"Monetary Rules for Peru"

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MONETARY RULES FOR PERU*

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Abstract

Properties of explicit monetary rules for Peru that specify monthly adjustments in the monetary base are examined, by conducting counterfactual historical simulations with VAR models over 1994-1999. Two alternative rules are considered for the analysis: one with nominal GDP growth as target variable and the other with inflation. The simulation results indicate that the rule with inflation as target fits better its target path, especially when it is defined as core inflation, and shows lower variability of the instrument variable. A forward-looking scheme is also tested in an implicit version of the rule with inflation as target, following the Svensson's approach (1998). We find that explicit rules provide better fit to the target than the implicit ones. Finally, counterfactual historical analysis of the type utilized by Stuart (1996) is conducted to evaluate monetary policy in Peru. For this purpose, actual settings of monetary base during the period of analysis are contrasted with the values that would have been specified by the rule with inflation target in response to prevailing conditions. According to this comparison, monetary policy in Peru was too loose over the period January 1994 - June 1995 and was too tight between June 1998 and August 1999.

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1.- Introduction

The election between a systematic conduction and a discretionary administration of the monetary policy has been one of the most controversial issues of discussion in academic and political circles in the last years. Nevertheless, it is not a recent topic of debate[1].

The classic rules versus discretion debate was usually carried out considering a narrow definition of a "policy rule", which used to assume it as a fixed setting of the instruments or as a mechanical procedure. However, the contributions of McCallum (1987, 1988) and Taylor (1993) in the development of the theory of monetary rules broadened this conception. A "policy rule" began to be understood as a systematic (methodical, according to a plan, and not casual or random[2]) contingency plan that lasts forever unless there is an explicit cancellation clause.

Three major theoretical contributions - Kydland and Prescott (1977), Barro and Gordon (1983), and Blanchard and Fisher (1989) - outlined the advantages of the rules over discretionary behavior[3]. In these studies, discretionary policy was referred to as the "inconsistent", the "cheating" and the "shortsighted" solution respectively. This literature also suggests that the superiority of rules over discretion is analogous to the advantage of a cooperative solution over a non - cooperative output in game theory.

There are powerful advantages attributed to the rules in the literature. According to them, central bank policy would become clear, regular and consistent if a rule were applied. Besides, it is stated that the use of rules can give quantitative guidance, when authorities are aware of the need to tighten or ease the policy but do not have the certainty and knowledge about the intensity required. In addition, it is considered that rules could discipline central bank behavior, especially when it is facing political pressures.

To this extent, why if the superiority of the rules is so evident, policymakers have privileged a discretionary handling? Two reasons are argued. The first one considers the rigidity of the agents' expectations in one single period. From this perspective, discretion will always be superior, even when the convenience of a systematic administration has already been demonstrated for long spans of time. The

[1] Thornton (1802), Bagehot (1873), Wicksell (1907), Fisher (1920,1926), Simon (1935) and Friedman (1948, 1960) made the most important contributions.
[2] Definition of the term "systematic" has been taken from the Oxford American Dictionary.

other reason is that monetary rules simplify too much the reality. In practice, central banks use more than a rule to design its monetary policy. This is probably why in recent study carried out by Mc Callum (2000) the importance of the use of rules as instruments for the design and evaluation of the monetary policy is emphasized.

This investigation aims at evaluating the properties of explicit monetary rules for Peru that specify monthly adjustments in the monetary base, by using counterfactual historical simulations with VAR models over 1994 - 1999. Two alternative rules are considered for the analysis: one with nominal GDP growth as target variable and the other with inflation. Forward looking scheme is also tested in an implicit version of monetary base rules with inflation as target, given the importance of Inflation Targeting in the central banks' behavior during recent years. Finally, the stance of the monetary policy is evaluated for the period of analysis with the monetary rules that fits better its targets during the simulations.

The outline of the paper is as follows. In Section 2, we develop a general framework that contains a quick review of some specific theoretical issues about the monetary policy rules. Then, in Section 2 we also follow and extend the Estrella and Mishkin (1997) framework to design optimal monetary rules for two alternative policy targets: nominal GDP growth and inflation. Afterwards, in Section 3 we explain the methodology of counterfactual historical simulations that are used to evaluate the properties of monetary rules. Simulation results are reported in Sections IV. The evaluation of monetary policy in Peru is developed in Section V and, finally, conclusions are presented in Section VI.

2. General Framework

In this section, we develop briefly the definition of rules, the different types of monetary rules according to Svensson (1998) and the main issues that should be considered in designing instrument monetary rules. Then, Estrella and Mishkin (1997) framework is used to specify the monetary policy rules for the Section IV evaluation.

2.1. Monetary policy rules

A monetary policy rule is a systematic contingency plan for monetary policy that lasts forever unless there is an explicit cancellation clause**.** According to Lars Svensson

[3] We use the McCallum definition (1997) for discretion: "discretion implies a period by period reoptimization on the part of the monetary authority".

(1998), monetary rules can be classified in two groups: instrument rules and targeting rules. The most popular monetary rules are instrument rules. This probably explains the fact that the most common definition of rules is associated with this group of rules. An instrument rule defines the policy instrument as a prescribed function of predetermined or forward - looking variables, or both. On the other hand, targeting rules define the policy instrument by minimizing a social loss function that increases in the deviation between the target level of the objective variable and its current level. The monetary rules that are evaluated in this paper belong to the first group mentioned.

The instrument rules can also be subdivided according to the kind of information used in its specification. In this sense, an explicit instrument rule refers to a situation where the instrument is a prescribed function of predetermined variables only. In the same way, an implicit instrument rule refers to a case where the instrument is a prescribed function of forward - looking variables. This last version of the instrument rules included in this paper is closer to actual operating procedures of inflation - targeting central banks. We do this, in response to the growing importance of the inflation-targeting scheme in the development of monetary policy and because we consider it could eventually be adopted in the future by the Central Reserve Bank of Peru.

2.2. The design of instrument monetary rules

The design of a monetary policy requires a clear definition of the target variable to be pursued and of the instrument variable. A monetary rule combines those elements taking the form of a reaction function that should also include a term that reflects possible changes in the agent's preferences and / or in the payment system.

2.2.1. Choice of Target Variable

The election of the target variable is one of the main issues of discussion in the design of a rule. Equally important is to define whether the path of this variable should be specified in a growth - rate or in a level form. In recent years, the most common target variable chosen by the monetary authority has been the inflation rate[4]. Nevertheless, McCallum approach mainly takes an aggregate spending magnitude as

[4] In other words, a comprehensive price - level variable with its target path set in growth - rate terms. As we discuss in previous works, it is possible to target a price level variable with a path set in growth - level terms. However, we prefer to treat the target variable with the former specification. A broad discussion can be found in McCallum (1997).

target variable. Additionally, in the literature it is suggested the use of an “hybrid” variable that consists of a weighted sum of the difference between inflation rate and its target and the output gap[5].

According to McCallum, a straightforward approach to choose among the three alternatives would be to select the target variable that corresponds most closely to the central bank’s views about social objectives that are influenced by the monetary policy. However, it is always necessary to consider the feasibility of the adoption of each type of target. From this point of view, the election of a hybrid variable[6] would appear to be a better approach to the central bank’s view[7] but it would not be operationally feasible. The absence of a professional consensus regarding the most appropriate measure of the output gap and the difficulties associated with the delays of the data releases are the two main problems related to this alternative[8]. Thus the hybrid variable target is more demanding of knowledge concerning the economy than either of the contenders variables in discussion; and unfortunately this great knowledge is not yet available.

On the other hand, the tendency for actual central banks to choose an inflation target is widely justified. First, it is argued that a central bank should concentrate its efforts in attaining a target variable (e.g. inflation) that is strongly affected by its policy actions on a long run basis. In this sense, an output target does not satisfy this restriction since the monetary policy is neutral in the long run. Second, it is mentioned that the communication to the public may be much easier when only the inflation variable is involved, because typical citizens have a better understanding of the concept of inflation but not of the national income accounting concepts.

Although the convenience of the use of an inflation target is evident, the impossibility of choosing a nominal GDP target has not yet been proved. McCallum rule (1993) works principally with a total nominal spending target (e.g. nominal GDP) arguing that its use may not cause a deterioration of the long-term inflation rate. Besides, his work remarks the convenience of this alternative, especially when the inflation rate is not the only policy target of the authorities.

McCallum also states a couple of reasons to support his election of a total nominal-spending target. The first argument essayed is that, apparently, the prices of

[5] It is important to remark that all of these choices presume that the economy where the rule is going to be applied does not have its monetary policy with an exchange rate target commitment.

[6] It is defined as $h_t = \alpha(\pi^* - \pi_t) + (1-\alpha)(q^* - q_t)$

[7] Blinder (1996) provides a detailed analysis about this theme.

[8] See Orphanides (1997, 1999)

goods and services react slower to the changes in the monetary policy than the production indicators do. Therefore, the use of an inflation target could expose the rule to "instrument instability", diminishing its effectiveness. The second relies on the fact that the stabilization properties of the nominal GDP proved to be better than those showed by the inflation rate. In this paper, we focus on two alternative policy rules: one with nominal GDP growth as target variable and the other with inflation.

2.2.2 Choice of instrument variable

Another important issue in the design of a monetary rule is the choice of the instrument variable through which a central bank's policy rule will be implemented. Svensson (1996) describes an ideal instrument (intermediate target) as a variable that "is highly correlated with the goal, easier to control than the goal, easier to observe by both the central bank and the public than the goal, and transparent so that central bank communication with the public and the public understanding and public prediction of monetary policy are facilitated (pp. 14-15)".

It is well - known that almost all actual central banks prefer to use some short - term interest rate as policy instrument, despite the important number of economists that favored the use of a monetary base or a reserve aggregate instrument. Many explanations of this issue have been essayed. The most relevant hypothesis is that the financial communities reject high variability of the interest rates. Therefore, the central banks often give up upon these pressures and decide to control some interest rate in order to preserve the financial system stability (financial perspective). However, the superiority of the monetary base from a macroeconomic perspective is clear. In this sense, it is worth to remark that the election of the policy instrument should be taken considering both perspectives. In this paper we avoid discussing the convenience of choosing an interest rate or a monetary aggregate[9] since we focus our investigation on the analysis of the properties of monetary base rules.

The election of this policy instrument is supported by the fact that the use this instrument is more effective from a macroeconomic perspective than others such as those that include the interest rate. Mainly, this suggested superiority stems on the ambiguity that surrounds the use of the nominal interest rate as an indicator of the stance of the monetary policy. For example, high interest rates associated with a

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[9] See Patinkin (1961), Sargent and Wallace (1975), Parkin (1961), McCallum (1984, 1986 p. 148) and Goodhart (1994) for a more detailed discussion of this topic.

monetary policy tightening in the short term can reflect also a loosening of this policy from a medium and long-term perspective.

The main problem here is that one indicator can reflect two opposite postures of the monetary policy at the same time. Additionally, it is noteworthy that the appearance of the monetary base in the Central Bank balance sheet (the monetary base is equal to the sum of components) allows a more effective control of the authority since the monitoring and adjusting process can be executed with a higher frequency.

2.2.3 Specification of monetary rules

In this section, we use a model similar to that developed by Estrella and Mishkin (1997) to specify a functional relationship between the monetary base (instrument variable) and the two alternative policy targets that we are interested in: nominal GDP growth and inflation.

2.2.3.1 Specification of a monetary rule with nominal GDP growth as target

As Estrella and Mishkin, the model is based on four assumptions. First, we use the identity associated with the quantity theory of money. Second, we assume that the growth of monetary base can be determined independently of current-period information. Third, since the velocity in the current period is unknown, we consider an univariate ARIMA model as an optimal prediction. Fourth, we assume that the monetary policy objective is to minimize the mean squared deviations of nominal GDP growth from a pre-specified target path. This last assumption is different in the model developed by Estrella and Mishkin because they assume that the policy objective is nominal GDP instead of nominal GDP growth as we do.

The quantity theory, in log difference form, may be expressed as follows:

$$\Delta x_t = \Delta b_t + \Delta v_t \qquad (1)$$

where *x* is the log of nominal GDP, *b* is the log of monetary base and *v* is the log of monetary base velocity. Likewise, the growth of velocity, as we assumed in the third assumption, has an ARIMA specification that it can be written in the form:

$$\Delta \mathrm{v}_t = \mathrm{a(L)}\Delta \mathrm{v}_{t-1} + \mathrm{u}_t + \mathrm{b(L)u}_{t-1} \qquad (2)$$

where u is a white noise. The objective function is to minimize the mean squared deviation of nominal GDP growth (Δx_t) from its target path (Δx_t^*) conditional on the information available at time t.

To simplify the derivation of the optimal policy rule, we can write the growth of velocity as :

$$\Delta v_t = E_{t-1}\Delta v_t + u_t \tag{3}$$

where E_t represents the expectation based on information available al time t. Finally, it is necessary to define the optimization problem of monetary policy to obtain the optimal monetary policy rule : minimize the variance of the difference among nominal GDP growth (Δx_t) and its target path (Δx_t^*) conditional on the information available at time t.

$$\text{MIN} \quad V_{t-1}(\Delta x_t^* - \Delta x_t) \tag{4}$$

To solve this problem, first, using equation (1) and (3), we need to specify that:

$$\Delta x_t^* - \Delta x_t = \Delta x_t^* - \Delta b_t - E_{t-1}\Delta v_t - u_t \tag{5}$$

If we define $j_t = \Delta x_t^* - \Delta b_t - E_{t-1}\Delta v_t$ (6) and consider that u_t is orthogonal to all the other terms in the right side of equation (5), we can rewrite (4) as:

$$\text{MIN} \quad V_{t-1} j_t + V_{t-1} u_t \tag{7}$$

Thus, the conditional variance is minimized by setting j_t=0, that is, by applying a growth of monetary base of the form:

$$\Delta b_t^* = \Delta x_t^* - E_{t-1}\Delta v_t \tag{8}$$

The ARIMA representations, equation 2, for Δv_t, implies that

$$E_{t-1}\Delta v_t = a(L)\Delta v_{t-1} + b(L)u_{t-1} \tag{9}$$

Substituting equation (9) into equation (8), and noting from equations (6) and (5) that j_t=0 implies that $u_t = -(\Delta x_t^* - \Delta x_t)$, we arrive to the optimal monetary policy rule:

$$\Delta b_t^* = \Delta x_t^* - a(L)\Delta v_{t-1} + b(L)(\Delta x_t^* - \Delta x_t) \tag{10}$$

Finally, to simplify the optimal monetary rule with nominal GDP growth as target, two additional assumptions are needed: the autoregressive part consists of a simple average of *k* lagged Δv_t; and b(L) = λ>0. Then the optimal rule (10) becomes:

$$\Delta b_t^* = \Delta x_t^* - (1/k)(v_{t-1} - v_{t-1-k}) + l(\Delta x_{t-1}^* - \Delta x_{t-1}) \tag{11}$$

Using the definition of velocity, we can also write equation 11 as :

$$\Delta b_t^* = \Delta x_t^* - (1/k)(x_{t-1} - b_{t-1} - x_{t-1-k} + b_{t-1-k}) + l(\Delta x_{t-1}^* - \Delta x_{t-1}) \tag{12}$$

In this study, we use this last specification as monetary rule with nominal GDP growth as target. The first term (Δx_t*) represents the nominal GDP target growth rate. The second term of the right side of the equation is an estimate of the velocity growth for the period t. It is specified as an average growth of monetary base velocity during the last k periods. Here, it is noteworthy that McCallum rule is a particular case of (12) where k=16 quarters. According to this author, this term is designed to reflect long-lasting institutional changes in the monetary base demand that are explained by technological developments or regulatory changes. The third term reflects cyclical conditions of the economy and includes the parameter λ, which is a non-negative policy feedback parameter. This value provides a significant response of the monetary base growth to past target misses. A negative third term would reflect the necessity of an adjustment in the monetary policy and could be associated with an economy overheating. In the opposite case, a positive third term would indicate the need of accelerating the monetary base growth.

2.2.3.2 Specification of a monetary rule with inflation as target

We used a model similar to that in 2.2.3.1 to specify the monetary rule with inflation as target. The first two assumptions of the previous section remain. The third assumption is that the real GDP growth (Δq_t) is exogenous. The fourth is that velocity in the current period is unknown, but the optimal prediction of it can be made by Δv_t.= $\Delta q_t+(\Delta p_t-\Delta b^d_t)$, where the first term is given by the third assumption and the last one(the growth of the rate price level/monetary base demand) can be predicted by an univariate ARIMA model. The fifth is that the monetary policy objective is to minimize the mean squared deviations of inflation from a pre-specified target path. It is remarkable that these last three assumptions are not included in the model developed by Estrella and Mishkin, since they assume that the policy target variable is nominal GDP.

The quantity theory, in log difference form, may be expressed as :

$$\Delta p_t + \Delta q_t = \Delta b_t + \Delta v_t \qquad (1)$$

where p is the log of price level, q is the log of real GDP, b is the log of monetary base and v is the log of monetary base velocity. Likewise, the growth of rate price level/monetary base demand, as we mentioned in the fourth assumption, has an ARIMA specification that can be written as follows:

$$\Delta z_t = a(L)\Delta z_{t-1} + u_t + b(L)u_{t-1} \qquad (2)$$

where u is a white noise and $z=p-b^d$. The objective function is to minimize the mean squared deviation of inflation (Δp_t) from its target path (Δp_t^*) conditional on the information available at time t.

To simplify the derivation of the optimal policy rule, we can write the growth of the price level/monetary base demand ratio as:

$$\Delta z_t = E_{t-1}\Delta z_t + u_t \qquad (3)$$

where E_t represents the expectation based on information available at time t. Finally, it is necessary to define the optimization problem of monetary policy to obtain the optimal monetary policy rule: minimize the variance of the difference among inflation (Δp_t) and its target path (Δp_t^*) conditional on the information available at time t.

$$\text{MIN} \quad V_{t-1}(\Delta p_t^* - \Delta p_t) \qquad (4)$$

To solve this problem, first, using equation (1) and (3), we need to specify that:

$$\Delta p_t^* - \Delta p_t = \Delta p_t^* + \Delta q_t - \Delta b_t - E_{t-1}\Delta v_t - u_t \qquad (5)$$

If we define $j_t = \Delta p_t^* + \Delta q - \Delta b_t - E_{t-1}\Delta v_t$ (6) and consider that u_t is orthogonal to all the other terms in the right side of equation (5), we can rewrite (4) as :

$$\text{MIN} \quad \mathrm{V}_{t-1}\mathrm{j}_t + \mathrm{V}_{t-1}\mathrm{u}_t \qquad (7)$$

Thus, the conditional variance is minimized by setting $j_t=0$, that is, by applying a growth of monetary base of the form:

$$\Delta b_t^* = \Delta p_t^* + \Delta q_t - E_{t-1}\Delta v_t \qquad (8)$$

The fourth assumption for Δv_t, implies that

$$E_{t-1}\Delta v_t = \Delta q_t + a(L)\Delta z_{t-1} + b(L)u_{t-1} \qquad (9)$$

Substituting equation (9) into equation (8), and noting from equations (6) and (5) that $j_t=0$ implies that $u_t = -(\Delta p_t^* - \Delta p_t)$, we arrive to the optimal monetary policy rule :

$$\Delta b_t^* = \Delta p_t^* - a(L)\Delta z_{t-1} + b(L)(\Delta p_t^* - \Delta p_t) \qquad (10)$$

Finally, to simplify the optimal monetary rule with inflation as target, two more assumptions are needed: the autoregressive part consists of a simple average of *k* lagged Δz_t; and b(L) = $\lambda>0$. Then the optimal rule (10) becomes:

$$\Delta b_t^* = \Delta p_t^* - (1/k)(z_{t-1} - z_{t-1-k}) + l(\Delta p_{t-1}^* - \Delta p_{t-1}) \qquad (11)$$

Using the definition of z and considering that in the period t-1 and before, the monetary base supply and the demand should be equal ($b^d=b$), we can also write equation 11 as:

$$\Delta b_t^* = \Delta p_t^* - (1/k)(p_{t-1} - b_{t-1} - p_{t-1-k} + b_{t-1-k}) + l(\Delta p_{t-1}^* - \Delta p_{t-1}) \qquad (12)$$

In this study, we use this last specification as monetary rule with inflation as target. The first term (Δp_t*) represents the price level target growth rate. The second term of the right side of the equation is an estimate of the growth of the ratio price level/monetary base for period t. It is specified as an average growth of the price level/monetary base ratio during the last k periods. The third term reflects cyclical conditions of the economy and includes the parameter λ, which is a non-negative policy feedback parameter. This value provides a significant response of the monetary base growth to past target misses. A negative third term would reflect the necessity of an adjustment in the monetary policy and could be associated with an economy overheating. In the opposite case, a positive third term would indicate that need of accelerating the monetary base growth.

3. Methodology

Counterfactual historical simulations are conducted for the period 1994 - 1999 to evaluate the properties of monetary base rules. For this purpose, we specify a model of the economy that includes three equations: (1) an equation for the target variable (growth of nominal GDP, inflation or core inflation), (2) an equation for the nominal exchange rate depreciation and (3) the monetary base rule that will be evaluated.

The target variable and the nominal exchange-rate depreciation equations were estimated individually by Ordinary Least Squares with monthly data over 1993-1999. The characteristics shown by each one are: good fit, stability of parameters, normality of errors, homocedasticity and absence of errors cross correlation **(Appendix 1)**. However, the estimated models are not immune to Lucas Critique (1976). But, it should be said that the estimated equations broadly satisfy the restrictions of an econometric stability test that evaluates the historical empirical importance of this critique. Besides, it is remarkable that the relationship between nominal variables only (as is the case of this study) are less likely to change its parameters in response to policy changes than the relationships among real and nominal variables.

Only after the equations are estimated, it is possible to conduct the simulations. We do these by using the initial conditions of December 1993 (and before) and the values being generated by the estimated equations and the monetary base rule between January 1994 and December 1999. Residuals of the target variable and the nominal exchange rate depreciation equations are fed into the model as estimates of the shocks that affect these variables during the simulation period. It is convenient to remark that there is no a pre-established value for the policy feedback parameter λ in the monetary rule. For this reason, it is necessary to conduct the simulations with different values for

λ in order to find the one that minimizes the difference between objective and simulated values of the target variable. All simulation results reported in this study, about each rule, are based on this optimal value for λ. Likewise, this value is reported in the graph that plots objective and simulated target variable values.

4. Evaluation of the properties of monetary rules for Peru

4.1. Data

We use monthly data in the present study. The specification of the variables is as follows:

b_t = log of 12 months moving average monetary base

x_t = log of 12 months moving average nominal GDP

tc_t= log of monthly exchange rate

p_t = log of 12 months moving average CPI

p^c_t= log of 12 months moving average core CPI

fp_t = log of monthly CPI

fp^c_t= log of monthly core CPI

CPI_t = monthly consumer price index

$CCPI_t$ = monthly core consumer price index

Likewise, the objective values for inflation are taken from Letters of Intent while we assume a long run average growth rate of real GDP of 5 percent per year (equivalent to 0.4 percent per month). We consider the objectives in **Table 1**

4.2. Evaluation of the monetary rule with nominal GDP growth as target

4.2.1. The model

The model of the economy that we use to carry out the simulation is composed by three equations: (1) a monetary base rule with nominal GDP growth as target variable; (2) a single monthly nominal GDP growth equation with the monetary base growth and the nominal exchange rate depreciation as explanatory variables; and (3) a functional relationship between the nominal exchange rate depreciation and the monetary base growth.

$$(1)\Delta b_t = \Delta x_t^* - (1/12)(x_{t-2} - b_{t-2} - x_{t-14} + b_{t-14}) + l(\Delta x^*_{t-2} - \Delta x_{t-2})$$

$$(2)\Delta x_t = -0.0098 + 0.7015\Delta x_{t-1} + 0.0657\Delta tc_{t-8} + 0.0590\Delta tc_{t-11} + 0.1435\Delta b_{t-3} + e_t$$

$$(3)\Delta tc_t = 0.2521 + 0.3987\Delta tc_{t-1} + 0.1993\Delta tc_{t-5} + 0.7097\Delta b_{t-1} - 0.6560\Delta b_{t-3} + v_t$$

To specify the rule (1), a 12-month average of the monetary base velocity growth is used. To estimate the second term of the rule, it is also necessary to consider the two-month delay in the release of the nominal GDP data. For the same reason, the third term of the rule adjusts the growth of monetary base according to the discrepancy between the lagged nominal GDP growth observed and its target. Finally, it is remarkable that e_t and v_t in the equations (2) and (3) are normal errors that represent shocks that affect the nominal GDP growth and nominal exchange rate depreciation during the period of analysis.

4.2.2. Results

The rule is not successful in keeping the nominal GDP growth target path, especially during 1996, as it is showed in **Figure 1**. This result reflects the monetary base ineffectiveness to stabilize the nominal GDP growth around its potential growth path for Peru. The existence of a group of components of the Peruvian real GDP (agriculture, fishing, mining and manufacturing production based on raw materials) that are more affected by aggregate supply and foreign demand shocks than by domestic demand shocks could explain this phenomenon. In this sense, we suggest that better results of this rule could be obtained by using an indicator of domestic demand growth as target variable instead of a nominal GDP growth indicator. However, in spite of the fact that the rule does not fit adequately the nominal GDP growth close to its target, the coefficient of variability of the simulated nominal GDP growth is lower than that one actually observed, just as it is reported in **Table 2**.

The simulated growth of monetary base shows a high volatility caused by the variability of the third component of the rule **(Figure 2)**. The discrepancies between the simulated growth of nominal GDP and its objective are considerably high and explain the instability of the growth of the monetary base. Likewise, its coefficient of variability is higher than the observed monetary base growth. For this reason, the variability of simulated nominal exchange rate depreciation is much higher than the observed. In this sense, we may say that the use of this rule would not be convenient for the monetary policy in Peru because, by doing so, the Central Bank may cause involuntarily exchange rate market instability.

4.3. Evaluation of the monetary rule with inflation as target

In this section, we evaluate the properties of a monetary base rule that specifies monthly adjustments to keep an inflation target path. The relevance of this kind of analysis stands on the fact that the Central Reserve Bank of Peru chose in 1993 the inflation as the only target variable. The objective values of the inflation are shown in Table 1. The inflation target path diminishes in a linear way during each year, except during 1998 because we incorporate the effect of "El Niño" disaster. This phenomenon causes the acceleration of the inflation target path in the first half of the year and a decrease of it during the second half of the 1998.

4.3.1. The model

The model of the economy that is used to carry out the simulation consists of three equations: (1) a monetary base rule that considers inflation as target (2) a single monthly inflation equation with the monetary base growth and the nominal exchange rate depreciation as explanatory variables; and (3) a functional relationship between the nominal exchange rate depreciation and the monetary base growth. Since, the monetary rules are designed by using 12-month moving averages of the whole variables that appear in and the inflation equation is estimated with monthly CPI data, a connection between equations 1 and 2 is required. For this reason, we specify a relationship between the growth of 12-month CPI moving average and the growth of CPI (equations 4 and 5).

$$(1)\Delta b_t = \Delta p_t^* - (1/12)(p_{t-1} - b_{t-1} - p_{t-13} + b_{t-13}) + l(\Delta p^*_{t-1} - \Delta p_{t-1})$$

$$(2)\Delta \mathrm{fp}_t = -0.1498 + 0.2514\Delta \mathrm{fp}_{t-12} + 0.1254\Delta \mathrm{tc}_{t-3} + 0.1208\Delta \mathrm{tc}_{t-6} + 0.2084\Delta \mathrm{b}_{t-11} + \mathrm{e}_t$$

$$(3)\Delta \mathrm{tc}_t = 0.2521 + 0.3987\Delta \mathrm{tc}_{t-1} + 0.1993\Delta \mathrm{tc}_{t-5} + 0.7097\Delta \mathrm{b}_{t-1} - 0.6560\Delta \mathrm{b}_{t-3} + \mathrm{v}_t$$

$$(4)\Delta \mathrm{p}_t = \log\sum_{j=0}^{11}\mathrm{CPI}_{t-j} - \log\sum_{j=0}^{11}\mathrm{CPI}_{t-j-1}$$

$$(5)\log \mathrm{CPI}_t = \log \mathrm{CPI}_{t-1} + \Delta \mathrm{fp}_t$$

To specify the rule (1), 12 months basis was used to estimate the monthly average of the price level/monetary base ratio growth. In the same way, we let the third term of the rule adjust the growth of the monetary base according to a one period lagged discrepancy between the inflation observed and its target. Finally, it is necessary to remark that e_t and v_t in the equations (2) y (3) are normal errors represents shocks that affect inflation and nominal exchange rate depreciation during the period of simulation.

4.3.2 Results

The monetary rule is successful in keeping the inflation target path, especially since 1996, just as it is shown in **Figure 3**. The monthly average deviation between simulated inflation and its target is 0.14 percent for the whole period of analysis; while it is only 0.10 percent since 1996. Also, the variability of simulated inflation is lower than the observed for the whole period of analysis **(Table 3)**. In the same way, it is interesting to remark that inflation target path goes up in the first half of 1998, incorporating the predictions of inflation acceleration associated with the "El Niño" disaster. However, it can be seen, that this temporary supply shock disappears gradually during this year. In this sense, the objective value for December 98 is 0.7 percent according to the value specified in Table 1. It is noticeable that if these supply shocks effects during 1998 had not been considered in setting the target path, the monetary rule would have over-adjusted the monetary base through its third term. This point is explained by the fact that whereas simulated inflation incorporates supply shock effects, the target path does not take them into account.

Another important result found is the stability of the simulated monetary base growth, as it is shown in **Figure 4**. In fact, the coefficient of variability of the monetary base growth proposed by the rule during the simulation (25 percent) is much lower than that one actually observed (65 percent), despite the coincidence in the election of the target variable between the rule and the Central Reserve Bank of Peru. This result is controversial, since it could suggest that the higher variability would be caused because the monetary policy tries to stabilize another variables as the interest rate or the exchange rate. However, the simulation results would not confirm this hypothesis for the exchange rate, since the coefficient of variability of the observed nominal exchange rate depreciation is higher than the simulated, as it is reported in Table 3. The last result could suggest that monetary policy could have caused instability in the exchange rate market.

Finally, it is remarkable that the monetary base growth proposed by the rule is higher than the observed values since 1996. This result is consistent with a lower inflation that it has been observed in Peru instead of the inflation that would have happened if the monetary policy rule had been in effect during the whole period of analysis, as it is showed in **Figure 5**. These facts also could suggest that the monetary policy in Peru was contractive. However, to evaluate monetary policy, it is better to contrast actual settings of monetary base with the values that would have been specified by the rule in response to prevailing conditions. In the simulations we conduct in this section, the values of simulated monetary base growth are influenced by the fact that the rule is used during the whole period and by the models we are using**.** In the other type of analysis, those do not influence the values.

4.4. Evaluation of the monetary rule with core inflation as target

Although the rule with inflation as target is successful in keeping its target path, it is important to outline the high precision required in setting the objective values. The inflation measured as the CPI growth is influenced by supply shocks (exogenous to the monetary policy) which are temporary and should not be considered by the monetary policy when adjusting its instrument variable. For these reasons, it is necessary to use a core inflation indicator that excludes supply shocks. With this indicator, monetary policy would not require to anticipate supply shocks nor take them into account when setting its inflation target path as it occurred when we carried out the simulation using the CPI growth as the measure of inflation.

4.4.1 The model

The model of the economy that is used to carry out the simulation consists of three equations: (1) a monetary base rule that considers core inflation as target (2) a single monthly core inflation equation with the monetary base growth and the nominal exchange rate depreciation as explanatory variables; and (3) a functional relationship between the nominal exchange rate depreciation and the monetary base growth. Since, the monetary rules are designed by using 12-month moving averages of the whole variables that appear in and the core inflation equation is estimated using monthly core CPI data, a connection between equations 1 and 2 is required. For this reason, we specify a relationship between the growth of 12-month CPI moving average and the growth of CPI (equations 4 and 5).

$$(1)\Delta b_t = \Delta p_t^{c^*} - (1/12)(p^c{}_{t-1} - b_{t-1} - p^c{}_{t-13} + b_{t-13}) + \ l(\Delta p^{c^*}{}_{t-1} - \Delta p^c{}_{t-1})$$

$$(2)\Delta \mathrm{fp}^c{}_t = -0.0378 + 0.3732\Delta \mathrm{fp}^c{}_{t-12} + 0.1329\Delta \mathrm{tc}_{t-3} + 0.0677\Delta \mathrm{tc}_{t-6} + 0.1201\Delta \mathrm{b}_{t-11} + \mathrm{e}_t$$

$$(3)\Delta \mathrm{tc}_t = 0.2521 + 0.3987\Delta \mathrm{tc}_{t-1} + 0.1993\Delta \mathrm{tc}_{t-5} + 0.7097\Delta \mathrm{b}_{t-1} - 0.6560\Delta \mathrm{b}_{t-3} + \mathrm{v}_t$$

$$(4)\Delta \mathrm{p}^c{}_t = \log \sum_{j=0}^{11} \mathrm{CCPI}_{t-j} - \log \sum_{j=0}^{11} \mathrm{CCPI}_{t-j-1}$$

$$(5)\log \mathrm{CCPI}_t = \log \mathrm{CCPI}_{t-1} + \Delta \mathrm{fp}^c{}_t$$

To specify the rule (1), 12 months basis was used to estimate the monthly average of the core price level/monetary base ratio growth. In the same way, we let the third term of the rule adjust the growth of the monetary base according to a one period lagged discrepancy between the core inflation observed and its target. Finally, it is necessary to remark that e_t and v_t in the equations (2) y (3) are normal errors represents shocks that affect inflation and nominal exchange rate depreciation during the period of simulation.

4.4.2 Results

This monetary rule is also successful in keeping its target path, except since September 1997 – August 1998, just as it is shown in **Figure 6**. The monthly average deviation between simulated core inflation and its target is 0.11 percent for the whole period of analysis; while it is only 0.09 percent if we exclude September 1997- August 1998 period from the analysis. Therefore, the rule with core inflation as a target is quite better than the one with inflation (measured by CPI) as target. This result is justified if we consider the higher influence that monetary policy has over core inflation than on a broad inflation measure. Besides, the variability of simulated core inflation is lower than the observed for the whole period of analysis **(Table 4)**.

On the other hand, the coefficient of variability of the observed growth of monetary base remains higher than the simulated. However, the coefficient of variability of the simulated monetary rule growth with core inflation as target is higher than that one with inflation as target.

4.5. Evaluation of implicit monetary rules with inflation as target

Besides modifying the objective between the rules, it is also possible to modify the reaction term specified by the rule. In previous simulations, the monetary base has been adjusted according to the discrepancies between the inflation target and its observed value in the previous period. However, the third term of the rule can also be specified in function to the discrepancy among its future target value and its forecast. In this case, the monetary rule represents an actual operating procedure of inflation targeting central banks.

In this section, counterfactual historical simulations are conducted to evaluate the properties of implicit monetary rules for two different target variables: inflation and core inflation. We do this kind of exercise in response to the increasing importance that Inflation Targeting is acquiring in the design of monetary policy worldwide.

4.5.1 The models

The models are the same used to evaluate explicit rules with two slight modifications: a) the third term of the rule is now defined as the difference between the inflation target and its forecast eleven months ahead and b) autorregresive models are added to forecast inflation (either measured as growth of 12 months moving average CPI or as growth of 12 months moving average core CPI).

4.5.2 Results

The forward looking rules are less successful than the explicit rules in keeping the inflation target, as it is showed in **figures 7 and 8**. However, these results could be sensitive to changes in the models to forecast the inflation as well as changes in forecast horizon. On the other hand, the growth of monetary base with implicit rules remains showing less variability than the observed one as it is showed in tables 5 and 6. Likewise, the coefficients of variability of the growth of monetary base with implicit rules are lower than those ones of the growth of monetary base with explicit rules. Finally, the variability of nominal exchange rate depreciation with the use of implicit rules is lower than the observed.

5. Monetary policy evaluation

In the previous sections, the efficiency of the explicit rules with inflation as target over the period 1994 – 1999 was shown. In this section, a counterfactual historical analysis of the type utilized by Stuart (1996) is conducted to evaluate monetary policy in Peru. For this purpose, actual settings of monetary base during the period of analysis are contrasted with the values that would have been specified by the rules with inflation and core inflation as targets, in response to prevailing conditions. In this way, by comparing the actual growth rate of the instrument variable with that proposed by the rule, it is possible to determine if the monetary policy was handled too tight or too loose in a specific point of time.

We use the optimum values of λ estimated in the preceding section, the objective values that we consider in the simulations and the prevailing conditions to obtain the values proposed by the rules each period. Then, we compare those values with actual values. We talk about a loosening in the monetary policy when the actual monetary base growth is higher than that one proposed by rule. The opposite case refers to a monetary tightening.

The results of this exercise suggest that the monetary policy was too loose over the period January 1994 and June 1995, as it is showed in **Figure 9**. When core – inflation is adopted as target, this result is valid until July 1995. We also found that between October 1995 and September 1996; and June 1998 and August 1999, the monetary policy conduction was tight for both inflation measures. Likewise, during January 1997 and May 1998, the monetary policy was neutral according to the rule with inflation as target. When core inflation is chosen as target, this result is valid only from October 1997; while the monetary policy over the period January 1997-September 1997 is qualified by this rule as tight.

6. Concluding Remarks

The monetary policy in Peru is more effective in keeping an objective inflation instead of nominal GDP growth. This result is consistent with the actual procedures applied by the Central Reserve Bank of Peru. Likewise, the variability of the monetary base is much lower when the target is the inflation.

In spite of the fact that the monetary base rule with nominal GDP growth as target does not fit adequately close to its target, the coefficient of variability of the simulated nominal GDP growth is lower than that one actually observed. But the variability of the instrument with the rule is much higher. In this sense, this rule is inadequate because it can cause instability in the exchange rate market.

The monthly target path setting is a crucial issue in the design of monetary rules, especially when the inflation is measured by CPI. In this sense, monetary policy should have an idea about the possible monthly trajectory of the inflation during the year when it adjust its instrument.

An explicit monetary rule is more successful in keeping core inflation as target instead of inflation measured by CPI in Peru. However, the monetary rule with core inflation as target shows much higher variability than that one with inflation as target.

The variability of actual monetary base growth is much higher than the simulated monetary base growth with inflation, despite of the coincidence between the election of the target variable among the rule and Central Reserve Bank of Peru. This result is controversial, since it could suggest that the higher variability would be caused because the monetary policy in Peru tries to stabilize another variables as the interest rate or the exchange rate. However, the simulation results would not confirm this hypothesis for the exchange rate, since the coefficient of variability of the observed nominal exchange rate depreciation is higher than the simulated.

The explicit monetary rules with inflation as target (measured by CPI or core CPI) are more successful in keeping its target path than the implicit ones. But, the variability of monetary base growth proposed by implicit rules is much lower than the variability of monetary base growth proposed by explicit ones. Likewise, in all cases, the variability of the inflation with the rules (explicit or implicit) is lower than that one observed.

Finally, counterfactual historical analysis of the type utilized by Stuart (1996) is conducted to evaluate monetary policy in Peru. For this purpose, actual settings of monetary base during the period of analysis are contrasted with the values that would have been specified by the rule with inflation target in response to prevailing conditions. According to this comparison, monetary policy in Peru was too loose over the period January 1994 - June 1995 and was too tight between June 1998 and August 1999.

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TABLES AND FIGURES

TABLE 1

ASSUMPTIONS OBJECTIVES: 1994-1999
(In monthly rates)

Year	Inflation	Real GDP growth
1994	1,4%	0,4%
1995	0,9%	0,4%
1996	0,8%	0,4%
1997	0,7%	0,4%
1998	0,7%	0,4%
1999	0,4%	0,4%

FIGURE 1

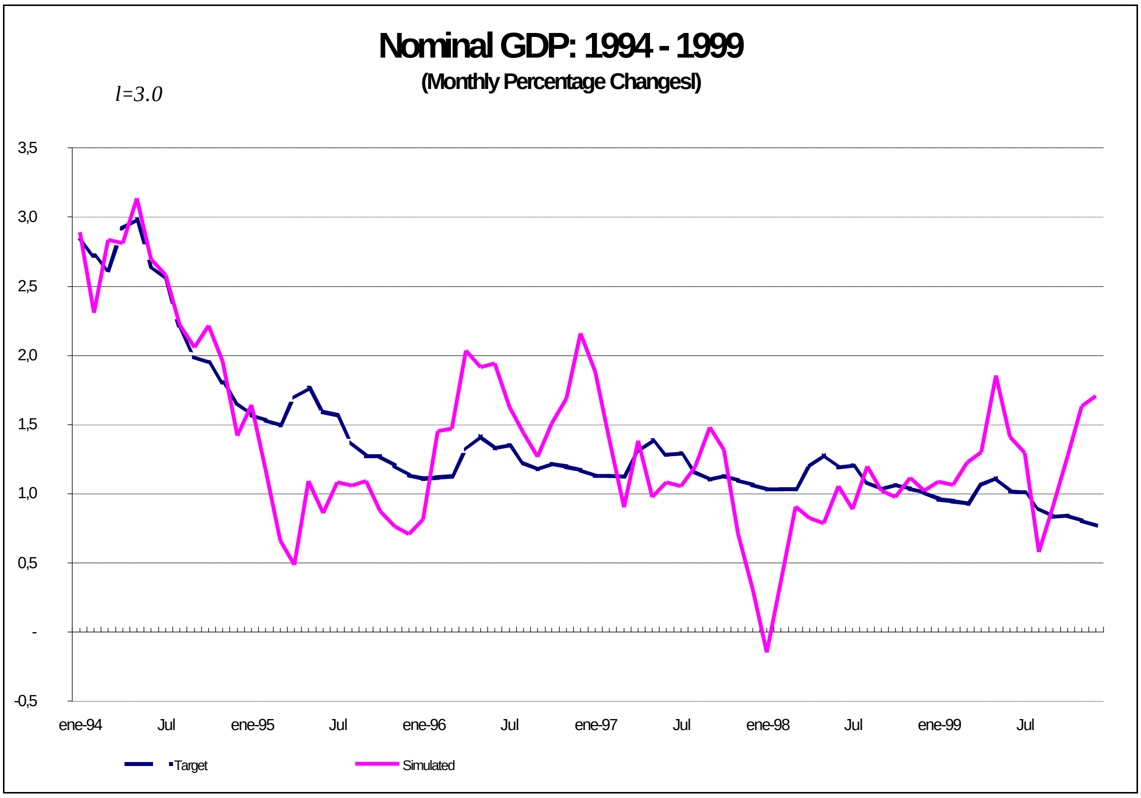


TABLE 2

COEFFICIENTS OF VARIABILITY
(In percentages)

	Simulated	Actual
Monetary base growth	80	27
Nominal GDP growth	47	66
Nominal exchange rate depreciation	244	177

FIGURE 2

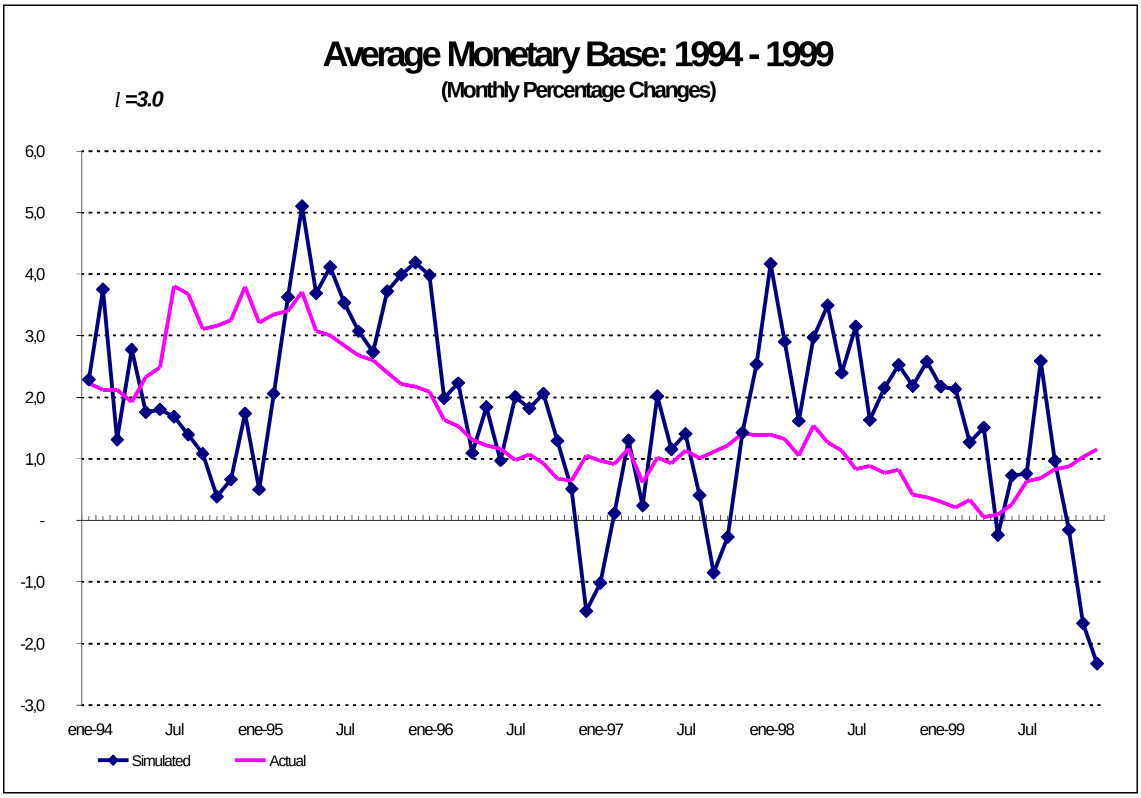


FIGURE 3

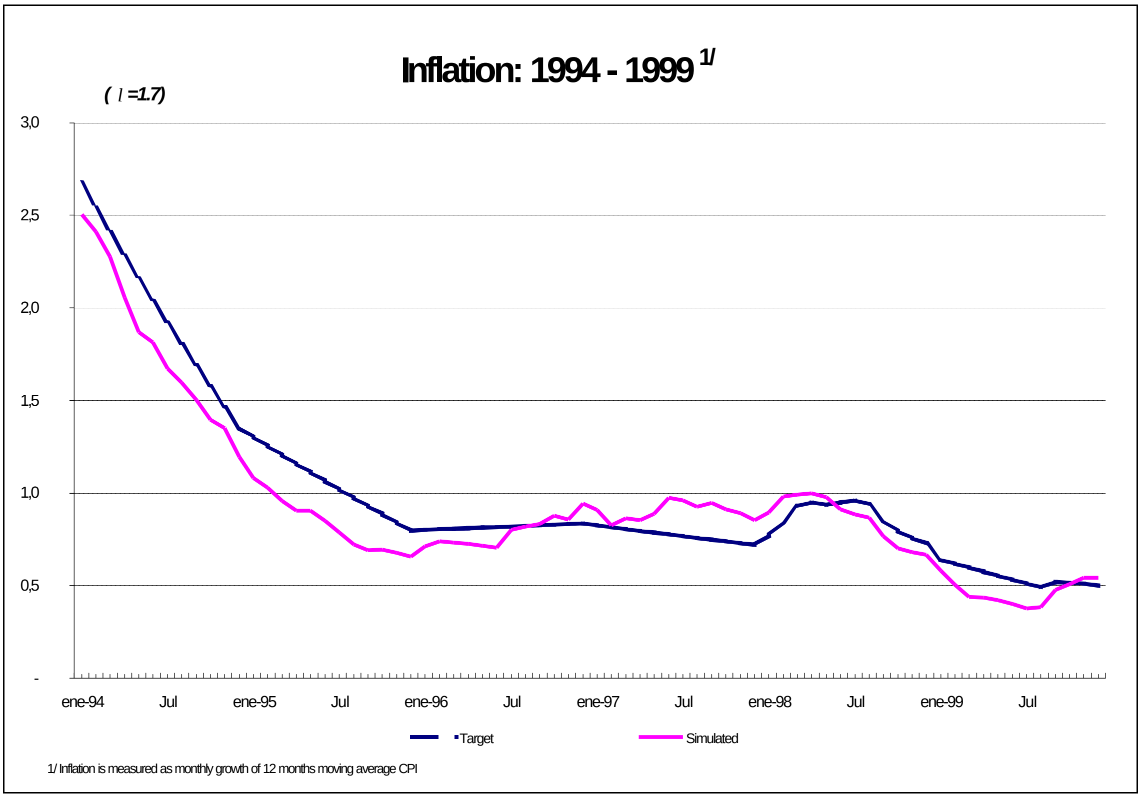


FIGURE 4

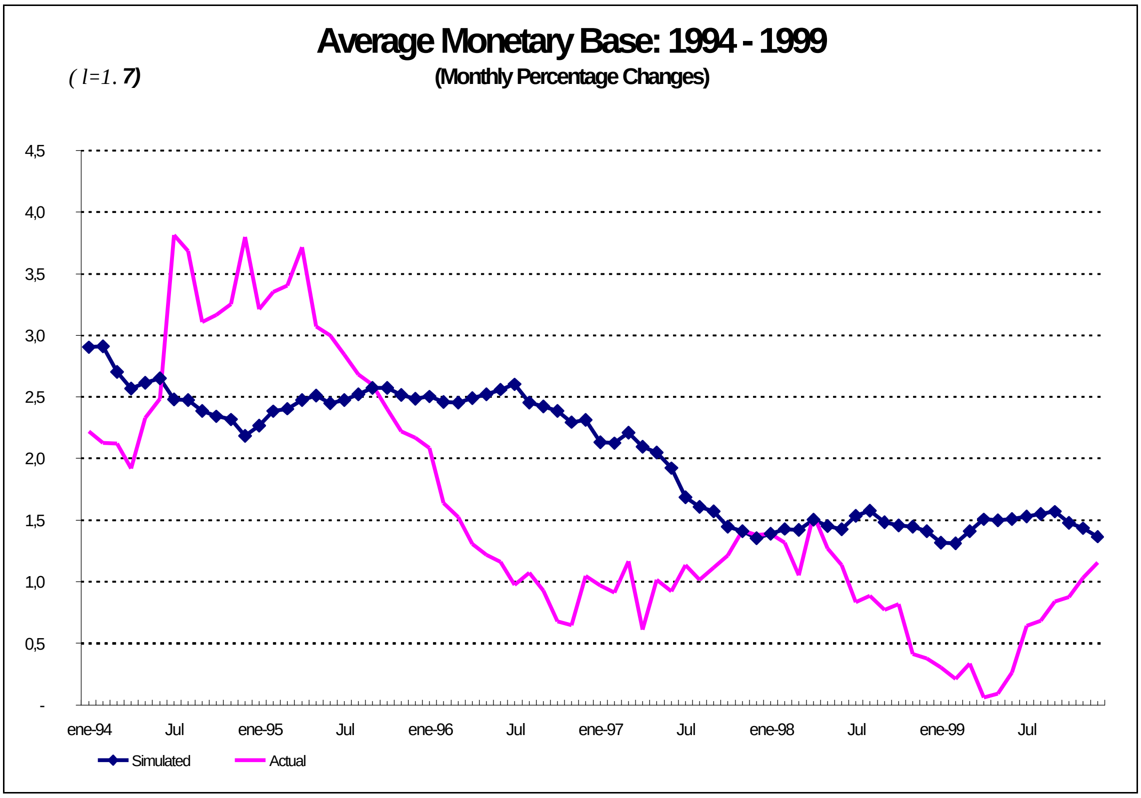


FIGURE 5

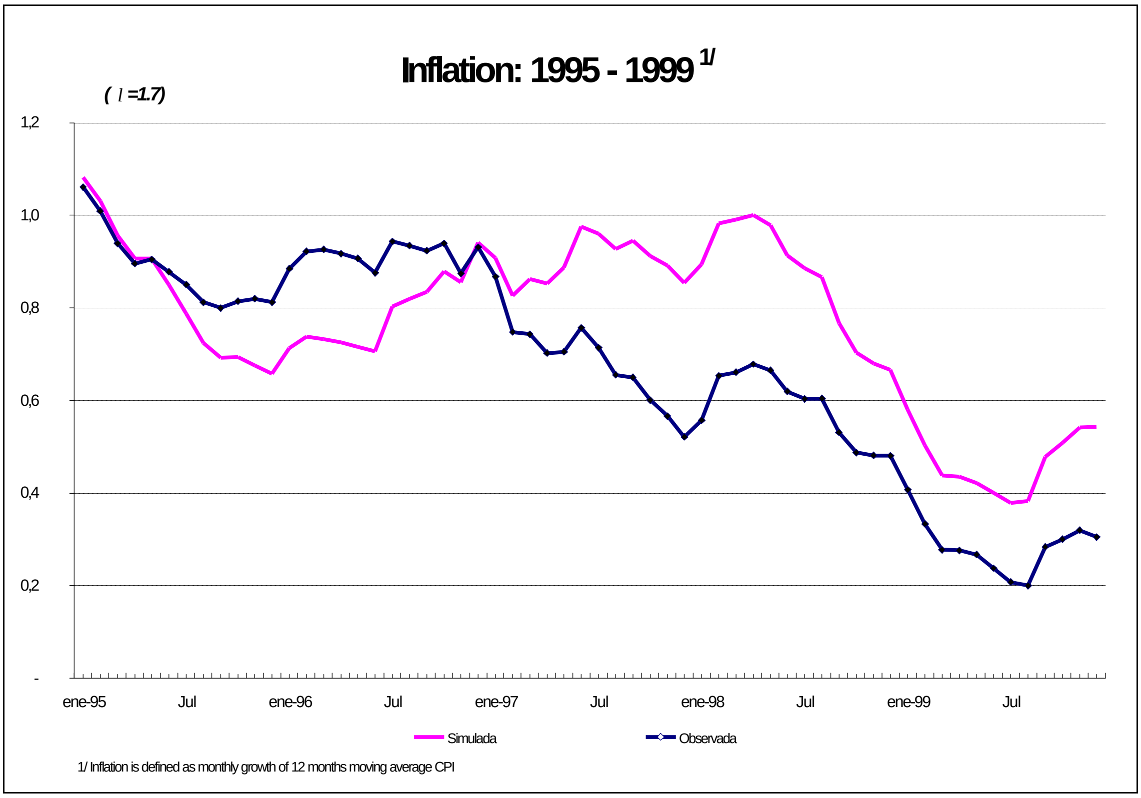


TABLE 3

COEFFICIENTS OF VARIABILITY (In percentages)	Simulated	Actual
Monetary base growth	25	65
Inflation	48	59
Nominal exchange rate depreciation	158	169

FIGURE 6

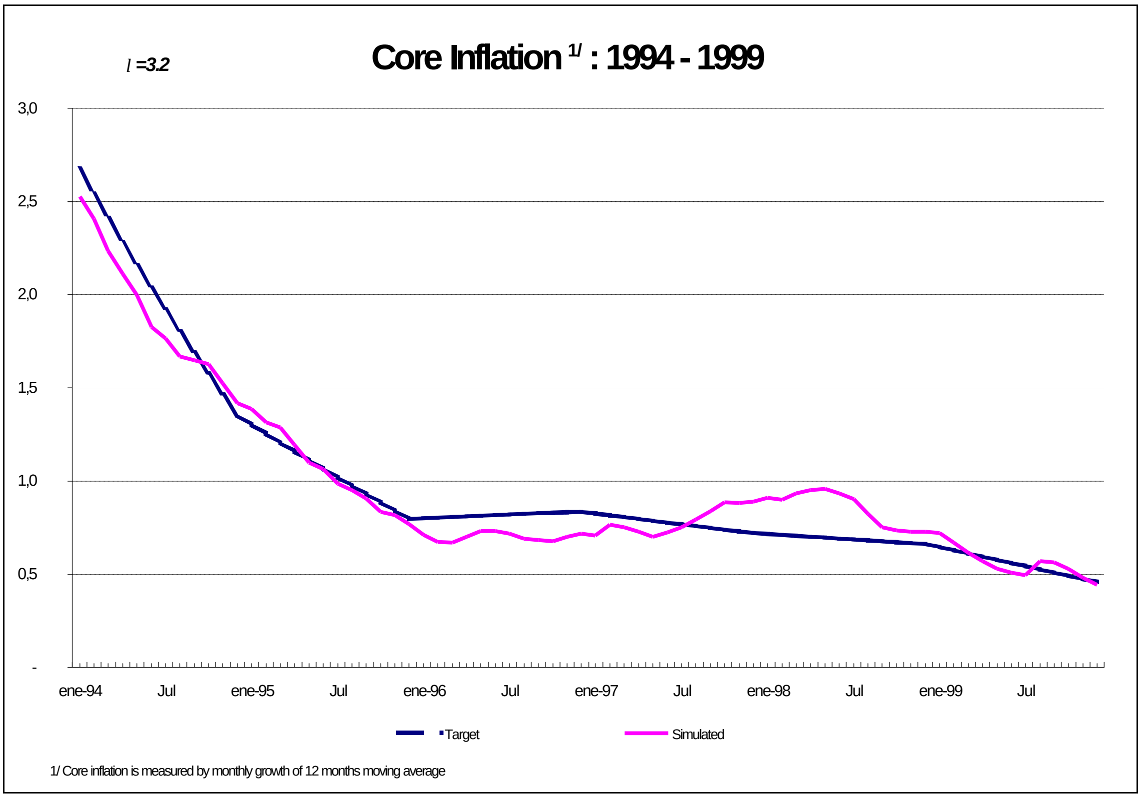


TABLE 4

COEFFICIENTS OF VARIABILITY (In percentages)	Simulated	Actual
Monetary base growth	62	65
Core Inflation	49	54
Nominal exchange rate depreciation	183	169

FIGURE 7

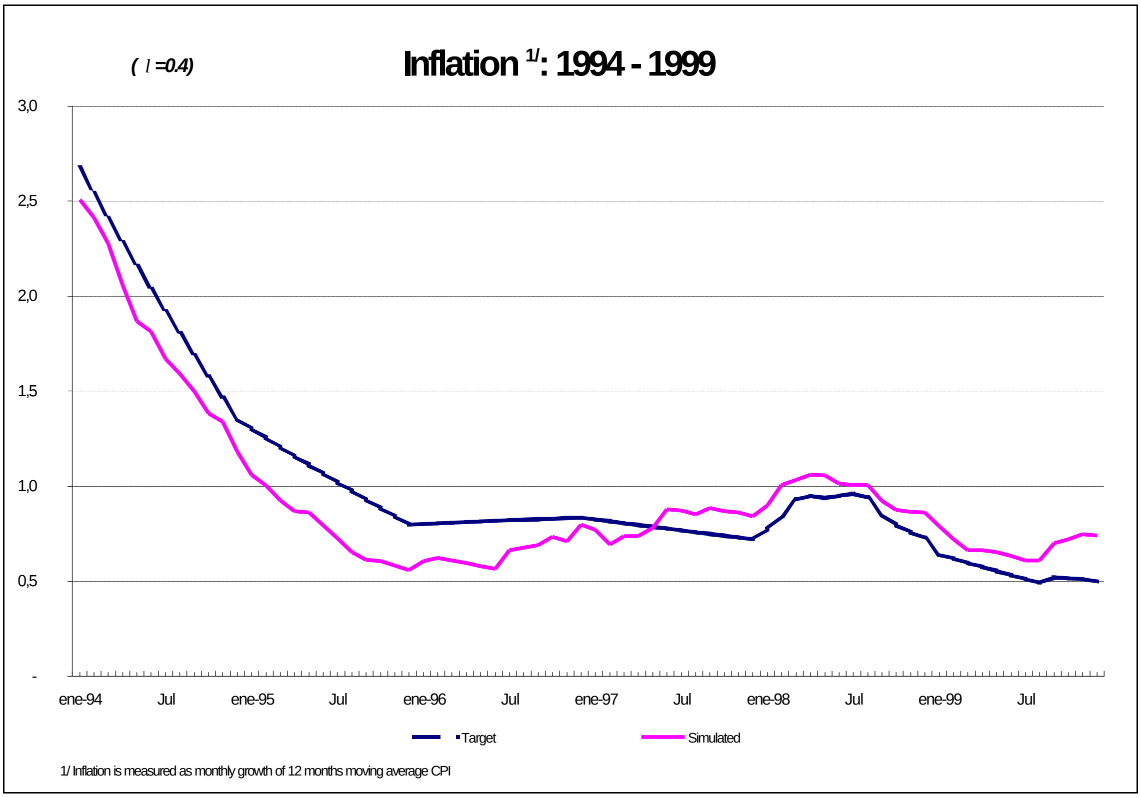


FIGURE 8

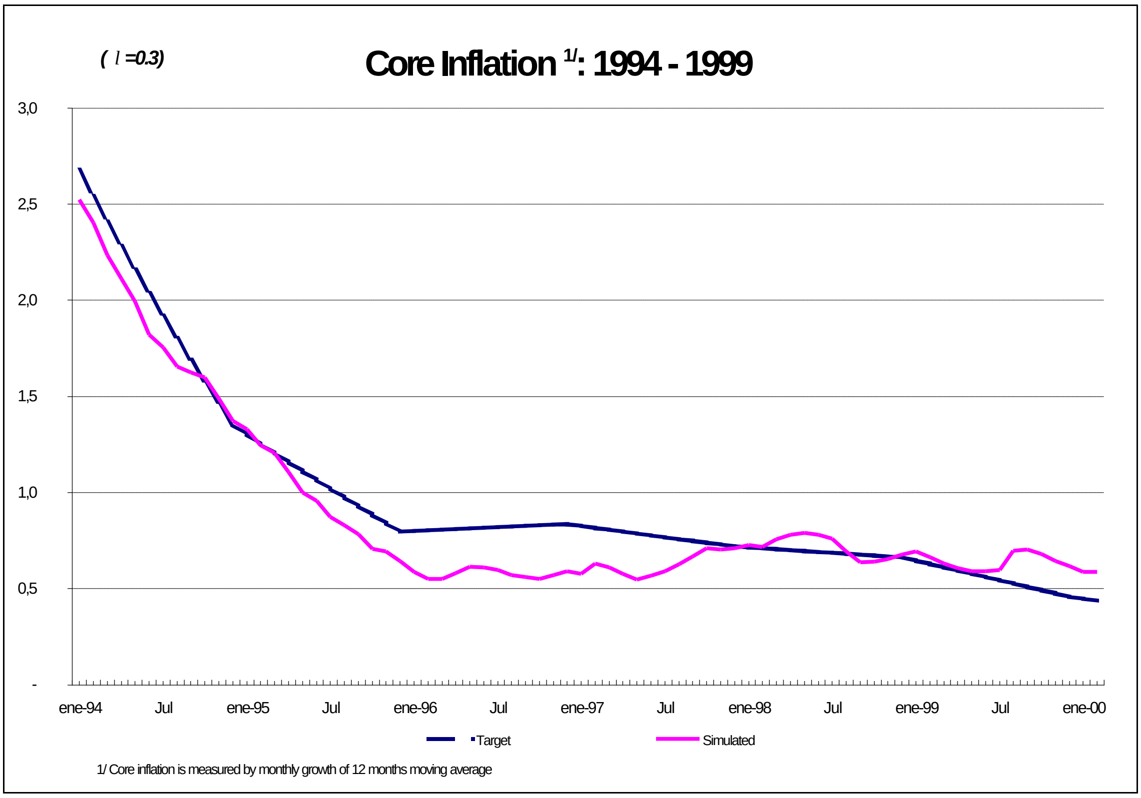


TABLE 5

COEFFICIENTS OF VARIABILITY
(In percentages)

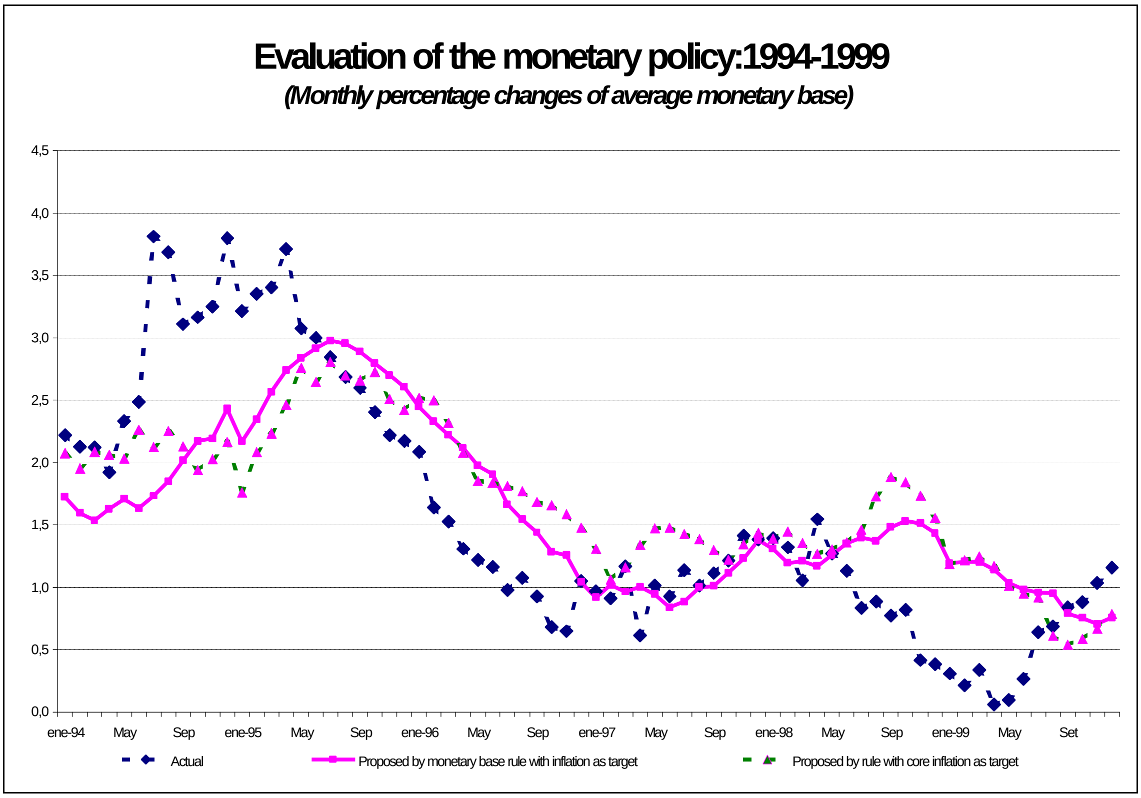
	Simulated	Actual
Monetary base growth	15	65
Inflation	46	59
Nominal exchange rate depreciation	154	169

TABLE 6

COEFFICIENTS OF VARIABILITY
(In percentages)

	Simulated	Actual
Monetary base growth	22	65
Core Inflation	55	54
Nominal exchange rate depreciation	152	169

FIGURE 9



APPENDIX 1

Nominal GDP growth equation

Equation

Dependent Variable: DPBINMOV
Method: Least Squares
Sample(adjusted): 1993:01 1999:12
Included observations: 84 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.0098	0.0659	-0.1488	0.8821
DPBINMOV(-1)	0.7015	0.0579	12.1070	0.0000
DTCF(-8)	0.0658	0.0179	3.6779	0.0004
DTCF(-11)	0.0591	0.0177	3.3339	0.0013
DBASEMOV(-3)	0.1434	0.048855	2.93657	0.0043

R-squared	0.9346	Mean dependent var	1.5838
Adjusted R-squared	0.9312	S.D. dependent var	1.2162
S.E. of regression	0.3189	Akaike info criterion	0.6099
Sum squared resid	8.0350	Schwarz criterion	0.7546
Durbin-Watson stat	1.8406	Prob(F-statistic)	0.0000

Autocorrelation and Heteroskedasticity Tests (with 12 lags)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.8498	Probability	0.6001
Obs*R-squared	11.0963	Probability	0.5207

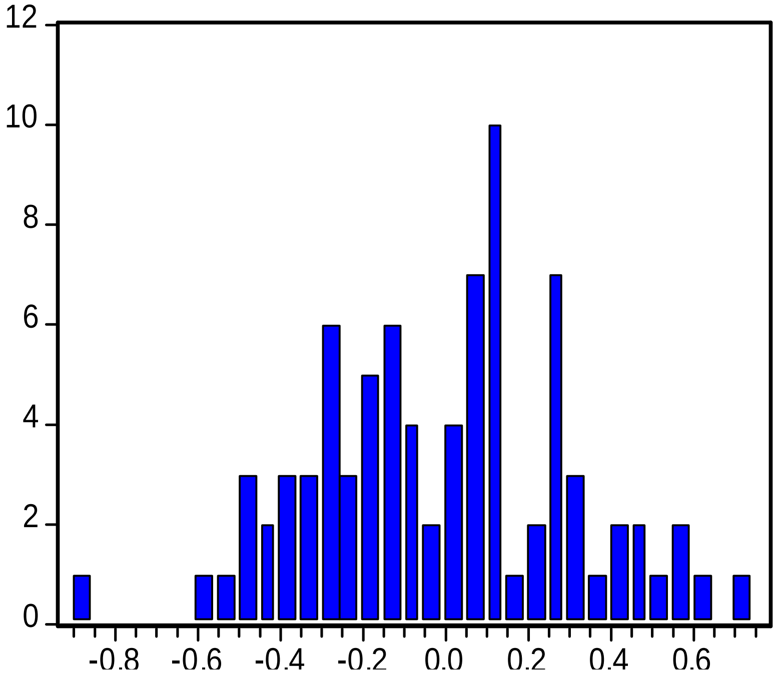
ARCH Test:

F-statistic	1.2480	Probability	0.2738
Obs*R-squared	14.5757	Probability	0.2655

White Heteroskedasticity Test (cross terms):

F-statistic	1.9164	Probability	0.0413
Obs*R-squared	23.2963	Probability	0.0556

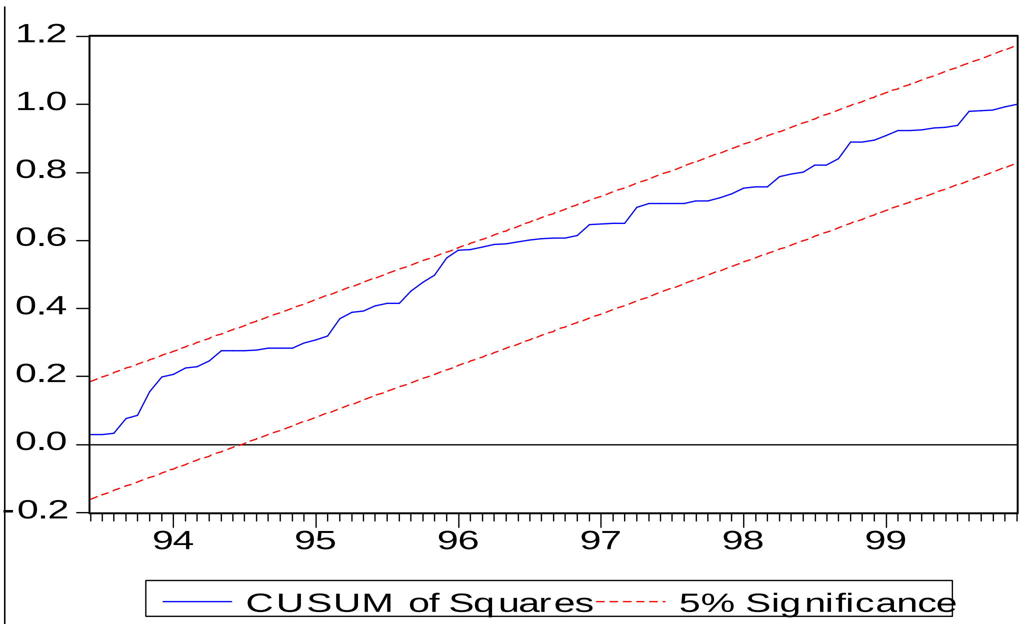
Normality of errors



Series: Residuals
Sample 1993:01 1999:12
Observations 84

Mean	1.18E-15
Median	0.033903
Maximum	0.740647
Minimum	-0.858013
Std. Dev.	0.311139
Skewness	-0.012053
Kurtosis	2.745943
Jarque-Bera	0.227941
Probability	0.892284

Stability of parameters: Test CUSUM Q



Inflation equation

Equation

Dependent Variable: DIPCF
Method: Least Squares
Sample(adjusted): 1993:01 1999:12
Included observations: 84 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.149769	0.107100	-1.398401	1.1521
DIPCF(-12)	0.251364	0.058279	4.313073	0.0000
DBASEMOV(-11)	0.208396	0.059554	3.499297	0.0008
DTCF(-6)	0.120756	0.030579	3.949002	0.0002
DTCF(-3)	0.125419	0.030579	4.101474	0.0001

R-squared	0.777453	Mean dependent var	1.01250
Adjusted R-squared	0.766185	S.D. dependent var	0.98143
S.E. of regression	0.474566	Akaike info criterion	1.40484
Sum squared resid	17.79179	Schwarz criterion	1.54953
Durbin-Watson stat	1.571839	Prob(F-statistic)	0.00000

Autocorrelation and Heteroskedasticity Tests (with 12 lags)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.357095	Probability	0.20886
Obs*R-squared	16.42492	Probability	0.17254

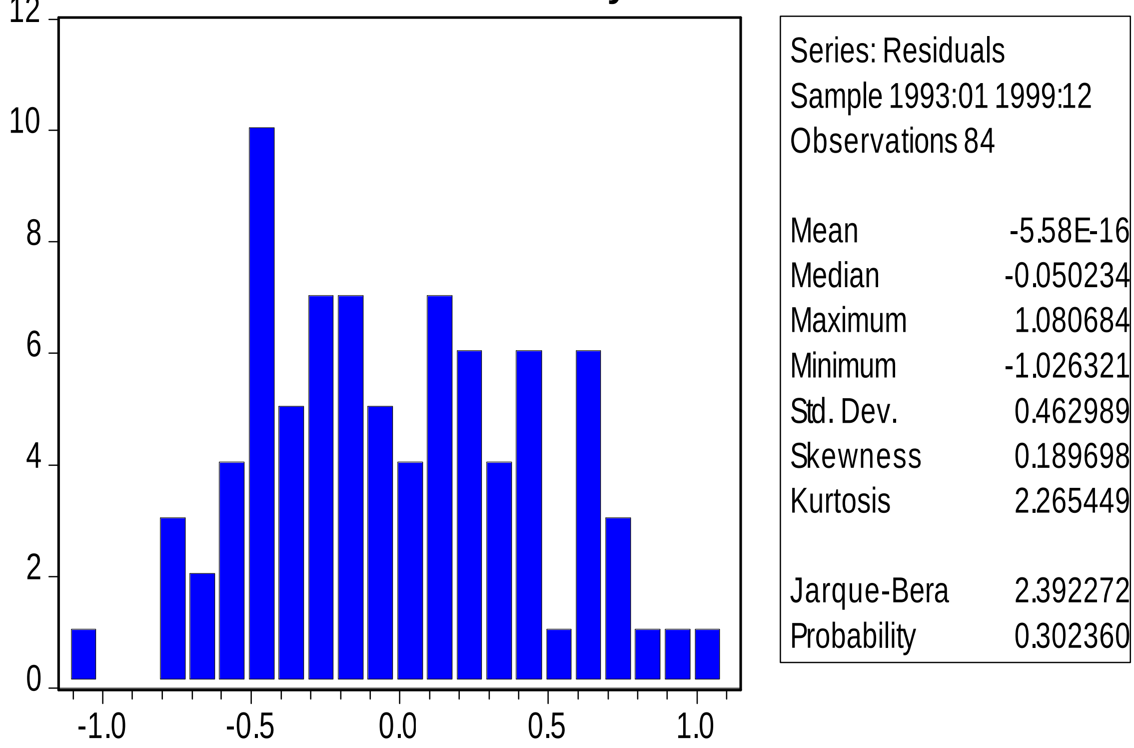
ARCH Test:

F-statistic	1.174811	Probability	0.32201
Obs*R-squared	13.88602	Probability	0.30804

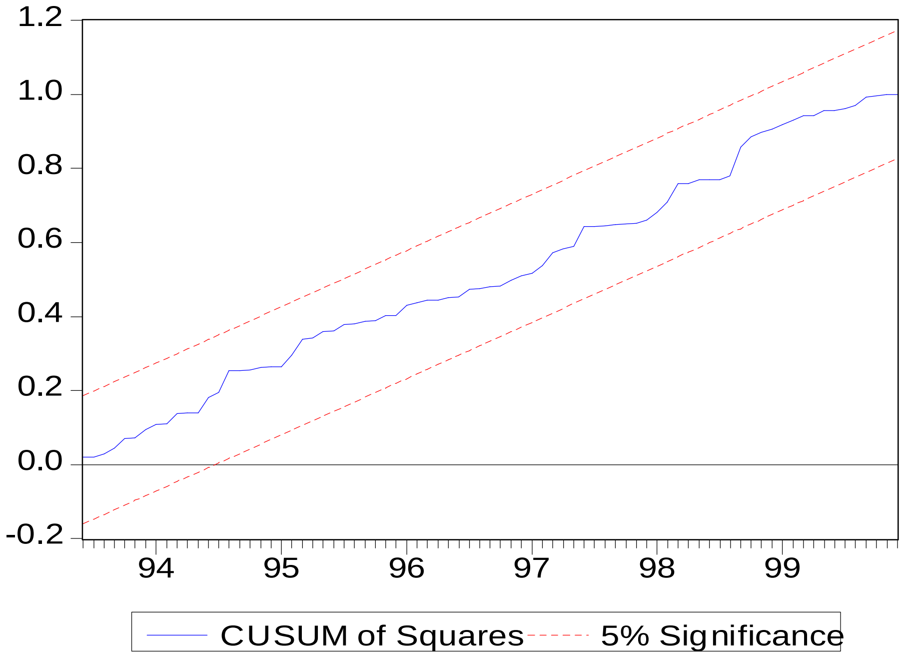
White Heteroskedasticity Test:

F-statistic	1.371742	Probability	0.19087
Obs*R-squared	18.28898	Probability	0.19393

Normality of errors



Stability of parameters: Test CUSUM Q



Core Inflation equation

Equation

Dependent Variable: DIPCSF
Method: Least Squares
Sample(adjusted): 1993:01 1999:12
Included observations: 84 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.037797	0.079991	-0.472516	4.4299
DIPCSF(-12)	0.373246	0.049745	7.503139	0.0000
DBASEMOV(-11)	0.120083	0.047200	2.544120	0.0896
DTCF(-3)	0.132930	0.022921	5.799550	0.0000
DTCF(-6)	0.067745	0.022800	2.971294	0.0039

R-squared	0.849320	Mean dependent var	1.046071
Adjusted R-squared	0.841691	S.D. dependent var	0.893017
S.E. of regression	0.355314	Akaike info criterion	0.826052
Sum squared resid	9.973622	Schwarz criterion	0.970743
Durbin-Watson stat	1.379847	Prob(F-statistic)	0.000000

Autocorrelation and Heteroskedasticity Tests (with 12 lags)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.774074	Probability	0.070721
Obs*R-squared	20.25472	Probability	0.062418

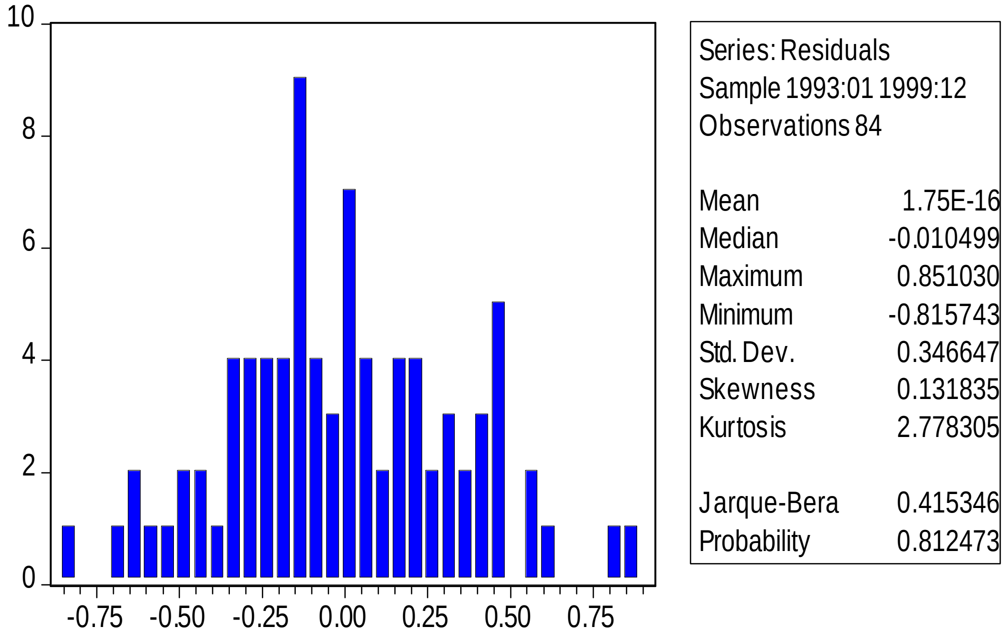
ARCH Test:

F-statistic	1.393843	Probability	0.194707
Obs*R-squared	15.90310	Probability	0.195714

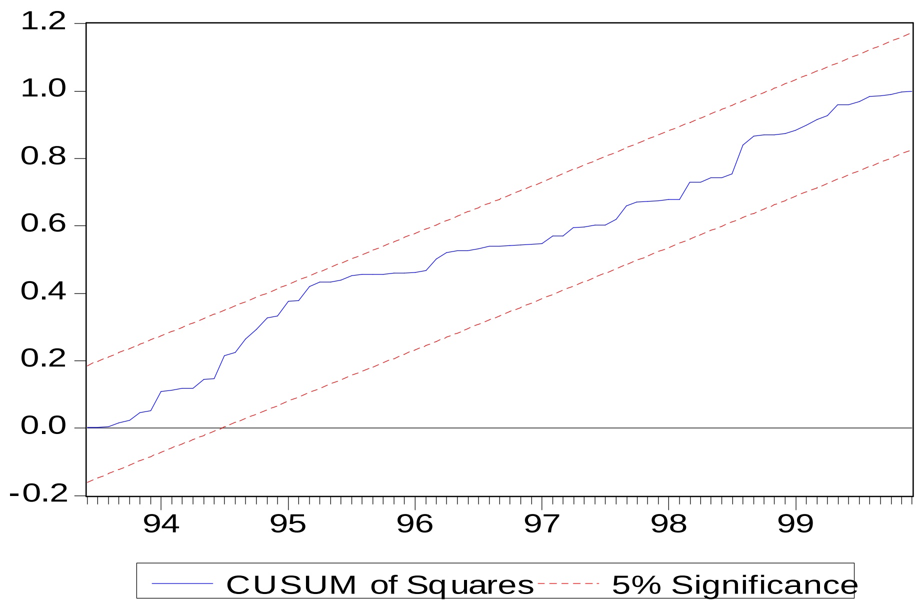
White Heteroskedasticity Test:

F-statistic	1.065145	Probability	0.403577
Obs*R-squared	14.92766	Probability	0.383117

Normality of errors



Stability of parameters: Test CUSUM Q



Nominal Exchange Rate Depreciation equation

Equation

Dependent Variable: DTCF
Method: Least Squares
Sample: 1993:01 1999:12
Included observations: 86

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.252139	0.232039	1.086624	1.9479
DTCF(-1)	0.398723	0.095985	4.154023	0.0001
DTCF(-5)	0.199332	0.064884	3.072119	0.0029
DBASEMOV(-1)	0.709665	0.315720	2.247767	0.1903
DBASEMOV(-3)	-0.656046	0.312184	-2.101472	0.2694

R-squared	0.356618	Mean dependent var	0.91869
Adjusted R-squared	0.324042	S.D. dependent var	1.32626
S.E. of regression	1.090407	Akaike info criterion	3.06865
Sum squared resid	93.92997	Schwarz criterion	3.21334
Durbin-Watson stat	1.894897	Prob(F-statistic)	0.00000

Autocorrelation and Heteroskedasticity Tests (with 12 lags)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.571500	Probability	0.85730
Obs*R-squared	7.799727	Probability	0.80057

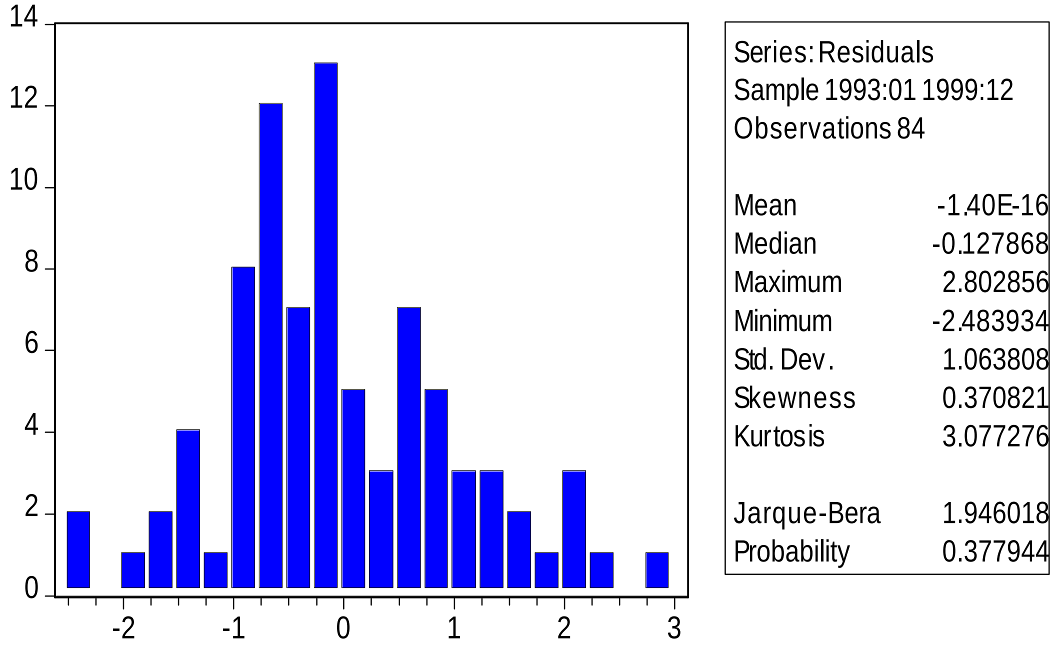
ARCH Test:

F-statistic	1.722171	Probability	0.08486
Obs*R-squared	18.67741	Probability	0.09661

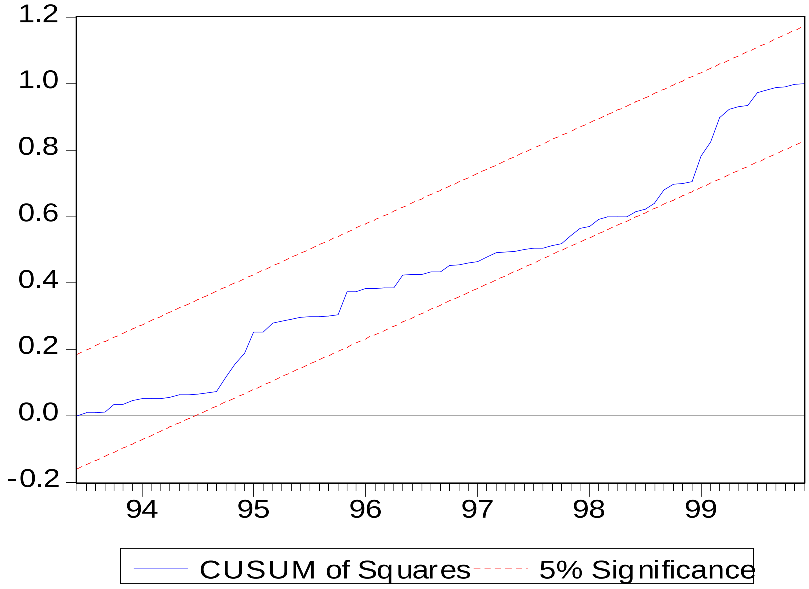
White Heteroskedasticity Test:

F-statistic	2.057347	Probability	0.05081
Obs*R-squared	15.11650	Probability	0.05691

Normality of errors



Stability of parameters: Test CUSUM Q



Equation to forecast inflation

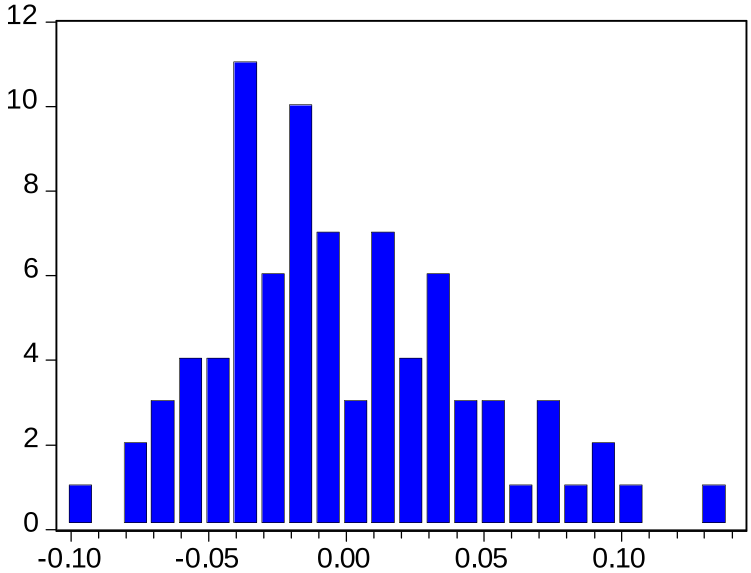
Equation

Dependent Variable: DIPCMOV
Method: Least Squares
Sample(adjusted): 1993:02 1999:12
Included observations: 83 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015128	0.008479	1.784147	0.5444
DIPCMOV(-1)	1.140686	0.087740	13.00080	0.0000
DIPCMOV(-2)	-0.371898	0.138049	-2.693947	0.0087
DIPCMOV(-3)	0.590042	0.137384	4.294836	0.0001
DIPCMOV(-4)	-0.331514	0.092412	-3.587350	0.0006
DIPCMOV(-9)	-0.130378	0.042941	-3.036212	0.0033
DIPCMOV(-12)	0.069772	0.027667	2.521878	0.0958

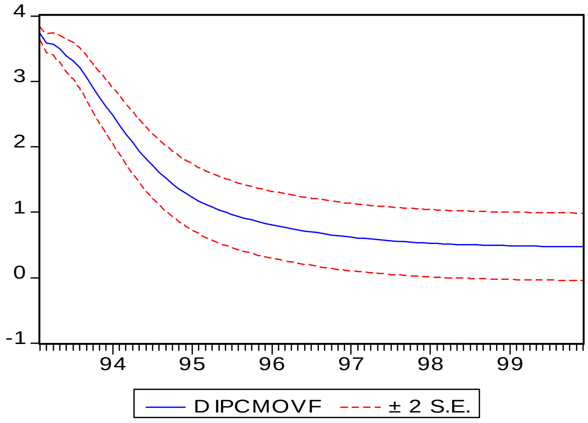
R-squared	0.997717	Mean dependent var	1.18224
Adjusted R-squared	0.997537	S.D. dependent var	0.96603
S.E. of regression	0.047942	Akaike info criterion	-3.15706
Sum squared resid	0.174684	Schwarz criterion	-2.95306
Durbin-Watson stat	2.063870	Prob(F-statistic)	0.00000

Normality of errors



Series: Residuals	
Sample 1993:02 1999:12	
Observations 83	
Mean	2.43E-16
Median	-0.009430
Maximum	0.139158
Minimum	-0.094249
Std. Dev.	0.046155
Skewness	0.555865
Kurtosis	3.002538
Jarque-Bera	4.274321
Probability	0.117989

Coefficient of Theil



Forecast: DIPCMOVF
Actual: DIPCMOV
Sample: 1993:02 1999:12
Include observations: 83

Root Mean Squared Error	0.142129
Mean Absolute Error	0.120745
Mean Abs. Percent Error	20.70710
Theil Inequality Coefficient	0.047064
Bias Proportion	0.016735
Variance Proportion	0.017697
Covariance Proportion	0.965568

Equation to forecast core inflation

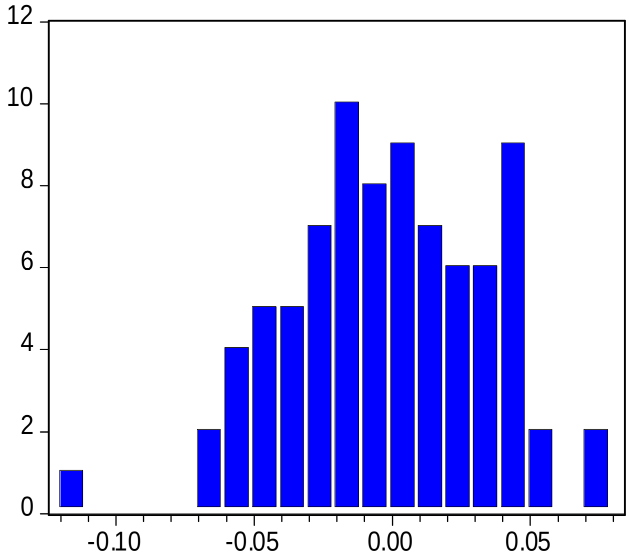
Equation

Dependent Variable: DIPCSMOV
Method: Least Squares
Sample(adjusted): 1993:01 1999:12
Included observations: 84 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009330	0.006533	1.428062	1.0917
DIPCSMOV(-1)	1.149528	0.035182	32.67402	0.0000
DIPCSMOV(-4)	-0.180854	0.036816	-4.912398	0.0000
DIPCSMOV(-12)	0.005866	0.012998	0.451332	0.6530

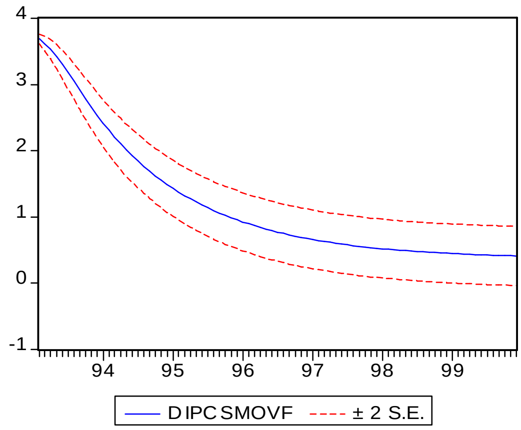
R-squared	0.998564	Mean dependent var	1.21555
Adjusted R-squared	0.998509	S.D. dependent var	0.93789
S.E. of regression	0.036210	Akaike info criterion	-3.75195
Sum squared resid	0.103584	Schwarz criterion	-3.63537
Durbin-Watson stat	1.888181	Prob(F-statistic)	0.00000

Normality of errors



Series: Residuals	
Sample 1993:02 1999:12	
Observations 83	
Mean	-2.52E-16
Median	-0.001337
Maximum	0.079534
Minimum	-0.110302
Std. Dev.	0.035542
Skewness	-0.232729
Kurtosis	2.957748
Jarque-Bera	0.755429
Probability	0.685426

Coefficient of Theil



Forecast: DIPCSMOVF	
Actual: DIPCSMOV	
Sample: 1993:02 1999:12	
Include observations: 83	
Root Mean Squared Error	0.115365
Mean Absolute Error	0.100856
Mean Abs. Percent Error	10.83827
Theil Inequality Coefficient	0.037918
Bias Proportion	0.033269
Variance Proportion	0.004292
Covariance Proportion	0.962439