated	Before: 1985Q3–1999Q2 After: 1999Q3–2006Q1	0.70	0.88

[1] These coefficients refer to the estimation that controls for time-varying means of inflation.   [2] Standard error of 0.51.   [3] Standard error of 0.5.

Table 4

Inflation persistence: HNKPC estimates

Study	Price index	γ_b Before 1999	γ_b Complete sample	γ_f Before 1999	γ_f Complete sample
Bergljot et al (2006)[1]	GDP Deflator	0.05–0.42	–0.01–0.04	0.53–0.8	0.91–1
García-Saltos (2006)[2]	GDP Deflator	0.047–0.074	–0.01– –0.007	0.801–0.926	0.9–1.01
García-Saltos (2006)[2]	CPI Headline	0.31–0.344	0.29–0.297	0.57–0.656	0.688–0.703

Numbers reported correspond to minimum and maximum values of the estimated coefficients under different econometric specifications and estimation methods.

[1] Samples: 1987Q1–1999Q2 and 1987Q1–2005Q4.   [2] Samples: 1986Q2–1999Q2 and 1986Q2–2006Q1.

Table 5

Inflation response to marginal costs gap: HNKPC estimates

Study	Price index	λ Before 1999	λ Complete sample
Bergljot et al (2006)[1]	GDP deflator	0.06–0.1[4]	0.12–0.14
García-Saltos (2006)[2]	GDP deflator	0.101–0.19	0.13–0.136
García-Saltos (2006)[2]	CPI headline	0.01–0.021[3]	0.042–0.044

Numbers reported correspond to minimum and maximum values of the estimated coefficients under different econometric specifications and estimation methods.

[1] Samples:1987Q1–1999Q2 and 1987Q1–2005Q4. [2] Samples:1986Q2–1999Q2 and 1986Q2–2006Q1. [3] Standard errors of 0.03. [4] The 0.1 estimate has a standard error of 0.14.

Table 6

Ratio of relative price change volatility to inflation volatility

	1982–1988	1989–1998	2000–today
Variance of SA quarterly headline CPI inflation	**3.15**	**1.31**	**0.22**
Food (subset)	0.64	2.53	3.55
Rents	0.91	1.22	2.67
Housing – tradable	1.79	1.51	5.26
Housing – non tradable	0.96	0.78	1.79
Clothing – tradable	0.85	0.92	0.88
Clothing – non tradable	1.06	1.12	9.92
Health – tradable	2.66	4.24	2.85
Health – non tradable	2.18	0.88	1.87
Education – tradable	1.83	5.57	1.90
Education – non tradable	2.22	4.19	1.81
Culture and recreation – tradable	3.07	1.40	6.91
Culture and recreation – non tradable	30.12	9.91	18.48
Transportation – tradable	7.37	4.66	15.16
Other expenses – tradable	1.84	1.53	3.67
Other expenses – non tradable	1.31	1.72	5.95

Ratios = variance of quarterly SA price changes/variance of quarterly SA CPI headline inflation. Each sector includes only the items present in the CPI baskets of all periods. Sectors with heavily regulated prices are excluded.

Source: Calculations by the Research Department, Banco de la República.

Table 7

Sources of funding of corporations

	2000	2001	2002	2003	2004	2005
A. Debt	63.0%	63.9%	63.2%	56.3%	51.6%	47.3%
Financial system	41.8%	43.0%	41.0%	33.8%	29.7%	24.9%
Suppliers	17.6%	17.2%	17.3%	16.6%	16.3%	16.2%
Bonds	3.6%	3.7%	4.9%	6.0%	5.6%	6.2%
B. Own resources	37.0%	36.1%	36.8%	43.7%	48.4%	52.7%
Capital	23.4%	22.6%	22.3%	27.4%	26.9%	25.5%
Reserves	14.3%	14.6%	13.8%	14.2%	14.8%	15.6%
Current profits	4.4%	4.1%	5.3%	7.0%	9.3%	11.8%
Previous periods profits	–5.1%	–5.2%	–4.7%	–5.0%	–2.6%	–0.2%
Total A + B	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Superintendencia de Sociedades y Superintendencia Financiera.

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