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By Marcelo Sánchez

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WITH AN APPLICATION TO ROMANIA[1]

by Marcelo Sánchez[2]

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Abstract

This paper attempts to characterise an anti-inflationary monetary targeting (MT) regime. In order to derive a formal representation of this regime, we formulate the central bank's optimisation problem under the assumption that it is possible for the monetary targeted variable to have an impact on inflation. We apply a rather general framework to the Romanian experience with MT in the period 1999-2005. We find that during this period Romania's MT regime can be characterised by a concern for price stability and an additional role for smoothing of the central bank's instrument (base money growth). Our results suggest that exchange rate variability and output gap stability appear not to have entered the objective function significantly.

Keywords: monetary targeting; optimal monetary policy; Romania
JEL classification: E52, E58, C32, C61

Non-technical summary

Over the years, many countries around the globe have adopted monetary targeting (MT) regimes under different circumstances. It is sometimes claimed that the Bundesbank's and the Swiss National Bank's outstanding record of inflation control stemmed from their use of monetary targeting. Moreover, a number of economies belonging to the sometimes called "US dollar bloc", such as Australia, Canada, and New Zealand, have also implemented MT strategies in the past. The decision of these economies to switch to inflation targeting from the very end of the 1980s onwards is related to the difficulties with using MT under conditions of financial innovation that led to instability in the velocity of money. While not following a MT approach, the Eurosystem has adopted a monetary policy framework which emphasises the role of monetary aggregates. Also among emerging market economies (EME), a rich variety of experiences provide us with evidence of the widespread use of MT over time, including China – currently the world's largest EME.

During the period of monetary targeting in Romania (1999-2005), inflation was reduced from very high and unstable levels. The technical problems involved in applying monetary targeting (e.g. conjunctural instability of money demand, ongoing financial innovation) do not appear to have interfered with the aim of bringing inflation rates down over time. If anything, those technical difficulties may have contributed to preventing the disinflation process from proceeding at a faster pace. Our characterisation of the monetary targeting regime in Romania between 1999-2005 implies that monetary policy was concerned with price stability and an additional role for smoothing of the central bank's instrument (base money growth). Exchange rate variability and output gap stability appear not to have significantly entered the objective function. Our results shed some light on both general issues concerning monetary targeting (such as the tradeoff between inflation and output, and instrument smoothing) and the more specific aspects relating to Romania's emerging market status. With regard to the former set of issues, our characterisation of past Romanian policy in terms of lack of instrument smoothing is in line with many previous studies carried out for explicit inflation targeting, including those conducted for advanced economies (see e.g. Collins and Siklos, 2004, and references therein) and South Korea (Sánchez, 2009).

The result that the exchange rate does not appear to have been a direct monetary policy concern – which resembles Sánchez's (2009) finding for inflation targeting South Korea – deserves further discussion. Although the NBR had price stability as it main policy goal and the leu was officially floating, it has been pointed out (see e.g. OECD, 2002) that Romania pursued an implicit exchange rate crawling peg during the MT period. This notion of a (successful) de facto peg is however not substantiated by the data (Frömmel and Schobert, 2006; Firdmuc and Horváth, 2008). This supplementary evidence supports the plausibility of our results. It is worth saying that our finding that the exchange rate does not appear to have been a direct concern does not *per se* invalidate the notion that the exchange rate had played a role in monetary policymaking. Indeed, it is worth stressing that, even if we find that the exchange rate did not directly enter the objective function in the MT era, this variable may have still played a role indirectly, given that inflation is both a policy goal and a variable responding to exchange rate movements e.g. via the pass-through channel. In this regard, earlier studies on Romania have emphasised financial stability considerations or the role of the exchange rate in the transmission process, such as Popa et al. (2002) or Antohi, Udrea and Braun (2003).

1. Introduction

Over the years, many countries around the globe have adopted monetary targeting (MT) regimes under different circumstances. This has been the case of many advanced economies, in which this strategy has been in place for a prolonged period of time in the postwar era (Laubach and Posen, 1997; Mishkin, 2001; Gerlach and Svensson, 2003). It is sometimes claimed that the Bundesbank's and the Swiss National Bank's outstanding record of inflation control stemmed from their use of monetary targeting. The extent to which these central banks have actually adhered to the strict anti-inflationary form of a MT rule, or instead have adopted a more pragmatic approach, has been a matter of debate. A number of economies belonging to the sometimes called "US dollar bloc", such as Australia, Canada, and New Zealand (Collins and Siklos, 2004), have also implemented MT strategies in the past. The decision of these economies to switch to inflation targeting (IT) since the late 1980s is related to the difficulties with using MT under conditions of financial innovation that led to instability in the velocity of money. While not following a MT approach, the Eurosystem has adopted a monetary policy framework that emphasises the role of monetary aggregates (ECB, 1999).

A rich variety of experiences with MT is available from emerging market economies (EME). Currently, the world's largest EME, China, follows a monetary strategy that contains elements of MT. Rather than resorting to interest rates as a policy tool, the Chinese authorities have set annual intermediate targets for money supply growth (M1 and M2), coupled – in recent years – with a target for credit growth (Koivu et al., 2008). In the case of the second largest Asian EME, South Korea, MT was in place over a period of time spanning the years 1973 to 1995 (Dueker and Kim, 1999). Back then, the Bank of Korea's mission could not be characterised as pursuing price stability, but rather allowing rapid credit expansion to foster growth.[3] Indonesia adopted MT until 2002, when the challenges created by unstable money demand prompted the country to switch to IT (McLeod, 2003). Further to Romania, other South-Eastern Europe countries and neighbouring Turkey have in recent years followed – at least for a period of time – some variant of MT (Oesterreichische Nationalbank, 2004; Berument and Taçi, 2003).

The present paper aims at characterising anti-inflationary MT regimes. In order to derive a formal representation of the MT regime, we formulate the central bank's optimisation problem under the assumption that the monetary targeted variable has an impact on inflation, either directly or indirectly, or both. Moreover, we solve for the constrained optimal reaction functions conditional on the equations describing the dynamics of the economy. Prior to thus characterising MT's ability to influence inflation, we consider two simpler approaches. First, we set up the problem in connection with Svensson's (1997) treatment of the "money growth targeting" regime. We extend this author's framework by allowing money demand to contemporaneously respond to financial variables (the interest rate and the exchange rate). This plays an important role here because it allows the money supply to be controlled by policy, without the need for the model to have the interest rate as the only available instrument. Second, we revisit Ruta's (1999) comparison – in the presence of unionised wage bargaining – of a regime that focuses on reaching the monetary target with one that focuses on meeting the inflation target. Our extensions of Svensson (1997) and Ruta (1999) follow these authors' basic approach of considering a single objective for monetary policy (price stability and,

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[3] Price stability has instead been made the primary objective of Korea's IT regime since 1999.

in the latter study's case, alternatively also money supply stability).[4] We then develop a somewhat more general framework that allows for various monetary policy objectives. To put this analytical framework to the test, we apply it to the conduct of monetary policy in Romania over the period 1999-2005, which is best characterised as a MT regime.

Considerable research has been devoted to uncovering central bank preferences. The empirical literature on optimal monetary policy has largely focused on the US, which is not an MT (nor an IT) country. Related work for other countries has focused on IT experiences (Collins and Siklos, 2004; Sánchez, 2009). Our paper extends the literature providing first estimates for an MT central bank's objective function – namely, the National Bank of Romania's (NBR) in the period 1999-2005.[5] While no estimates of central bank preferences are to date available for Romania, for the MT period the European Institute of Romania (2004) characterises NBR reactions in terms of borrowed reserves responses to inflation and the value of the leu. Unlike estimated policy rules – which cannot address questions about the policy formulation process – the identification of policy weights attempted here has the advantage of aiming to unveil central bank objectives.

Our study addresses two questions concerning the operation of anti-inflationary monetary policies, namely, general issues (in particular, instrument smoothing) and the more specific aspects relating to Romania's EME status. With regard to the former, our assessment of Romanian policy in terms of instrument smoothing is relevant given the

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[4] Svensson (1997) also investigates the case of IT inflation targeting with multiple objectives, showing that it implies a gradualist approach to inflation stabilisation on the part of "flexible" monetary policymaking. Ruta (1999) considers multiple goals in society's welfare function, which raises the issue of whether IT or MT leads to smaller social losses.

[5] A rigorous assessment of current policy intentions is out of the question due to the short period elapsed since the launch of the IT regime (announced in August 2005) – a period in which the country was also subjected to significant external shocks.

experience of countries explicitly targeting inflation, with smoothing in the present case referring to base money growth instead of the interest rate. With regard to the latter instrument, smoothing has been documented for advanced economies (Collins and Siklos, 2004; Ozlale, 2003; Dennis, 2006) and South Korea (Sánchez, 2009). Moreover, we evaluate in a Romanian context the question whether monetary policy was concerned about exchange rate stability – an issue particularly relevant for emerging market economies (EME). Exchange rate fluctuations have in recent years become wider among this group of countries, but the extent of such variability is still debated. EMEs have special characteristics that could motivate their "fear of floating", i.e. their desire for a relatively small degree of exchange-rate flexibility. One possible explanation for this is that a devaluation/depreciation would raise the domestic-currency real value of external liabilities, thus provoking a drop in economic activity.[6] Although the NBR had price stability as it main policy goal and the leu was officially floating, it has been pointed out (see e.g. OECD, 2002) that Romania pursued an implicit exchange rate crawling peg during the MT period. This notion of a (successful) *de facto* peg is however not substantiated by the data (Frömmel and Schobert, 2006; Firdmuc and Horváth, 2008).

We look at the conduct of monetary policy in Romania over the period 1999-2005. We begin our analysis in 1999 because, in the two years before that (which can also be classified as MT), Romania was affected by considerable macroeconomic instability as the country adjusted to the launch of an IMF-backed programme and faced unfavourable international conditions (Gabor, 2008). In order to examine the relative

[6] A weaker currency is generally found to be contractionary in the empirical literature, even after including a number of different controls. For discussions on the implications of contractionary depreciations for monetary policy, see e.g. Sánchez (2007, 2008).

short period 1999-2005, we resort to monthly data, employing smoothed versions for candidate monetary policy objectives that could be affected by high-frequency volatility.[7]

Technically speaking, Ozlale’s (2003) US study comes closest to ours. This author employs maximum-likelihood methods to uncover central bank preferences conditional on private sector behaviour. Dennis (2006) proposed a different methodology, jointly estimating the macro-model and monetary policy weights. Otherwise, the latter study, like Ozlale (2003), employs Rudebusch and Svensson’s (1999) model to describe the macroeconomy and uses an infinite horizon quadratic objective function. One caveat with this literature – one that also applies to the present study – is the lack of forward-looking elements. In acknowledgement of this limitation, we adopt a seemingly unrelated regression approach to estimation of the macro-model – a technique allowing for correlation across simultaneous equation errors. Another way in which we depart from the studies mentioned in this paragraph is the introduction of the money market equilibrium and small-open-economy features. Drawing on Collins and Siklos' (2004) and especially Sánchez's (2009) studies for other small open economies, the latter features involve the NBR's possible concern for exchange rate stability, and the role of the exchange rate and external variables in Romanian macroeconomic developments.

The structure of the paper is as follows. Section 2 outlines the main characteristics of Romania's MT regime, also comparing key macroeconomic developments at the time with the periods immediately before and after it. Section 3 describes the paper's theoretical approach and empirical methodology. Results and policy implications are discussed in section 4. Section 5 offers concluding remarks.

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[7] A first idea of the developments concerning two key Romanian statistical series (namely, inflation and money base growth) can be obtained from looking at Figure 1.

2. Formal characterisation of the MT regime

This section attempts to set up a formal representation of the MT regime. In order to characterise anti-inflationary MT regimes, we adopt two perspectives, the key one consisting in setting up the problem in connection with Svensson's (1997) treatment of the "money growth targeting" regime (subsection 2.1). An important part of the analysis here consists of extending the author's framework by allowing money demand to contemporaneously respond to financial variables (the interest rate and the exchange rate). This has the implication that it allows the money supply to be controlled by policy, without the need for the model to have the interest rate as the only available instrument. We focus on the approach to MT that we label conditional monetary targeting (CMT), which involves a policy rule and is thus different from simply setting money growth to a constant, that is, unconditional monetary targeting (UMT).[8] In subsection 2.2, we revisit Ruta's (1999) comparison between CMT and UMT in the presence of unionised wage bargaining.[9] Our extensions of Svensson (1997) and Ruta (1999) follow these authors' basic approach of considering a single objective for monetary policy (price stability and, in the latter study's case, also money supply stability).[10] Our extension of Svensson (1997) is meant to help us set up the somewhat more general framework of section 3, which allows for various monetary policy objectives and is then (in section 4) taken to Romanian data over the period 1999-2005. The extension of Ruta (1999) does justice to a

[8] We borrow the label "conditional" from Svensson (1997), who uses it for the MT regime where, unlike here, the instrument is the interest rate.

[9] It is worth clarifying that our concepts of CMT and UMT are called by Ruta (1999) "inflation targeting" and "monetary targeting", respectively.

[10] Svensson (1997) also investigates the case of IT with multiple objectives, showing that this amounts to a gradualist approach to inflation stabilisation on the part of "flexible" monetary policymaking. Ruta (1999) considers multiple goals in society's welfare function, which raises the issue of whether UMT or CMT leads to smaller social losses.

different valid approach to inflation-fighting under MT, which we look at for completeness and reference.

In our reference to different monetary regimes in the present section, it must be borne in mind that the central bank objective is always price stability, but that there is a difference between IT and MT in that only the latter adopts as an instrument money supply, and not the interest rate. Instead, in Svensson (1997) the instrument is always the interest rate. The two would achieve equivalent results only if there were no disturbances affecting the relation between the money base and the interest rate, but this is not in general the case in our setup because of the presence of shocks to the monetary multiplier and money demand.

2.1 An anti-inflationary MT regime

This subsection extends Svensson's (1997) treatment of the "money growth targeting" regime by allowing money demand to contemporaneously respond to financial variables (the interest rate and the exchange rate).

Consider the simple model:

$$\pi_{t+1} = \pi_t + \alpha_1 y_t + \varepsilon_{t+1} \quad (1)$$

$$y_{t+1} = \beta_1 y_t + \beta_2 (i_t - \pi_t) + \beta_3 e_t + \eta_{t+1} \quad (2)$$

$$m_{2,t+1} - p_{t+1} = y_{t+1} - \kappa i_{t+1} + \lambda s_{t+1} + \nu_{t+1} \quad (3)$$

$$m_{2,t+1} = c + m_{t+1} + \xi_{t+1} \quad (4)$$

$$s_{t+1} = -\theta (i_{t+1} - i^*_{t+1}) + \phi_{t+1} \quad (5)$$

where π_t is the inflation rate in year *t*, $p_t(p_t^*)$ is the log price level at home (abroad), y_t is an endogenous variable ((log) output (relative to potential output), say), s_t is the nominal exchange rate (an increase meaning a depreciation), $e_t \equiv s_t - p_t + p_t^*$ is the real exchange rate, $i_t(i_t^*)$ is the nominal interest rate at home (abroad), and ε_t, η_t, ν_t, ξ_t and ϕ_t are i.i.d. shocks in year *t* that are not known in year *t+1*. The coefficient α_1 is assumed to be positive; the other coefficients are assumed to be nonnegative; β_1 in addition fulfils $\beta_1 \in (0,1)$.

In (1), the change in inflation increases with lagged output.[11] In (2), output is serially correlated, decreasing in the real interest rate, $i_t - \pi_t$, and increasing in the real exchange rate. The long-run natural output level is normalised to equal zero. Equations (3) and (4) capture the existence of an equilibrium for the market for money. The instrument of monetary policy is the money base, m_t, which affects m_{2t}, the broad (M2) money supply, via a money multiplier mechanism. Concerning the money demand specification, the income velocity for simplicity is unity. Moreover, unlike Svensson (1997), who models money demand as including a (predetermined) interest rate term, we allow for this link to be contemporaneous. Likewise, a contemporaneous relation is allowed between money demand and the exchange rate. Finally, in (5) we postulate a positive link between interest rates and exchange rates; this can be interpreted to mean

[11] We ignore a direct exchange-pass through term in (1) on the basis that it would not have any implication for monetary policymaking as long as the central bank cares only about "domestic inflation", that is, neglecting such terms which simply captures foreign inflation pressures. This is equivalent to positing that policymakers ignore temporary deviations of inflation induced by real exchange rate movements. In this regard, Ball (2002) redefines the inflation target by subtracting the exchange-pass through term in question from the inflation target, $\tilde{\pi}$.

that higher interest rates induce larger capital inflows which in turn yield an exchange rate appreciation.

Let us further discuss the inclusion of the exchange rate in the money demand function. The idea goes back to Mundell (1963) and has been tested in a number of empirical applications. From a theoretical perspective, the overall impact of the exchange rate on money holdings is ambiguous, with the two different possible signs involved tending to be interpreted as depending on whether a wealth effect or a substitution effect prevails.[12] A depreciation of the domestic currency increases the value of foreign financial assets held by domestic individuals. When this increase is seen as raising the value of wealth, the demand for money may go up. A second possible channel relates to a "direct currency substitution" effect, which operates via the rate of return on foreign money (Calvo and Rodriguez, 1997). According to the currency substitution literature, when the exchange rate is expected to depreciate, the expected return from holding foreign money increases, and the demand for domestic currency falls (as individuals substitute foreign money for domestic currency).

Initial prices (that is, computed at a given reference value of t) are normalised to equal 0 (in logs) both at home and abroad, i.e. $p_t = p_t^* = 0$.

Foreign variables are allowed to exhibit autoregressive processes of order up to 2:

[12] For early empirical studies, see e.g. Arango and Nadiri (1981) and Bahmani-Oskooee and Pourheydarian (1990).

$$\pi^*_{t+1} = \gamma_1 \pi^*_t + \gamma_2 \pi^*_{t-1} + \varepsilon_{\pi^*,t+1} \tag{6}$$

$$i^*_{t+1} = \phi_1 i^*_t + \phi_2 i^*_{t-1} + \varepsilon_{i^*,t+1} \tag{7}$$

with $0 < \gamma_1 + \gamma_2 < 1$ and $0 < \phi_1 + \phi_2 < 1$.

We assume that the central bank conducts monetary policy trying to reach the inflation target, $\tilde{\pi}$. More concretely, the central bank's objective in period *t* is to select a path of values of the instrument so as to minimise the expected sum of discounted squared future deviations of inflation from the target.

$$E_t \sum_{\tau=t}^{\infty} \delta^{\tau-t} L(\pi_\tau) \tag{8}$$

where E_t denotes expectations conditional upon information available in year *t*, $\delta \in (0,1)$ is the discount factor, and the period loss function is given by

$$L(\pi_\tau) = \frac{1}{2}\left(\pi_\tau - \tilde{\pi}\right)^2 \tag{9}$$

From (1) and (2), we get

$$\pi_{t+2} = (\pi_t + \alpha_1 y_t + \varepsilon_{t+1}) + \alpha_1 [\beta_1 y_t - \beta_2 (i_t - \pi_t) + \beta_3 e_t + \eta_{t+1}] + \varepsilon_{t+2}$$

which, using (5), yields

$$\pi_{t+2} = a_1 \pi_t + a_2 y_t + a_3 (s_t + \pi^*_t) - a_4 i_t + (\alpha_1 \eta_{t+1} + \varepsilon_{t+1} + \varepsilon_{t+2}) \tag{10}$$

where $a_1 \equiv 1 + \alpha_1(\beta_2 - \beta_3)$, $a_2 \equiv \alpha_1(1 + \beta_1)$, $a_3 \equiv \alpha_1 \beta_3$ and $a_4 \equiv \alpha_1 \beta_2$.

Moreover, from (3) and (4), we get for period *t*

$$m_t = y_t + \pi_t - \kappa i_t + \lambda s_t - c + \zeta_t \tag{11}$$

where $\zeta_t \equiv v_t - \xi_t$. Substituting the value of s_t from (10) into (11) leads to

$$\pi_{t+2} = Bc + b_1\pi_t + b_2 y_t + Bm_t - a_4 i_t + a_3\pi_t^* + \kappa B i_t^* + (\alpha_1\eta_{t+1} + \varepsilon_{t+1} + \varepsilon_{t+2}) + B\left(\frac{\kappa}{\sigma}\phi_t - \zeta_t\right) \quad (12)$$

where $B \equiv a_3\sigma/(\kappa - \sigma\lambda)$, $b_1 \equiv a_1 - B$, and $b_2 \equiv a_2 - B$.

From (12), the conditional expectation of π_{t+2} based on information available at time t in terms of period t variables can thus be written as:

$$\pi_{t+2|t} = Bc + b_1\pi_t + b_2 y_t + Bm_t - a_4 i_t + a_3\pi_t^* + \kappa B i_t^* + B\left(\frac{\kappa}{\sigma}\phi_t - \zeta_t\right) \quad (13)$$

The conditional expectation of π_{t+2} based on information available at time t is expressed in terms of period t variables, including the monetary policy instrument, In the model, money base is allowed to affect money supply (M2), and thus the interest rate and exchange rate, contemporaneously. Output is affected with a one-period lag, and thus inflation with a two-period lag, which is the control lag in the model. Therefore, minimisation of (8) can be seen as equivalent to finding, at each point in time, the current value of the optimal money base, m_t, with the aim of reaching the inflation target two periods ahead. That is, the monetary authority can be modelled as deciding money base at time t as the solution to the simple period-by-period problem

$$\min_{m_t} E_t \delta^2 L(\pi_{t+2})$$

Minimising this expression with respect to m_t yields

$$\pi_{t+2|t} = \tilde{\pi}$$

This means that the money base in period t is to be set so that the forecast of the one-period 'forward' inflation rate from period *t+1* to period *t+2*, conditional upon information available in period *t*, equals the inflation target. Replacing the expression above into (13), we obtain the optimal reaction function[13]

$$m_t = \frac{1}{B}\left\{\tilde{\pi} - b_1\pi_t - b_2 y_t - a_3\pi_t^* + a_4 i_t\right\} - c - \kappa i_t^* + \zeta_t - \frac{\kappa}{\sigma}\phi_t$$

The equilibrium inflation rate can be written as

$$\begin{aligned}\pi_{t+2} &= \pi_{t+2|t} + \left(\alpha_1\eta_{t+1} + \varepsilon_{t+1} + \varepsilon_{t+2}\right) \\ &= \tilde{\pi} + \left(\alpha_1\eta_{t+1} + \varepsilon_{t+1} + \varepsilon_{t+2}\right)\end{aligned}$$

The deviation of inflation from target can thus be expressed as

$$\pi_{t+2} - \tilde{\pi} = \alpha_1\eta_{t+1} + \varepsilon_{t+1} + \varepsilon_{t+2}$$

In turn, equilibrium output can be found to equal

$$y_{t+1} = -\frac{1}{\alpha_1}\varepsilon_t + \eta_{t+1} - \eta_t$$

An MT regime of the type here outlined implies a simple rule for its implementation. The central bank's inflation forecast for the horizon corresponding to the control lag (i.e. two periods ahead) becomes an intermediate target. The instrument, m_t, is thus to be set so as to make the inflation forecast equal to the inflation target. The monetary authority's optimal reaction function implies a simple feedback rule: if the inflation forecast is above (below) the target, the money base should be decreased (increased). Given that the inflation forecast is a function of all relevant information, the instrument also depends on all relevant information. It is worth clarifying that the

[13] We assume that present-period shocks are observed by the central bank. Otherwise, they should not enter the reaction function, but the prediction error. This aspect is not crucial to our setup, which can easily allow for imperfectly controlled money supply (M2) developments. What is important is that we extend Svensson (1997) by allowing money growth to react contemporaneously to financial variables (interest rates and exchange rates).

instrument depends on current inflation, not because the central bank targets current inflation but because the latter, *inter alia* along with output and the exchange rate, helps predict future inflation. Observed inflation will differ from the target, because of shocks impinging on the economy within the control lag. As long as the central bank conducts policy optimally, it makes the mean forecast errors vanish and minimises the variance of the forecast errors.

In our model, money supply (M2) reacts contemporaneously to the instrument (the money base, M0). This deviates from Svensson (1997)'s treatment of money growth targeting, in which money growth reacts with a lag to the instrument (the interest rate). Which characterisation of MT is better will naturally depend on the features of the economy in question, being thus a purely empirical matter. In any case, all other implications obtained by Svensson (1997) for conditional money growth targeting carry over to the extension (CMT) pursued here.[14] First, either type of "sophisticated" money growth targeting can achieve the same equilibrium as an IT regime's optimal reaction function (see Svensson, 1997, for details on the case of money growth forecast targeting). Second, one could argue that conditional money growth targeting is less direct and less transparent on the part of the central bank than simply setting the interest rate to reach the inflation target.[15] UMT (as given by the monetary authority's choice of a constant money

[14] The (conditional and unconditional) MT that we refer to here differs from the corresponding concepts in Svensson (1997) in that in our case the instrument is money base, and in his case it is the interest rate. If the interest rate and the exchange rate do not react on impact to money supply (as we allow for), then Svensson's (1997) treatment would be an appropriate alternative.

[15] Despite some similarities between conditional money growth targeting and IT, Svensson (1997) makes the point that the former regime can be less direct and transparent than the latter. This argument carries over to our comparison between CMT and IT, when the instrument we use for CMT no longer is the interest rate but the money base. Money is here allowed to play a role in the transmission process by affecting interest rates and exchange rates – a channel that is obscured by shocks to the monetary multiplier and money demand. In contrast, IT directly controls the interest rate making the role of inflation forecasts easier to communicate to the public. In this context, market participants might have doubts about whether

growth rate over time) can be regarded as more transparent than the conditional one. It results in long-run average inflation equal to the target, but inflation and inflation expectations will be more variable and show persistent deviations from the target. The reason is that domestic output as well as foreign interest rates and inflation are themselves persistent. The ensuing higher variability of inflation implies that unconditional money growth targeting would lead to a larger intertemporal loss, being thus inefficient.[16]

2.2 The role of unionised wage bargaining

The previous subsection attempted to characterise MT on the basis of a simple model. There we extended Svensson's (1997) standard approach to allow for contemporaneous interaction between financial variables and money balances – with the money base redefined to be the monetary policy instrument. In terms of comparisons between the MT and IT regimes, this exercise mostly confirmed Svensson's (1997) results. The present subsection further explores the robustness of Svensson's (1997) analysis, this time trying a different type of extension. More concretely, here we revisit Ruta's (1999) earlier examination of monetary regimes in the context of strategic interaction between the central bank and unionised wage setters. Ruta's (1999) study is insightful in that it shows that UMT may offer an inflation-fighting advantage over CMT when wage setters are

the central bank is trying to reach an inflation goal using a monetary instrument or is simply focused on trying to reach a value (intermediate target) for the money target with the objective(s) pursued not necessarily being so clear to the public.

[16] According to Svensson (1997), the only case under which unconditional money growth targeting would be optimal is if future inflation for a small open economy is best predicted only by money growth. In this case, inflation forecast targeting would imply unconditional money growth targeting. Likewise, inflation forecast targeting would imply exchange rate targeting if the exchange rate is a sufficient statistic for future inflation, in which case exchange rate targeting would be optimal. However, under normal circumstances neither money growth nor exchange rate depreciation is a sufficient statistic for future inflation; that is, other information has additional predictive value. Under those conditions, money growth targeting or exchange rate targeting is inefficient and leads to a worse outcome than inflation forecast targeting.

inflation averse – a possibility that does not arise in standard analyses that abstract from strategic wage setting considerations. While adopting the latter novel feature, the model of the present subsection is simplified in other dimensions, such as having a static setup, or cutting off the link between money supply and financial variables.

The connection of subsection 2.1 (extension of Svensson, 1997) with the extension of Ruta's (1999) analysis in the present subsection deserves further discussion. CMT can in principle achieve the same macroeconomic outcome reached by inflation targeting but being less transparent. The public might then not be able to fully understand what the policymaker is doing, for instance whether policy follows CMT or UMT given the uncertainty surrounding the connections between money, interest rates and inflation. In this context, Ruta's (1999) contribution is useful as it offers insights about different macroeconomic consequences of CMT versus UMT. Having said this, as with subsection 2.1, this paper from section 3 on will concentrate on the role of some version of CMT as an inflation-fighting approach. The adequacy of this modelling strategy will be assessed on the basis of the plausibility of the results obtained in the application chosen, namely, Romania's experience with MT over 1999-2005. Subsection 2.2 simply makes the point that the possibilities with MT are somewhat more varied, with Ruta's (1999) game-theoretical setup pointing to the chance for lower inflation to arise not from the policymaker's focus on inflation (in CMT) but, on the contrary, from the concentration on reaching the money target (in UMT) and implicitly at the expense of reaching the inflation target. This allows us to show that the success that policy could obtain in terms of inflation stabilisation might be traced not only to control over the monetary instrument

– as we emphasise elsewhere in this paper – but also to strategic effects involving the interaction of the central bank with wage-setters.

Suppose that the economy in question comprises one single labour union. The latter's preferences are described by the loss function

$$\Omega = -2w^r + Au^2 + B\pi^2 \tag{14}$$

where $w^r \equiv w - \pi$ denotes the (log of the) real wage,[17] w is the (log of the) nominal wage, and u and π are, respectively, the unemployment rate and inflation rate. In addition, monetary policy is conducted by a central bank who dislikes variability in the instrument, which is assumed to be the money base, *m*, around its target, $\bar{m}$. That is, the central bank minimises:

$$\Gamma = \frac{1}{2}\left(m - \bar{m}\right)^2 \tag{15}$$

The production function (in levels) linking output (*Y*) to the labour input (*L*) is $Y = L^b X$, where X is the level of labour-augmenting technology, and b a parameter between 0 and 1. Moreover, let $w^{rc} \equiv d - 1/\alpha$ be the (log of the) competitive real wage at which the national labour market clears in the absence of shocks (i.e. $u = x = 0$), and $\Phi \equiv w^r - w^{rc}$ be the real wage premium (over the competitive real wage).

Overall labour supply is L, which is assumed to be supplied inelastically at $L=1$. The union faces the labour demand:

$$L^d = \alpha\left(d - w^r + x\right) \tag{16}$$

[17] Note that we normalise the previous-period price level to 1 (0 in logs).

where $\alpha \equiv 1/(1-b) \in (1,\infty)$ is the elasticity of labour demand (with respect to the real wage) and d is a constant. From (16) the unemployment rate equals

$$u \equiv \frac{L - L^d}{L} = \alpha(\Phi - x) \qquad (17)$$

Moreover, the production function and (16) lead to the expression (in logs)[18]

$$y = -(\alpha - 1)\Phi + \alpha x \qquad (18)$$

Regarding real demand for output, we postulate the equation $y = m_2 - p + \mu$, which includes real demand shock term μ. A money multiplier mechanism is captured in the equation $m_2 = c + m$, where c is a constant. We can thus write the demand for output as

$$y = c + m - p + \mu \qquad (19)$$

From (18) and (19), the output market clears when

$$\pi = \frac{1}{\alpha}\left[(\alpha - 1)\left(w - w^{rc}\right) + c + m\right] + \left(\frac{\mu}{\alpha} - x\right) \qquad (20)$$

With regard to the timing of decisions, the present model consists of a two-stage game that we solve by backward induction, focusing on discretionary policy. In the second stage the central bank chooses the money base m to minimise (15), which simply yields $m = \bar{m}$. In the first stage the union chooses the nominal wage to minimise the expected value of (14), that is, $E\Omega$, taking the reaction function (20), with $m = \bar{m}$, as given. We assume that the operator E denotes rational expectations. The union's optimisation problem yields the equilibrium nominal wage

[18] This uses the following first-order approximation (around a "flexible price" equilibrium value of 1 for L^d): $l^d = L^d - 1$, where l^d is the log of L^d.

$$w = w^{rc} + \frac{\alpha}{(\alpha-1)^2 B + \alpha^2 A} + \left[\frac{\alpha^2 A - (\alpha-1)B}{(\alpha-1)^2 B + \alpha^2 A}\right]\left(c + E\bar{m}\right) \qquad (21)$$

The sign of the second term on the RHS of (21) is ambiguous, as can be seen from the numerator of the expression within square brackets. The reason is that a higher expected money supply (that is, a higher value of $c + E\bar{m}$) may raise or lower wages depending on the relative strength of two effects. The first one, which contributes to raising wages, relates to the higher economic activity (and, in particular, lower unemployment) associated with monetary injection. The second one, which exerts downward pressure on wages, concerns the higher inflation associated with monetary injection; the inflationary consequences induce an inflation-averse trade union to moderate its wage demands.

Following Ruta (1999), we assume that social welfare is given by

$$\Gamma = y^2 + \chi\pi^2 \qquad (21)$$

where χ is the society's weight on inflation aversion relative to output stabilisation. Socially optimal values for both output and inflation are set to zero. The equilibrium values of the endogenous variables that influence social welfare – namely, inflation and output – can be found to equal

$$\pi = \frac{\alpha-1}{(\alpha-1)^2 B + \alpha^2 A} + \frac{1}{\alpha}\left(\bar{m} - E\bar{m}\right) + \left[\frac{\alpha^2 A}{(\alpha-1)^2 B + \alpha^2 A}\right]\left(c + E\bar{m}\right) + \left(\frac{\mu}{\alpha} - x\right) \qquad (22)$$

$$y = -\frac{\alpha-1}{(\alpha-1)^2 B + \alpha^2 A} + \left(\frac{\alpha-1}{\alpha}\right)\left(\bar{m} - E\bar{m}\right) + \left[\frac{(\alpha-1)^2 B}{(\alpha-1)^2 B + \alpha^2 A}\right]\left(c + E\bar{m}\right) + \left[\frac{(\alpha-1)}{\alpha}\mu + x\right] \qquad (23)$$

Finally, we can find the socially optimal value of monetary target, $\bar{m}$. This can be done by plugging (22) and (23) into (21), and then minimising the resulting expression with respect to $\bar{m}$, also assuming no uncertainty (i.e. $\mu = x = 0$) and a credible target (i.e. $\bar{m} = E\bar{m}$). That socially optimal value of $\bar{m}$ equals

$$\bar{m}_{opt} = -c + \frac{(\alpha-1)\left[(\alpha-1)^2 B - \chi\alpha^2 A\right]}{\chi\left(\alpha^2 A\right)^2 + \left[(\alpha-1)^2 B\right]^2} \tag{24}$$

This differs from the monetary target implied by setting inflation equal to zero (that is, making π hit its socially optimal target). That monetary target would amount to

$$\bar{m}^{\times} = -c + \frac{1}{(\alpha-1)B} \tag{25}$$

once more assuming no uncertainty (i.e. $\mu = x = 0$). This is an option to the monetary policymaker, but it will not be chosen unless $A=0$, in which case equations (24) and (25) are equivalent. The reason why a UMT central bank otherwise dominates that operating in a CMT regime is that the former can take advantage of union's unemployment aversion ($A>0$), which makes wage claims more moderate. This is so because wage setters correctly perceive that, if inflation is not anchored (in the sense of being kept at its target), it might be too low and thus elicit excessive unemployment. In order to insure against this event, the union is less aggressive and the ensuing equilibrium entails lower wages and inflation, along with a drop in unemployment. In contrast, by attaching priority to inflation in monetary policymaking, a CMT regime dampens the union's incentive to moderate its wage claims. This in turn stems from the circumstance that a CMT central bank is known to be in need of countering the union's wage demands in order to reach its inflation target.

3. Empirical model specification

This section focuses on the central bank's optimisation problem, conditional on a macro-model describing the rest of the economy. The setup is more general than those in section 2 in that we allow for a number of monetary policy goals. Moreover, as our focus is on characterising a given MT regime more than explaining why it emerged or remained in place, the analysis conducted here is more related to Svensson (1997) than Ruta (1999). The latter's analysis, by explicitly addressing the role of unionised wage bargaining, might however help explain why a real-world MT experience is either launched or maintained over time. More precisely, we adopt a Rudebusch and Svensson (1999) setup, extended to accommodate for money balances and open-economy features. The latter include: a) modelling the exchange rate and its implications for inflation and output fluctuations; and b) controlling for external variables that influence Romania's macroeconomic developments. We postulate that the monetary authority's instrument is m_t, the base money defined in real terms and in deviation from a time-varying trend. This instrument is set so as to minimise the following loss function:

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[\omega_\pi \pi_s^2 + \omega_y \left(y_s^Q \right)^2 + \omega_{dm} (m_s - m_{s-1}^Q)^2 + \omega_e (e_s^Q)^2 \right] \quad (26)$$

where $\beta \in (0,1)$ is a subjective discount factor. The first argument in the loss function is π_t, the annual inflation rate (in deviation from its trend). In light of our use of monthly data, which tend to be rather volatile, we resort to three-month moving averages for the remaining arguments: y_t^Q is three-month moving average of the output gap y_t, e_t^Q is the three-month moving average of the REER (in deviation from its trend) and m_t^Q is three-month moving average of m_t.[11] The (non-negative) weights the central bank places on these various goals are given by ω_π, ω_y, ω_{dm} and ω_e. The first two weights are well known and refer to a desire for price stability and output stability, respectively. The third term is meant to capture an instrument smoothing motive. In analogy to the standard interest rate smoothing, we incorporate ω_{dm} mainly to reflect the notion that an MT central bank might want to adjust the base money in a sequence of relatively small steps over several years with limited reversals of direction. Finally, weight ω_e refers to the idea that the central bank might want to stabilise the value of the exchange rate.

The rest of the economy is determined by the following equations:

$$y_t = \delta(L)y_{t-1} + \theta(L)m_{t-1} + \alpha(L)e_{t-1} + \eta(L)r_{t-1} + \tau(L)x_{t-1} + \varepsilon_{yt} \tag{27}$$

$$\pi_t = \gamma(L)\pi_{t-1} + \nu(L)y_{t-1} + \kappa(L)e_{t-1} + \xi(L)x_{t-1} + \varepsilon_{\pi t} \tag{28}$$

$$e_t = \rho(L)e_{t-1} + \mu(L)m_{t-1} + \phi(L)y_{t-1} + \upsilon(L)r_{t-1} + \psi(L)x_{t-1} + \varepsilon_{et} \tag{29}$$

$$m_t = \vartheta(L)m_{t-1} + \zeta(L)y_{t-1} + \varsigma(L)i_t + \chi(L)s_t + \sigma(L)x_{t-1} + \varepsilon_{mt} \tag{30}$$

where s_t denotes NEER, i_t is the nominal interest rate, $r_t \equiv i_t - \pi_t$, and $\delta(L)$, $\theta(L)$, etc., are polynomials in the lag operator L. In equation (27), aggregate demand is determined by its own lags, the interest rate, real money balances, the exchange rate and foreign variables x_t (involving commodity prices, output, interest rates and inflation). For money balances, we use the money base under the assumption that it is linked to a broad aggregate (say, M2) in a simple way; more precisely (in logs): $m_t = m_{2,t} + \varepsilon_t$, i.e. M0 and M2 are proportional to each other up to an iid. error term. Equation (28) is the Phillips curve, where inflation reacts – other than to external variables – to its lags, output and the exchange rate – the latter capturing a direct exchange rate pass-through effect. Equation

(29) is an exchange rate equation, with REER depending on its recent past, as well as on interest rates and output both at home and abroad (alongside other exogenous variables). Equation (30) is the money market equilibrium. The behavioural side of the demand for base money is assumed to come from the demand for M2, connected to m_t as mentioned above. We also allow for inertia in the quantity of real money balances demanded.

The market for money deserves further discussion. Our money demand specification allows not only for standard determinants (income and interest rates), but – in line with the model of subsection 2.1 – also for the exchange rate. In this regard, Romania is a small open economy where international trade liberalisation during the transition process arguably affected money holding behaviour, allowing agents to more easily switch between foreign and domestic currencies. In the literature on money demand for new EU Member States (NMS), analysts (Buch, 2001; Orlowski, 2004) have included as a regressor the exchange rate against the euro. However, the euro was only introduced in January 1999 (and in circulation only in January 2002). Prior to that, for many NMS either the US dollar or the German mark has been the most important currency (Dreger et al., 2006). For this reason, we favour the use of NEER in Romania's money demand function. As mentioned earlier, from a theoretical standpoint the overall effect of the exchange rate on money holdings is ambiguous – with the interpretation of the overall result being mostly traced to the relative strength of a wealth and a substitution effect.[19]

The macro-model is estimated using a seemingly unrelated regression (SUR) methodology. We favour SUR over OLS because the former enables error terms to be

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[19] Another possibly relevant impact of exchange rate depreciations is that they may induce extra demand for domestic goods from abroad which, alongside the pass-through effect, would raise domestic inflation rate and thus the quantity of money demanded as the value of transactions rises (Bilson, 1979).

correlated across equations, in acknowledgement that our model is too simple to be deemed fully structural. It is also worth saying that, in line with statistical significance, the estimated version of the model may not include some of the terms generally allowed for in equations (27)-(30). We employ monthly data ranging from 1999:1 to 2005:12.[20] The series for the short-term (three-month) interest rate – the ROBID (Romanian Interbank Bid Rate) – and monetary aggregates are obtained from the NBR. The data on real output (measured as an industrial production index) and headline CPI are from the International Monetary Fund's International Financial Statistics (henceforth IFS). REER and NEER data are from IFS and BIS, respectively (an increase being defined to mean an appreciation). Concerning global variables in x_t, world economic activity is measured in terms of G7 countries' industrial production indicators (from IFS), weighted according to an average over the entire sample of their quarterly national accounts (from the OECD database) expressed in US dollars. The same weights are used to construct G7 averages for the CPI index (country data from IFS), short-term interest rates (country from IFS), and equity prices (country data from BIS). Brent oil prices in US dollars are from IFS. Non-oil commodity prices in US dollars are from the Hamburg Institute of International Economics (HWWA), and are computed using OECD countries' weights. Trend values for the different variables are estimated by the Hodrick-Prescott filter.

The central bank's problem is to minimise (26) subject to (27)-(30). The solution yields the central bank's optimal reaction function. Because the loss function is quadratic, the optimal reaction function is linear in the forcing variables:

[20] Appendix subsection A.2 contains the details of our macro-model estimation. Estimating the model until the announcement of the IT regime (August 2005) did not substantially change any of the results reported below.

$$m_t = \varphi_m(L)m_{t-1}+\varphi_y(L)y_t+\varphi_\pi(L)\pi_t+\varphi_e(L)e_t+\varphi_i(L)i_{t-1}+\varphi_s(L)s_t+\varphi_x(L)x_t \quad (31)$$

where $\varphi_m(L)$, $\varphi_y(L)$, etc., are polynomials in the lag operator. Given the parameter estimates for equations (27)-(30), and values for β and the weights ω_π, ω_y, ω_{dm} and ω_e, one can use numerical methods to obtain the parameters in $\varphi_m(L)$, $\varphi_y(L)$, etc. The parameter β is set to 0.997, which amounts to 0.99 in quarterly terms. The parameters in monetary policy reaction function (31) can be seen as depending on the coefficients characterising the economy in equations (27)-(30). The intuition behind this is that policy is to be conducted to achieve the goals in (26) taking macroeconomic developments into account. Data are used to estimate the parameters of equations (27)-(30), upon which the computation of the policy weights in objective function (26) is conditioned. This proceeds by reaching the best possible match between observed base money growth rates and those implied by reaction function (31). The estimation of central bank preferences is done using a maximum-likelihood approach. The solution to the optimisation problem determines the decision rule that the NBR uses to set base money growth. The estimation procedure involves backing out the objective function parameters that best describe the data from the way macroeconomic variables evolve over time.

In order to better understand NBR intentions we consider two types of loss functions (Table 1). First, we look at two rule-of-thumb benchmarks: a) strict anti-inflationary MT, i.e. a central bank focusing purely on inflation; and b) "flexible" MT, whereby the NBR cares about both inflation and output ($\omega_\pi = \omega_y = 1$). Second, we turn to optimisation-based objective functions. This includes both the set of optimal policy weights (line 3 in Table 1) and those resulting from switching off one given optimal weight estimate at a time to assess its relative contribution to the observed base money growth path. As will be made clear in the next section, ω_π and ω_{dm} are ultimately the only weights that are estimated to be non-zero. Given that ω_π is one of the weights set to zero in one specific scenario, this time we decide not to normalise the weights by setting ω_{dm} = 1, but instead by letting included weights add up to one only at the optimum.

4. Empirical results

The methodology used here identifies optimal policy on the basis of an empirical macro-model and a postulated infinite horizon loss function for the policymaker. This section presents the model results in terms of a comparison between actual base money growth rates and paths obtained by simulating the optimal reaction functions (conditional on the set of policy weights that we employ). More specifically, we compare actual base money growth rates (thick lines in all Figures 2 through 4) with the scenarios described in section 3, which consist of a number of rule-of-thumb benchmarks and optimisation-based paths (Table 1). We also report correlation coefficients between simulated and actual base money growth rates (see Table 2).

Underlying all base money growth paths are the set of weights reported in Table 1. Concerning the weights that are based on optimisation and thus estimated (lines 3 and 4 in Table 1), the empirical results involved are reported in Table 3. The estimate for ω_π is 0.455. The null hypothesis that ω_{dm} equals zero is rejected (Wald test: χ^2 = 110.203; *p*-value = 0.000); the coefficient's point estimate is 0.254. The table shows that ω_y and ω_e are each insignificant at the 5% level. Since this is also true for them jointly (Wald test: χ^2 = 3.167; *p*-value = 0.075), we set both coefficients to zero. The final estimates for ω_π and by ω_{dm} are thus re-normalised to 0.641 and 0.359, respectively.

Our results imply that the NBR attached a negligible direct emphasis to both output and the exchange rate. The latter two variables however play indirect roles in the determination of inflation, and thus of monetary policy itself. Inspection of our estimated macro-model allows us to see that inflation is directly affected by REER (see equation (A.2) in the Appendix). Output influences inflation indirectly, given that it enters money demand function (A.4), thus affecting interest rates and – indirectly via equation (A.3) – the exchange rate which in turn impacts inflation, as we have just seen. The demand for output reacts (negatively) to the exchange rate in equation (A.1), which can be rationalised in terms of the adverse effect of the exchange rate on competitiveness. Overall, thus, even if they are not monetary policy objectives, output and exchange rates indicators appear to have been worth being monitored on a regular basis by the NBR.

Figures 2 and 3 contrast the rates of base money growth that a strict anti-inflationary and flexible monetary targeter, respectively, would have selected (each one depicted as dashed lines) alongside the corresponding actual rates.[21] The Figures imply that Romania did not pursue strict anti-inflationary nor flexible MT. Under the latter two regimes, base money growth rates would have varied much more than observed in reality. A better approximation to reality is given by optimal MT – its associated path being represented (as a thin solid line) in both Figures 2 and 3. This is consistent with the higher correlation with actual base money growth shown by the implied optimal MT path compared with strict anti-inflationary and flexible MT policies – a superiority that also extends to pure instrument smoothing as discussed in the next paragraph (Table 2).

[21] More specifically, actual base money growth rates depicted in Figures 2 through 4 correspond to smoothed (six-month moving averages) transformations of annual growth rates. Simulated paths are not smoothed, as they are already derived from an optimisation involving smoothed goals.

In Figure 4, we report actual money growth rates alongside optimal MT (again as a thin solid line) and another optimisation-based path, namely, that resulting from constraining the inflation policy weight to zero (i.e. $\omega_\pi = 0$). As said before, we do not report the case where $\omega_{dm} = 0$ as this would, in the present circumstances, be identical to the "inflation nutter"[22] scenario (that is, strict anti-inflationary MT) already depicted in Figure 2. In analogy to what we reported for strict anti-inflationary and flexible MT, optimal MT also appears to beat the case where we switch the inflation policy weight off in the optimal MT case. The latter scenario indeed implies wider fluctuations than those exhibited by both actual and optimal base money growth rates.

Visual inspection of the alternative base money growth paths is informative, but a more formal exercise can be conducted by comparing them using the encompassing test (Hendry, 1995; see the application in Collins and Siklos, 2004). The latter tests allow us to check for the statistical significance of the base money growth paths suggested by candidate reaction functions against each other. The aim is to determine whether one reaction function statistically dominates a given alternative by better tracking actual base money growth rates. The test is based on regressions of the form $\mu_t = \varsigma^1 \mu_t^* + \varsigma^2 \mu_t^{**} + \varepsilon_t$, where μ_t is the actual nominal base money (annual) growth path, and μ_t^* and μ_t^{**} are the corresponding rates as implied by any two competing reaction functions. We discriminate between one of these two competitors using Wald tests of the form: H*: $\varsigma^1 = 1$, $\varsigma^2 = 0$, or H**: $\varsigma^1 = 0$, $\varsigma^2 = 1$. If H* is not rejected, but H** is, then μ_t^* would be said to encompass μ_t^{**} (and vice versa).

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[22] The expression was used by King (1997).

Table 4 shows the results of our encompassing tests. All tests corroborate what stems from visual inspection of Figures 2 through 4. The optimal base money growth path appears to encompass all of its three alternatives at the 5% significance level. In contrast, neither of these alternative paths – namely, strict anti-inflationary MT, flexible MT and pure instrument smoothing – encompasses the optimal base money growth path.

Summarising this section thus far, our characterisation of the MT regime in Romania reveals that monetary policy evinces a dominant concern for price stability, while also displaying a considerable role for instrument (that is, base money growth) smoothing. Given these two objectives, increasing the weight that the National Bank of Romania (NBR) placed on potential additional goals (such as the variability in output gaps and exchange rates) appears to have been redundant, not helping simulated optimal base money growth rates track the policy decisions significantly more closely. Finally, optimal policy characterised in this way is shown to better track base money growth paths than the two benchmarks considered, namely, strict anti-inflationary and flexible MT.

Although the literature usually reports that interest rate smoothing is an important characteristic of central banks, a consensus has not yet been attained regarding the link between instrument smoothing and concerns about output variability. Monetary policy inertia is often associated with the idea that wide fluctuations in interest rates may imply a reputation or credibility loss if the policy decision is reversed in the near future. Policymakers would also tend to be cautious when changing interest rates due to parameter uncertainty (Sack, 2000). Yet other reasons for smoothing conveyed in the literature involve forward-looking expectations (Woodford, 2003) and data uncertainty (Orphanides, 2003). All these approximations to smoothing rely on the absence of any connection between instrument smoothing and output stability concerns. Adopting this perspective and applying it to an MT context, Romania would have engaged in a gradualist approach to inflation fighting coupled with a neglect for output variability. This would be broadly consistent with the NBR's mandate, which has price stability as its main goal. An alternative interpretation of the nexus between interest rate and output stability (Collins and Siklos, 2004) is that considerable interest rate smoothing could indirectly reflect concerns for output variability. This view is based on Svensson's (1999) notion that IT central banks are imbued with a sense of gradualism or flexibility in three cases: emphasis on output stability, model uncertainty and interest rate smoothing. In particular, monetary authorities could engineer smooth changes in interest rates so as to stabilise economic activity. Applying this logic to Romania, despite our failure to identify a positive weight on output, the NBR could be seen as having been indirectly concerned for output variability in light of strong base money growth smoothing. The notion that the NBR followed a gradualist approach toward inflation and output stabilisation would be roughly in line with Romania's monetary policy framework – which envisaged a secondary role for economic stability. In sum, the two interpretations given here for the link between instrument smoothing and output stabilisation are broadly plausible characterisations of Romania’s MT scheme. It is however worth noting that these two views convey different implications for the role that output stability played in NBR policy moves.

Finally, let us further discuss our finding that the Romanian monetary authority does not appear to be have been concerned about exchange rate movements. This result is still compatible with the idea that the NBR looked at realisations of the exchange rate as a leading indicator for inflation developments. Furthermore, the apparent lack of an explicit concern for exchange rate variability is in line with the evidence about the leu's considerable flexibility during the MT period. Romania has intervened in the foreign exchange market over the MT period, but without preventing the value of the leu from fluctuating considerably.

5. Concluding remarks

During the period 1999-2005 of Romania's experience with MT, inflation was reduced from very high and unstable levels. While not interfering with the aim of bringing inflation rates down over time, the technical problems known to be involved in applying monetary targeting (e.g. conjunctural instability of money demand, ongoing financial innovation) may have limited the effectiveness of MT. We find that Romania's MT regime can over this period be characterised by concerns for both price stability and base money growth smoothing. Exchange rate variability and output stability do not appear to have entered the objective function significantly.

Our results shed some light on both general issues concerning monetary policy (in particular, instrument smoothing) and the more specific aspects relating to Romania's emerging market status. With regard to the former set of issues, our characterisation of Romanian policy in terms of instrument smoothing is in line with the experience of countries explicitly targeting inflation, although smoothing in the present case is related to base money growth instead of the interest rate. In line with the IT literature, we have provided two different explanations for our results. First, base money growth smoothing can be seen as independent from concerns for output stability. Adopting this standpoint, our findings should be interpreted as capturing a gradualist approach to disinflation, coupled with a neglect for output variability. This is consistent with Romania's MT framework, which had price stability as the primary monetary policy objective. Second, our results can be rationalised in a second way, along the lines of Collins and Siklos (2004). These authors draw on Svensson (1999) and, keeping within the boundary of IT, interpret the result that central banks evince strong interest rate smoothing as indirectly reflecting some concern for output stability. In analogy to this, the NBR could be seen as having adopted a flexible policy in which monetary policy inertia (concerning base money growth) aims at mitigating output volatility. This is broadly in line with NBR's acknowledgement of a (secondary) output stabilisation goal. All in all, both interpretations of smoothing presented above can be deemed broadly compatible with NBR's mandate, although they imply contrasting views concerning how crucial output variability was for Romanian monetary authorities under the MT regime.

Our result that the exchange rate does not appear to be a monetary policy goal resembles Sánchez's (2009) finding for South Korea's IT regime. It is also consistent with Romania's considerable exchange rate flexibility during the MT regime. This occurred despite foreign exchange intervention, with fewer signs of variability in inflation, output gap or interest rates than prior to MT. Still, it appears that the NBR responded to movements in the value of the leu in light of their consequences for inflation.

Appendix

A.1 Monetary targeting in Romania

This section describes the main aspects of MT in Romania over the period 1999-2005. Already at that time, the NBR had the main objective of ensuring and maintaining price stability. Without prejudice to this primary goal, it was envisaged that the NBR would support "general economic policy", i.e. aim at preserving economic stability more broadly defined. Romania had been pursuing policies related to MT from the first half of the 1990s. During the first years of the transition period (from 1991 to the first half of 1993), the NBR attempted to directly control a broad monetary aggregate (M2). From the second half of 1993, after having created the basis for exerting indirect control over the money supply, the central bank turned to base money (M0, i.e. currency in circulation plus deposits with the central bank) as an operational objective of monetary policy (Gherghinescu and Gherghinescu, 2008). The period until 1996 was marked by the pre-eminence of exchange rate stabilisation over MT considerations. This, together with unstable macroeconomic conditions in the period 1997-1998, prompts us to delay our starting date to 1999. During the period of interest, NBR's MT strategy used M0 as the operational objective and M2 as the intermediate objective. Popa et al. (2002) justify the pursuit of an MT strategy since the attempts at using the exchange rate as an anti-inflationary anchor failed, while the interest rate was not taken into consideration to this end. Having said this, the anti-inflationary MT framework has not been in use in a pure form, having cohabited at times with some elements of exchange-rate management aiming to stem the leu appreciation process. Along the way, capital controls and foreign exchange intervention helped maintain consistency in the MT framework (Antohi et al., 2003; Daianu and Lungu, 2007). To avoid an excessive appreciation of the leu, the NBR has sterilised large volumes of capital inflows and then to absorb the resulting excess liquidity. Below we present evidence that this has not precluded the value of the leu from fluctuating over time.

In terms of communication strategy, during the MT era NBR annually submitted to the Parliament a report on the monetary policy conducted in the previous year and the guidelines for the current year, being accountable for attaining its objectives. The NBR released monthly bulletins, annual reports and press releases, whereby it explained its views about economic developments, as well as monetary and foreign exchange policy decisions. The NBR also engaged in communication with the public via presentations and speeches by top officials. With regard to relevant requirements for EU membership, over the period of interest the Romanian government submitted its Pre-Accession Economic Programmes, reaffirming its commitment to economic reform agenda. This included a number of aspects relating to monetary policy such as central bank independence.

From the point of view of policy management, Romanian authorities had to cope with some structural characteristics affecting the market for money. The large informal sector created some complications as the sector's demand for cash (both domestic and hard currency) was rather difficult to predict. The high degree of dollarisation/euroisation also constrained the central bank's control over money supply (Daianu and Lungu, 2007). Finally, indexation of financial contracts in foreign currency was widespread.

The NBR officially adopted IT regime in August 2005, explaining the switch as a response to the increasing inadequacy of MT (NBR, 2005). Inflation targets had been made public prior to the switch to IT. For instance, the end-2005 inflation target was initially set at 7%, then changed to a target band of +/- 1% centered around 7.5%, which compares with actual inflation of 8.6% – slightly above the upper band.

The MT strategy carried out by the NBR over 1999-2005 led to a gradual disinflation process (see Figure 1).[23] Disinflation proceeded alongside a decrease in (nominal) base money growth up to the second half of 2004, when disinflation started coexisting with higher base money growth, which points to an ongoing strong monetisation process. Table 5 allows us to look in more detail at macroeconomic developments (including those in inflation and monetary trends), distinguishing between the first half of the 2000s – roughly covering the MT period under study – and two proximate periods before (1995-1998) and after that (IT's initial years since 2006).[24] As mentioned earlier, Romania's experience in the second half of the 1990s was surrounded with significant macroeconomic and financial instability (Budina et al., 2006).

With regard to consumer price developments, the period 1995-1998 preceding the MT period under study displayed high rates as well as large swings in headline inflation (Figure 1 and Table 5). Both the level and variability of inflation dropped considerably over the MT period. This continued after the launch of IT – a development that can be confirmed by looking at core inflation measures – even if the extra gains have not been very large. This should however be seen against the background of sizeable external shocks facing the Romanian economy over the last few years – an aspect we turn to later in this section. Moreover, any analysis of the IT regime has to be interpreted carefully in

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[23] See section 4 for a description of the main data series used in Figure 1 and Table 5. Additionally, BIS data are employed for core inflation measures, real GDP and bilateral exchange rates. Two core inflation measures are used: core 1 excluding volatile (vegetables, fruit, eggs, fuel) and administered prices, and core 2 excluding only administered prices. The external variables included in Table 1 are a subset of all those considered in our analysis.

[24] The reason for dropping year 1999 from this period is that we lack quarterly data for some variables (M2, core inflation measures and real GDP). The results reported here for other variables would be substantially unchanged if we included year 1999.

light of the short time span elapsed since its launch. Monetary trends largely mirrored what was said about inflation volatility for the MT period, with the variability in base money growth declining at that time. While remaining at a much lower level than in the second half of the 1990s, base money growth volatility increased somewhat in the IT regime, partly due to the change in the policy instrument to the interest rate and an intensified monetisation process seen since about the mid-2000s. In the MT period, the autoregressive component of nominal base money growth fell, but that of this variable in real terms rose slightly. In the context of the policymaker's optimisation process, we shall later empirically assess whether base money growth smoothing was a significant motive on the part of the NBR. Turning to nominal (money market) interest rates, they exhibited a downward trend and became more predictable over the years.

Concerning the real economy, real output growth improved in the MT period, judging from a brisk industrial production expansion that contrasted with the drop registered in 1995-1998. While decelerating slightly over the IT period, industrial production growth became at the time even more stable than in the MT era. The more broad-based information conveyed by real GDP growth instead points to a faster expansion and marginally lower variability since 2006. Output gap volatility (based on industrial production data) decreased markedly in the MT period – a process that continued into the IT period but is barely detectable in the case of real GDP data.

Exchange rate fluctuations turned much smoother in the MT period, judging from the summary measure given by NEER's standard deviation as well as the corresponding statistics for bilateral exchange rates. Having said this, the degree of exchange rate volatility remained considerable in the first half of the 2000s, and in particular much higher than the same measures computed by Sánchez (2009) for South Korea in its IT period 2000-2006 – another experience of officially floating exchange rates. While the nominal exchange rate of the leu depreciated over the entire decade 1995-2005, the secular trend appeared to be one of REER appreciation, which even extended into the IT era. One factor behind this are sizeable capital inflows into the country. The considerable flexibility of the leu witnessed ever since the MT regime has occurred despite foreign exchange intervention underpinning Romania's fast-expanding international reserves.

Let us finish by discussing the evidence on whether the decline in macroeconomic volatility in the MT period can be attributed to the higher predictability of external variables. This is not found to be the case for the G7 variables considered (industrial production, interest rates and stock prices) whose variability increased from the period 1995-1998. Neither does this notion receive support from the fluctuations in oil and non-oil commodity prices, which – mostly due to the latter group – became on balance wider. In addition, during the MT era the Romanian economy was hit by considerable rises in both categories of prices, in contrast with the drops observed in 1995-1998. In comparison with the first half of the 2000s, the IT period benefited from some reduction in the volatility of G7 variables, but had to withstand similarly high variability, as well as even stronger rises, in oil and non-oil commodity prices.

In sum, the evidence presented here points to an improved macroeconomic performance in Romania in the MT period compared to the period 1995-1998. In this regard, we find evidence that the level and volatility in inflation went down, and so did output gap variability. Moreover, we observe smoother fluctuations in base money growth – the policy instrument under the MT regime – as well as in interest rates and exchange rates. However, exchange rate variability remained considerable under the MT scheme, which suggests the lack of a "fear of floating" motive behind NBR policy moves. The less predictable developments in external variables such as G7 macroeconomic aggregates and world commodity prices witnessed during the MT scheme suggests that the improvement in Romanian macroeconomic performance during the first half of the 2000s may not stem from "good luck" (as given by international developments outside the authorities' control). However, we do not aim at further exploring this matter here. This paper has instead concentrated on characterising the NBR's objective function over the period 1999-2005. More specifically, we shall assess general issues concerning MT (such as the weights attached to inflation and output variability in the monetary authority's preferences, or the role of instrument smoothing), as well as the evidence about possible central bank concerns for exchange rate stability.

A.2 Model estimates and the empirical policy reaction function

The Romanian model used here has an IS equation, a Phillips curve, an exchange rate equation and the money market equilibrium (see expressions (A.1) through (A.4) below). This system of equations plays the role of expressions (27) through (30) in the main text. The equations are estimated over the period 1999:1-2005:12 using monthly data and a SUR methodology. Variables are in deviations from Hodrick-Prescott trends.

The model estimates are as follows:

$$
\begin{aligned}
y_t &= 0.389\, y_{t-1} - 0.394(e_{t-3} - e_{t-4}) + 0.749\, y^{G7}_{t-2} \\
&\quad (4.145) \qquad (-2.065) \qquad\qquad (3.490) && \text{(A.1)} \\
\pi_t &= 0.825\, \pi_{t-1} - 0.180\, (e_{t-1} - e_{t-2}) \\
&\quad (12.512) \quad (-2.677) && \text{(A.2)} \\
e_t &= -0.059\, (oil_{t-3} - oil_{t-4}) - 0.223\, (i_{t-1} - \pi_{t-1}) \\
&\quad (-2.263) \qquad\qquad (-4.168) && \text{(A.3)} \\
m_t &= 0.452\, (y_{t-1} - y_{t-3}) - 0.308\, i_t + 0.648 s_{t-4} \\
&\quad (2.579) \qquad\qquad (-2.252) \quad (2.857) && \text{(A.4)}
\end{aligned}
$$

where oil_t stands for oil price inflation and superscript G7 denotes an aggregate for this group of countries. *t*-values (in parenthesis) are robust to heteroskedasticity and serial correlation. We selected lags on the basis of the Akaike criterion, allowing for up to a maximum of 6 lags and choosing on the basis of relevant variables; variables may enter a given equation alternatively in levels or in first differences. In order to close the model, we estimate autoregressive processes for external variables entering our model. We allow for up to 6 lags; however, only one (of an order no larger than two) is found to be significantly different from zero. The values for the autoregressive coefficients are as follows. The first-order coefficients for y_t^{G7} and (month-on-month) foreign inflation, $\pi_{M,t}^{G7} \equiv p_t^{G7} - p_{t-1}^{G7}$, are 0.845 and 0.399, respectively, while the second-order coefficient for (month-on-month) oil price changes, $oil_{M,t} \equiv oil_t - oil_{t-1}$, is -0.190. Finally, we assume that the real effective exchange rate obeys the PPP constraint $e_t = -s_t + p_t - p_t^{G7}$.

This macro-model resembles that in the European Institute of Romania (2004). Both explicitly identify G7 foreign demand as an important variable, which is in line with our inclusion of y_t^{G7} in (A.1). We also have p_t^{G7} entering the PPP equation. A difference vis-a-vis European Institute of Romania (2004) is that the latter uses a measure of deposits as the policy variable, while we employ base money growth. Among other estimation results, the role of exchange rate pass-through in (A.2) is consistent with Pelinescu and Turlea (2004). In (A.4), money demand depends on output, interest rates and NEER. Concerning the latter, the substitution effect dominates, implying a move to domestic money holdings when the leu appreciates (i.e. when s_t is higher). This effect is lagged, while that of the interest rate is found to be contemporaneous.

Table 6 reports three types of monetary policy reaction functions, all of them being conditional on the same state variables of the model. The first column shows fitted values from the unrestricted policy rule, $m_{fit,t}$. The next two policy rules, associated with money growth paths m_t^1 and m_t^2, correspond to the rule-of-thumb benchmark cases described in section 3 and analysed in section 4. Finally, the last two decision rules in Table 6 are money growth paths m_t^3 and m_t^4, which refer to the optimisation-based money growth paths discussed in sections 3 and 4 (see also footnote in Table 6 for details). Money growth paths m_t^3 and m_t^4 denote the optimal money growth path and that associated with pure money growth smoothing, respectively.

In Table 6, the coefficients of the optimal feedback rule m_t^3 show that the NBR adjusted money growth rates in a gradual fashion in response to movements in inflation and output, among other variables. The lagged dependence of money growth reflects an instrument smoothing motive. It is also worth noting that the results in Table A.1 point to the differences between the optimal policy rule for m_t^3 and unconditional policy rule $m_{fit,t}$. This makes sense since the monetary policy rule consistent with the optimal objective function coefficients may fail to resemble that obtained by the direct estimation of an unconstrained decision rule (even when we use the same controlling variables). One interesting implication is that we can assess the fit of the model by comparing fitted values from both approaches. This is done in Figure 5 for the Romanian MT case. Both the optimal money growth path and that derived from the unconditional policy rule are similar to observed money growth rates. This suggests that our model is reasonably well specified, at least as far as the state variables considered here are concerned. In other words, both our macro-model elasticities and our characterisation of NBR's objective function appear to be informative about Romania's MT period.

In any case, we do not wish to put forward a detailed interpretation of the results in Table 6. There are a number of reasons for this. In the case of the unconstrained policy rule, the estimates suffer from endogeneity. It is beyond the scope of this paper to improve on the estimation by fixing this problem. Moreover, the focus of the present empirical application to Romania is the identification of central bank preferences, with the optimisation-based policy rules not being entirely easy to interpret. The reason for the latter is that these rules are affected not only by the macro-model's elasticities, but also by the correlation between error terms in different equations.

Table 1. Weights used in central bank loss function

Case	w_{π}	w_y	w_{dm}	w_e
1. Strict anti-inflationary monetary targeting	1	0	0	0
2. "Flexible" monetary targeting (no base money growth smoothing)	1	1	0	0
3. Optimal monetary targeting	0.641	0	0.359	0
4. Pure base money growth smoothing	0	0	0.359	0

Table 2. Correlation matrix for different base money growth paths

	μ_t	μ_t^1	μ_t^2	μ_t^3	μ_t^4
μ_t	1				
μ_t^1	0.658	1			
μ_t^2	0.713	0.881	1		
μ_t^3	0.889	0.770	0.782	1	
μ_t^4	0.713	0.880	1.000	0.781	1

The base money growth paths featuring in this Table are: μ_t denotes actual base money growth (as three-month moving averages of year-on-year rates); and μ_t^{κ} are simulated paths corresponding to cases κ=1,…,4 in Table 2. Correlations are computed over the longest possible period, namely, 2001:1 - 2005:12.

Table 3. Estimates of central bank objective function parameters

	point estimate	t-statistic	p-value
ω_{π}	0.455	2.491	0.013
ω_y	0.000	0.091	0.927
ω_e	0.291	1.780	0.075

The reported weights, together with those put on base money growth smoothing, must add up to one. The null hypothesis that ω_{dm} equals zero is rejected (Wald test: χ^2 = 110.203; p-value = 0.000); the coefficient's point estimate is 0.254. The table shows that ω_y and ω_e are each insignificant at the 5% level. Since this is also true for them jointly (Wald test: χ^2 = 3.167; p-value = 0.075), we set both coefficients to zero. The final estimates for ω_{π} and ω_{dm} are thus re-normalised to 0.641 and 0.359, respectively.

Table 4. Encompassing tests for simulated base money growth paths

μ_t^*		μ_t^{**}	μ_t^* versus μ_t^{**}	μ_t^{**} versus μ_t^*
Strict anti-inflationary MT	versus	Optimal MT	**0.017**	77.979
(w_{π}=1, w_y=0, w_{dm}=0, w_e=0)		(w_{π}=0.641, w_y=0, w_{dm}=0.359, w_e=0)	**(0.992)**	(0.000)
"Flexible" monetary targeting	versus	Optimal MT	**0.583**	58.657
(w_{π}=1, w_y=1, w_{dm}=0, w_e=0)		(w_{π}=0.641, w_y=0, w_{dm}=0.359, w_e=0)	**(0.747)**	(0.000)
Pure smoothing	versus	Optimal MT	**0.581**	59.137
(w_{π}=0, w_y=0, w_{dm}=0.359, w_e=0)		(w_{π}=0.641, w_y=0, w_{dm}=0.359, w_e=0)	**(0.748)**	(0.000)

Encompassing regressions are of the form $\mu_t = \varsigma^1 \mu_t^* + \varsigma^2 \mu_t^{**} + \varepsilon_t$, where μ_t is the 3-month moving average of the actual nominal (year-on-year) base money growth, and μ_t^* and μ_t^{**} are the corresponding competing (unsmoothed) base money growth paths. In the table, the test statistics are Wald tests of the joint hypotheses that $\varsigma^i = 1$ and $\varsigma^j = 0$, $i \neq j$, with *p*-values in parentheses. A low *p*-value indicates that the null hypothesis is rejected. Bold values indicate cases where one simulated base money growth path encompasses another.

Table 5. Summary statistics: 1995Q1 - 2008Q2

Table 1. Summary statistics: 1995Q1 - 2008Q2

	1995Q1 - 1998Q4					2000Q1 - 2005Q4					2006Q1 - 2008Q2				
	Mean	**SD**	**Max**	**Min**	**AR**	**Mean**	**SD**	**Max**	**Min**	**AR**	**Mean**	**SD**	**Max**	**Min**	**AR**
A. Domestic variables															
Base money (M_0)															
Nominal	50.8	36.4	129.4	9.2	0.7	31.2	14.7	74.7	14.1	0.3	32.9	18.7	55.3	-4.8	0.1
Real	1.5	42.4	84.0	-84.5	0.4	12.3	18.1	66.9	-15.5	0.5	26.8	19.3	52.4	-13.4	0.1
Broad money (M_2)															
Nominal	na	na	na	na	na	32.0	5.2	42.7	20.8	0.6	26.2	6.8	38.3	19.1	0.6
Real	na	na	na	na	na	13.1	10.1	28.5	-5.0	0.8	20.1	5.6	28.9	12.9	0.5
Short-term interest rate	58.1	24.6	129.6	32.4	0.1	23.3	12.4	48.8	3.8	0.9	7.7	1.5	11.0	6.2	0.9
Real output															
Industrial production	-2.9	17.0	16.1	-37.8	0.5	8.3	11.9	44.5	-9.3	0.5	7.4	3.3	11.4	0.5	0.2
GDP	na	na	na	na	na	5.1	5.4	13.5	-7.0	0.3	6.4	5.2	14.0	-0.3	0.1
Output gap															
Industrial production	3.5	8.9	16.7	-0.1	1.0	1.3	3.6	6.7	-0.1	0.4	-0.2	0.9	1.0	0.0	0.3
GDP	na	na	na	na	na	-0.2	1.2	2.6	-2.5	0.3	0.1	1.0	1.8	-1.5	0.1
CPI inflation															
Headline	49.3	36.4	150.9	17.6	0.7	19.0	10.4	39.2	7.6	0.9	6.2	2.5	10.2	2.9	0.6
Core 1	na	na	na	na	na	11.5	5.5	24.9	4.9	0.8	5.3	2.1	9.4	-0.9	2.8
Core 2	na	na	na	na	na	12.7	5.2	21.4	5.4	0.9	5.5	3.2	10.5	-2.0	1.5
Exchange rates															
REER	6.7	27.0	64.7	-28.7	0.5	5.0	9.1	28.2	-9.2	0.7	3.5	10.0	13.0	-18.2	0.6
NEER	-36.8	36.3	-7.9	-127.1	0.4	-10.9	13.4	21.2	-34.4	0.8	0.6	11.3	12.2	-23.7	0.5
Leu/EUR	40.6	34.2	124.3	12.0	0.4	12.0	14.6	38.7	-20.1	0.8	1.0	11.9	26.4	-11.5	0.6
Leu/USD	42.2	40.3	141.7	11.2	0.5	9.6	18.5	41.4	-34.1	0.8	-8.6	10.0	9.0	-20.2	0.2
B. External variables															
G7 industrial production	2.9	1.9	5.5	0.2	0.8	1.0	3.3	5.0	-6.4	0.7	2.0	1.6	3.7	-1.3	1.0
G7 short-term interest rate	4.4	0.5	5.4	3.6	1.0	2.5	1.1	4.6	1.3	0.9	3.4	0.5	3.9	2.5	1.0
G7 stock prices	23.2	4.9	30.0	7.9	0.4	6.7	9.0	18.1	-16.3	0.7	12.2	7.5	21.0	-1.0	1.0
Oil price	-8.8	32.1	34.9	-68.7	0.5	16.4	32.2	55.4	-68.5	0.5	24.3	35.6	55.4	-68.5	0.6
Non-oil commodity prices	-5.5	12.3	18.2	-20.1	0.6	6.1	15.3	44.0	-21.8	0.6	24.1	13.8	42.7	1.2	0.3

Note: Variables reported here are measured as annualised rates of growth, with the following exceptions: interest rates (in per cent per annum) and output gaps (in per cent), which are both averages for the period in question. Moreover, all underlying series are 6-month moving averages (2-quarter averages in the case of real GDP). An increase in the nominal and real effective exchange rates (NEER and REER, respectively) denotes an appreciation; an increase in the bilateral exchange rates denotes a depreciation. The potential output measure used to compute the output gap consists of a Hodrick-Prescott trend, calculated separately for each period considered. SD is the standard deviation and AR the first-order serial correlation coefficient.

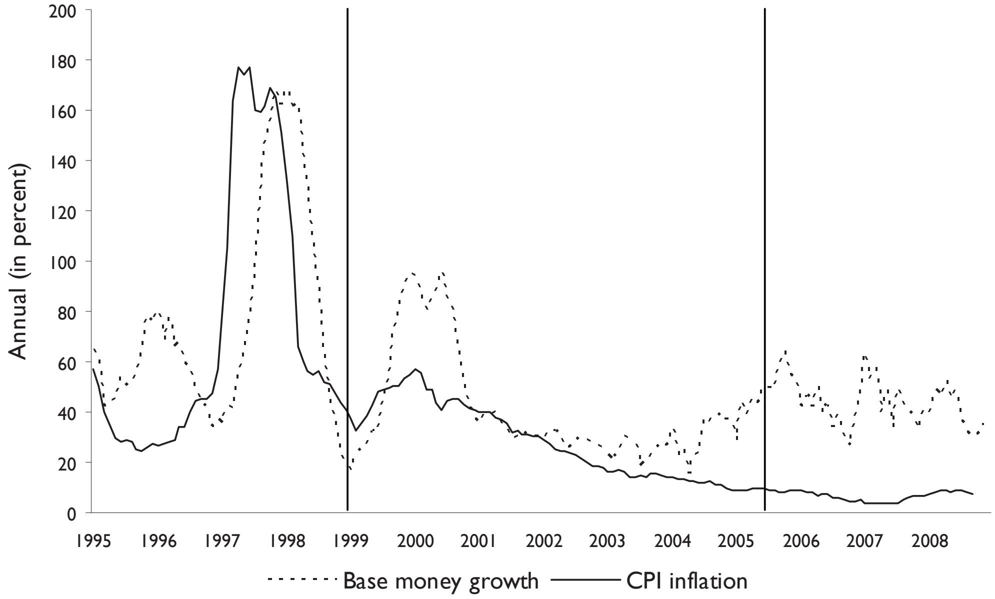
Sources: See the main text (section 3).

Table 6. Monetary targeting rules implied by different policy objective weights

State variable	$m_{fit,t}$	m_t^1	m_t^2	m_t^3	m_t^4
First lag of dependent variable	-0.0539	0.0000	0.0000	0.2747	0.2642
Second lag of dependent variable	0.0917	0.0000	0.0000	0.2728	0.2654
Third lag of dependent variable	0.0525	0.0000	0.0000	0.2886	0.2798
y_t	-0.7336	0.8458	0.9357	0.0918	0.1092
y_{t-1}	0.1372	0.0000	0.0000	-0.0382	-0.0348
y_{t-2}	-0.7475 ***	-0.8458	-0.8458	-0.1002	-0.1224
π_t	-1.7887	3.7758	1.9344	0.1757	0.0851
$\pi_{M,t-1}$	-0.1182	-0.0172	-0.0093	0.1237	0.0069
$\pi_{M,t-2}$	0.2280	-0.0474	-0.0223	0.0427	0.0118
$\pi_{M,t-3}$	-0.1368	-0.0638	-0.1094	-0.3547	-0.0377
$\pi_{M,t-4}$	0.0752	-0.0804	-0.1355	-0.4706	-0.0332
$\pi_{M,t-5}$	0.0225	-0.0976	-0.1403	-0.3096	-0.0279
$\pi_{M,t-6}$	0.1849	-0.1160	-0.1192	-0.2466	-0.0190
$\pi_{M,t-7}$	-0.0176	-0.1364	-0.1132	-0.3759	-0.0268
$\pi_{M,t-8}$	0.4314 ***	-0.1614	-0.1304	-0.2788	-0.0303
$\pi_{M,t-9}$	0.2464	0.0640	0.0196	0.1600	0.0234
$\pi_{M,t-10}$	0.4195	0.0387	0.0267	0.2752	0.0186
$\pi_{M,t-11}$	0.1758	0.0184	0.0290	0.0856	0.0109
$\pi_{M,t-12}$	0.3207 ***	0.0000	0.0000	0.0000	0.0000
e_t	-0.4215	0.2441	0.2421	0.1083	0.1026
e_{t-1}	1.3926	0.8145	0.8145	0.1056	0.1090
e_{t-2}	-0.5454	0.0136	0.1477	-0.0019	0.0042
e_{t-3}	-0.0105	0.0000	0.0911	-0.0027	0.0001
s_{t-2}	0.5562	-0.0136	0.0000	0.0348	0.0352
s_{t-3}	-0.4139	0.7675	0.7675	0.0909	0.1111
i_{t-1}	-0.0591	-0.0522	0.0002	-0.0011	-0.0051
y_{t-1}^{G7}	1.6834	0.0000	2.9159	0.0584	0.1914
$\pi_{M,t-1}^{G7}$	0.1657	-0.0209	0.0000	-0.0122	-0.0009
oil_{t-2}	-0.0790	0.0630	0.0768	0.0084	0.0093
oil_{t-3}	0.0107	-0.0281	-0.0143	-0.0025	-0.0039

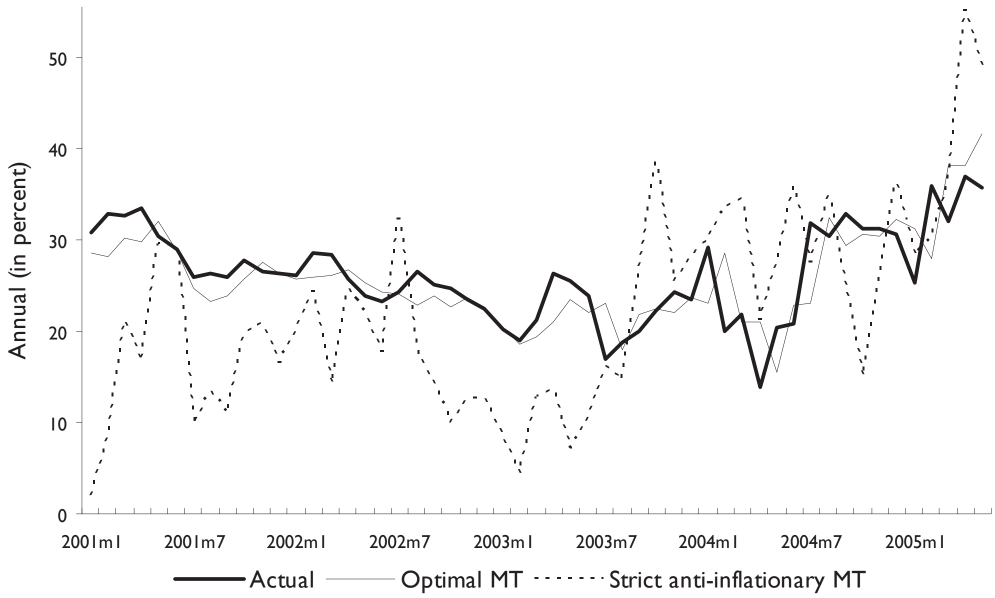
See the footnote in Table 2 for a description of the different money growth paths. For the unconstrained estimate of the policy rule (column labelled $m_{fit,t}$), */**/*** denote statistical significance at the 10%/5%/1% level. Values below 0.0001 are rounded to zero in order to facilitate visual inspection of the Table.

Figure 1. Base money growth and CPI inflation, 1995-2008.



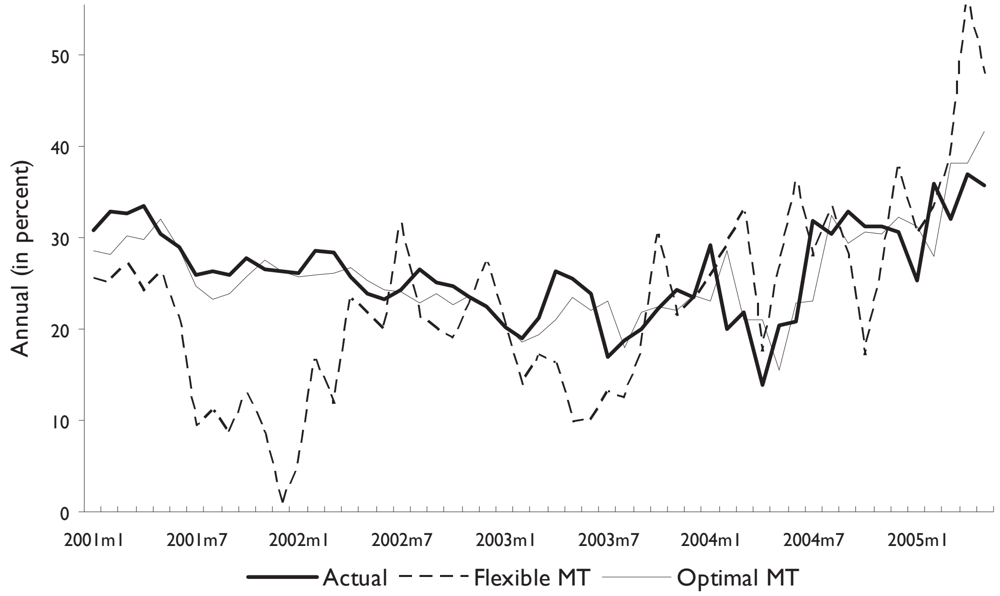
Notes: Vertical lines mark the start of monetary targeting and inflation targeting regimes.
Base money growth data are computed as 3-month moving averages.

Figure 2. Actual and simulated base money growth rates (strict anti-inflationary and optimal MT).



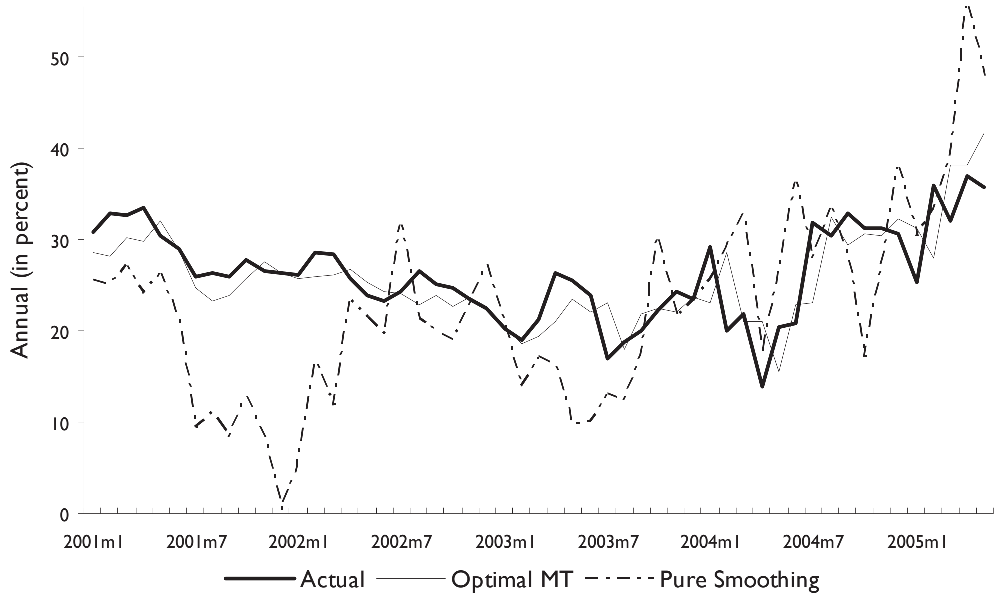
Note: Actual base money growth data are computed as 3-month moving averages.

Figure 3. Actual and simulated base money growth rates (flexible and optimal MT).



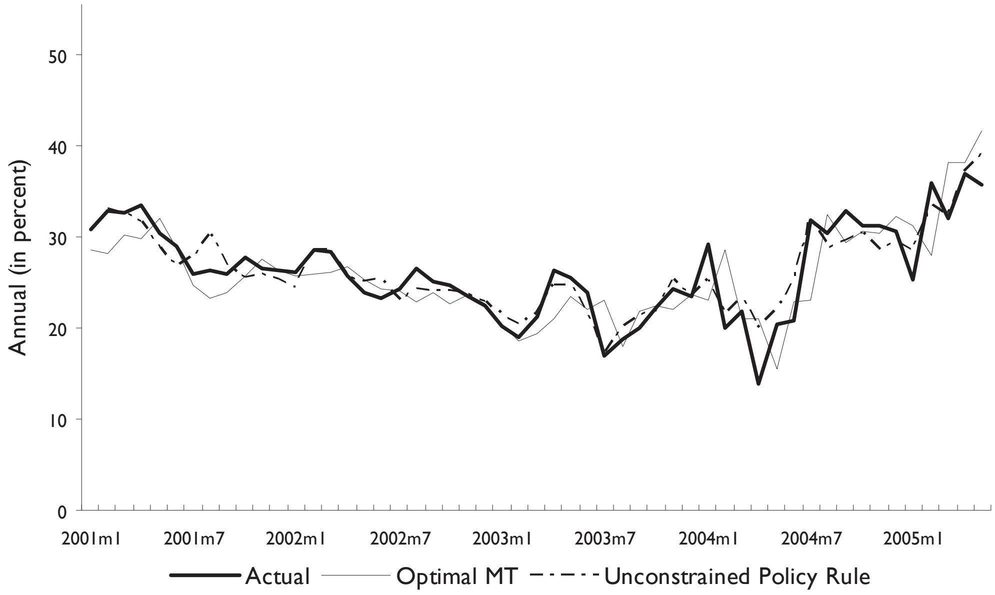
Note: Actual base money growth data are computed as 3-month moving averages.

Figure 4. Actual and simulated base money growth rates (optimal MT and pure smoothing).



Note: Actual base money growth data are computed as 3-month moving averages.

Figure 5. Actual, optimal and fitted M0 growth rates.



Note: Actual and fitted money base growth data are computed as 3-month moving averages.

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