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Money Rules for the Eurozone Candidate Countries

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Abstract:

This study proposes the adoption of money growth rules as indicator variables of monetary policies by the countries converging to a common currency system, in particular, by the eurozone candidate countries. The analytical framework assumes an inflation target as the ultimate policy goal. The converging countries act in essence as "takers" of the inflation target, which, in this case, is the eurozone's inflation forecast. The study advances a forward-looking money growth model that might be applied to aid monetary convergence to the eurozone. However, feasibility of adopting money growth rules depends on stable relationships between money and target variables, which are low inflation and stable exchange rate. Long-run interactions between these variables are examined for Poland, Hungary and the Czech Republic by employing a Johansen cointegration test, along with short-run effects assessed with a vector error correction procedure.

JEL classification: E42, E52, F36, P24

Key words: common currency system, eurozone, monetary convergence, money growth rules, inflation targeting.

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I. Introduction

Following the May 2004 accession to the European Union (EU), the new member states (NMS) face a task of devising an appropriate monetary policy regime for a successful future convergence to the eurozone. Therefore, during the post-accession period NMS need to properly select policy goals, optimal indicator variables and instruments[2].

The literature on the subject of optimal monetary policy regimes for convergence to the eurozone has not presented a clear consensus about most effective venues of convergence. A gradualist approach to convergence suggests an interim policy based on direct inflation targeting (Jonas and Mishkin, 2003, as well as Orlowski, 2001 and 2003) or on flexible exchange rate targeting (Bofinger and Wollmershäuser, 2001 and 2002). A contrary view is presented by the proponents of an early unilateral euroization (Begg et.al., 2001). Due to the lack of uniformity about policy targets, little attention has been devoted to selecting appropriate indicator variables that would serve as a basis for monitoring the actual progress of monetary convergence. Instead, most of the analytical papers have focused on the Maastricht criteria that are in essence formulated as purely numerical benchmarks for the final stage of convergence rather than as dynamic measures of its progress.

The analytical framework of this paper assumes inflation targets as ultimate policy goals. Specific inflation targets for the converging economies are presumed to be identical with the eurozone inflation target, thus the converging countries are perceived as 'target-takers'. In this way, they need to follow strategies facilitating a smooth entry to the common currency block. However, in order to monitor the speed and the degree of advancement of monetary convergence, they need to adopt appropriate indicator variables. Such variables may include a declining path of inflation risk premia (i.e. excess real interest rates over those prevailing in the eurosystem), decreasing exchange rate risk premia, money growth rates, or deviations of inflation forecasts from the inflation target.

This paper examines feasibility of adopting money growth rules in the converging countries. It is an extension of my earlier study (Orlowski, 2003), which discussed conditionality of adopting inflation risk and exchange rate risk premia as indicator variables for economies converging to the eurozone. The underlying hypothesis of this paper is that policy-makers in NMS may consider incorporating money growth rules into the operational framework of monetary regimes, even though such rules have been recently rather unpopular and seemingly absent from strategies applied by the leading industrial countries. Money-based monetary policies seem to have merit for the advanced transition countries as the previously derailed link between money, inflation and income growth appears to be now gradually restored. Reasonable money growth rules might serve two purposes for these countries – (1) they help inject liquidity sufficient for a sustained economic growth, and (2) they might serve as a policy anchor defending these economies from renewed inflation expectations.

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[2] A comprehensive macroeconomic policy framework based on goals, indicator and instrument variables was originally proposed by Tinbergen (1956). The search for optimal indicator variables of monetary policy has been recently revived by a number of studies including Svensson and Woodford (2000) who examine optimal weights on such variables in partial information, forward-looking models under policy discretion and commitment. However, unlike Svensson and Woodford who assign meaningful weights to output stability, this paper prioritizes exclusively inflation targets. A policy framework assigning a strong weight on inflation targets is believed to be more appropriate for accomplishing a successful monetary convergence to a common currency system, and to the eurozone in particular.

In principle, money growth rules might be applied in the presence of a stable dynamic relationship between money growth and changes in policy target variables, such as output growth, inflation and variability of exchange rates. Although such dynamic stability is unlikely in the pre-EU accession period due to the prevalence of transition-related processes, such as the growing monetization coupled with disinflation, reasonable money growth targets can be determined in the post-accession period.

Section II of the paper presents a model outlining dynamic, permanent interactions between money velocity and the opportunity cost of holding money that reflect transition-related process of increasing monetization and evolving financial intermediation in these economies. These dynamic changes ultimately lead to a more stable relationship between money and output, which should enable policy-makers to devise realistic money growth targets. Empirical evidence supporting these interactions is provided for Poland, Hungary and the Czech Republic - the three largest NMS. A two-country model outlining a specific money growth formula for the converging economies is presented in Section III. Section IV investigates feasibility of adoption of money-based rules depending on co-movements between medium-range money, inflation rates and exchange rates, by employing the Johansen cointegration tests for the three selected countries. Section V presents a summary of key findings and policy recommendations.

II. Money Neutrality and the Transition Process

The economic transition in Central and Eastern Europe had to overcome the command economy conditions where a financial system played a passive role and was insulated from economic decision-making. Under such conditions, money did not perform its normal functions; it served as a unit of account, but hardly as a measure or a store of value. National currencies were not convertible on either current or capital account transactions. Consequently, monetization of these economies was rather low; but the stable money stock in combination with the prices of the majority of goods and services fixed at extremely low levels led to a sizeable monetary overhang (Bruno, 1992). At the initial stage of transition, most of the governments enacted a comprehensive price liberalization that led to a rapid erasure of the monetary overhang and a one-time, corrective high inflation. The initial episode of misalignment between money growth and inflation could be perceived as a transitory shock that lasted no longer than two to three quarters and had a diverse magnitude depending upon the scope of the initial price fixing and the depth of price liberalization (Fischer, Sahay and Végh, 2002).

The initial distortion to a stable relationship between money and income has no bearing on more permanent transition-related processes that affect present monetary policy strategies and tactics in these economies. For this reason, the early shock is not embedded in the dynamic model of interactions between money velocity and the opportunity cost of holding money that is presented in this section. In essence, the model disregards any transitory shocks to this relationship and takes into consideration permanent, transition-related factors, including growing financial intermediation, the overall development of modern financial markets and, in general terms, a 'catching-up' monetization process of these economies.

The interactions between money velocity and the opportunity cost of holding money that correspond with the transition-related dynamic structural and institutional processes are shown in Figure 1. The opportunity cost of holding money is defined here as a difference between market interest rates (for instance, three months Treasury bill rates) and bank deposit rates. Under theoretical assumptions, velocity of money generally increases with a rising difference between market rates and deposit rates, thus velocity of money and the opportunity cost of holding money are directly related. Higher market interest rates tend to lower demand for money as individuals move their assets into interest-bearing instruments. The decreasing money balances at a given level of income result in a higher money velocity[3].

….. insert Figure 1 around here …..

Point A on Figure 1 denotes an initial process of economic transition. At this early stage, the degree of monetization remains low, thus money velocity tends to be high (disregarding possible distortions stemming from corrective inflation). At the same time, monetary authorities apply high interest rates in order to contain inflation. In the environment of an insufficiently competitive banking system, bank deposit rates are considerably lower than market interest rates.

As the process of monetization evolves and the banking system becomes more developed and competitive, velocity declines and the deposit rates rise relative to market interest rates driving down the opportunity cost of holding money. These transition-related tendencies move a combination of money velocity and the opportunity cost of money to point B. Subsequently, as the transition progresses to a more developed stage, money balances and bank competitiveness reach more stable levels. At the advanced stage, financial institutions engage in competitive games by furthering technology and introducing new products (electronic banking, credit card emission, etc.) and by bringing deposit rate closer to market interest rates level (assuming that bank deposit rates are not fixed by government regulation). These advances labeled in Figure 1 as financial system efficiency improvements (FSEI) are likely to raise money velocity while a bank competition increase (BCI) is likely to reduce the opportunity cost of holding money. The interplay between both variables settles at point C. At this most advanced stage, the transition economies are expected to gain a stable velocity of money, which enables them to follow more closely a monetarist link between money and income growth.

In reality, the dynamic interactions between money velocity and the differential between market rates and bank deposit rates is unlikely to be as straightforward as implied by Figure 1. To reiterate, the outlined model reflects only dynamic institutional processes related to economic transition, while the practical experience of Central and East European countries implicates the occurrence of strong transitory shocks. These shocks include: the initial corrective inflation, contagion effects of international financial crises, or monetary regime switching, all of which have caused distortions to money velocity and the opportunity cost of holding money. As an example, the international financial crisis of 1997 and, to a lesser extent, the Russian financial crisis of August/September 1998 exerted upward pressures on market interest rates, particularly in the Czech Republic and Hungary. Moreover, the changes in monetary policy regimes, i.e. the departure from exchange-rate-based policies and the adoption of inflation targeting in the Czech Republic (January 1998), Poland (January 1999) and Hungary (June 2001), raised the opportunity cost of holding money relative to money velocity (as clearly evidenced by data in Table 1).

….. insert Table 1 around here …..

[3] A comprehensive analysis of factors affecting velocity of money can be found in Thornton (1983).

The actual experience of the three examined countries with attaining monetary stability is summarized in Table 1. The data show that the degree of monetization as measured by the ratio of nominal M2 to GDP has advanced in Poland and the Czech Republic[4] during the eleven-year period 1992-2002. In Hungary this ratio was fairly high already at the early stage of transition. It appears that the NMS post-EU accession strategy, which will be aimed at monetary convergence to the eurozone, will be likely accompanied by the degree of monetization roughly comparable to that prevailing in most of the industrial countries. It is likely to get settled within the 45-50 percent range in Poland and Hungary and around 75 percent in the Czech Republic.

Correspondingly with the advancement of monetization, velocity of M2 has declined in both the Czech Republic and Poland. A noteworthy decline in velocity has taken place in these countries since the inception of monetary regimes based on direct inflation targeting. It can therefore be argued that by adopting direct inflation targeting the policy-makers succeeded in their commitment to containing inflation, both in actual and expected terms, which in turn has allowed for an accelerated money growth without exerting inflationary pressures (Jonas and Mishkin, 2003). As a result, velocity of M2 has steadily decreased. A similar effect can be expected to take place in Hungary, although it is still too soon for observing a definite pattern of change in velocity since the inflation targeting regime was enacted there only in mid-2001.

The opportunity cost of holding money has been very unstable in all three countries. Toward the end of the Czech hard currency peg regime that was ultimately abandoned in May 1997, the differential between the three months T-bill rates and the bank deposit rates reached a very high level reflecting the policy-makers efforts to defend the peg. For the same reason, it was also high in Hungary. In response to the relaxation of the fixed exchange rates in both countries, the opportunity cost of holding money steadily declined by 2002. It also decreased in Poland after the elimination of the crawling devaluation system in April 2000.

The income elasticity of the M2 money demand surged in the Czech Republic particularly on the eve of the 1997 financial crisis as the country experienced very large capital inflows. International investors flocked the Czech financial markets, particularly with short-term capital, as they perceived the currency peg to be unsustainable (Linne, 1999; Brada and Kutan, 2001). As a result, money supply showed a substantial increase so did the income elasticity coefficient. In Poland, the coefficient is showing a declining tendency until the end of 1999 due to relatively smaller capital inflows in relation to the faster growing GDP than in the remaining two countries. It shows a one-time surge in 2000, followed by a deep correction in 2001, reflecting dramatic changes in capital inflows. Hungary's income elasticity of money demand generally exceeded unity during the 1993-1998 period (except for 1995) proving a faster growth of M2 money than of GDP, thus a growing monetization. During that time, the country's monetary regime was based on the currency peg with a narrow band of permitted fluctuations, accompanied by a crawling devaluation. This policy framework coupled with a favorable outlook for economic growth induced large capital inflows, which in turn accelerated the M2 growth and increased the income elasticity of money demand coefficient. In general, the analyzed elasticity measure has been very volatile and at times it exceeded unity in all three countries, implying a stronger percentage growth of M2 money than of the nominal GDP. However, the recent (2000-2003) trends are more encouraging. The income elasticity of money demand coefficients have all fallen below the

[4] The medium range M2 money in the Czech Republic is a considerably broader monetary aggregate than the M2 in Poland and Hungary. Therefore, direct comparisons of the degree of monetization and M2 velocity between these countries are not plausible.

unity. They have become a bit more stable and, therefore, predictable, which is likely to enable policy-makers to devise fairly realistic money growth rules. In a simplified scenario, if the coefficients stabilize around a 0.75 level and the inflation forecast settles around two percent, a four percent nominal (two percent real) GDP growth target can be associated with a three percent M2 money growth target, certainly assuming a full completion of the 'catching-up' process of monetization.

In sum, it appears that money growth rules might be considered as important indicator guideposts for monetary policy framework in NMS preparing for accession to the eurozone. As the process of expanding monetization of NMS seems to have been completed at the present time, the preconditions for a feasible application of money rules, such as a stable path of both money velocity and income elasticity of money demand, might be in place in a near future. In order to establish effective money growth rules in NMS pursuing monetary convergence to the eurozone, policy makers need to gain full knowledge of interactions between the key policy goals, namely disinflation and exchange rate stability, and dynamic changes in money balances. The following model is developed for the purpose of identifying these interactions.

III. Money Growth Rule and Monetary Convergence within the Flexible Inflation Targeting Framework

The model outlining interactions between money supply, inflation and exchange rate is based on the assumption that the converging economy follows a policy of flexible inflation targeting, i.e. it gives priority to the inflation target and assumes exchange rate stability as a supplemental target. Flexible inflation targeting has been endorsed as an optimal policy regime for the countries converging to the eurozone by Orlowski (2001), Jonas and Mishkin (2003), and Natalucci and Ravenna (2003). Their analytical models are based on a central bank reaction function showing a tradeoff between inflation and exchange rate stability, with a preferential weight assigned to the inflation target.[5] Their approach differs from that proposed by Bofinger and Wollmershäuser (2001 and 2002) who favor a regime of flexible exchange rate targeting, which assigns a considerably stronger priority to the exchange rate stability.

In the model presented below, the exchange rate is determined exogenously by financial markets, which means that it is fully flexible. The countries converging to a common currency area, in this case the eurozone, assume the unified currency bloc forward-looking inflation target as their own. Thus in principle, the converging countries are viewed as 'target-takers' since they need to align the domestic policy goal with the foreign inflation target for their convergence to be successful. In addition, the model is based on money growth as the key indicator variable of monetary policy in the converging economy.

Consistently with these assumptions, a forward-looking money targeting function is specified as

$$\hat{m}_{t,t+t} - mt = \overline{m}_t + a_1 j_t + a_2 u_t + x_t \qquad (1)$$

[5] An open-economy central bank reaction function that is based on alternative choices between inflation and exchange rate volatility has been pioneered by Ball (1999).

The variable $\hat{m}_{t,t+t}$ is the forecast of the log of money growth for t -periods ahead, formulated at time t, $\overline{m}_t$ is the steady-state money growth, while j_t and u_t denote respectively predictable and stochastic shocks to money growth path.

The money growth model can be expanded further into an open-economy framework that is derived from the Obstfeld-Rogoff (OR) two-country model of exchange rate determination (Obstfeld and Rogoff, 1995). However, unlike in the OR, our model does not assume identical domestic and foreign real interest rates in order to reflect seemingly realistic conditions of economies converging to a large common currency system. Real interest rates in these economies always exceed foreign real rates denoting a higher *inflation risk premium* relative to the foreign monetary system. Therefore in the money growth model, predictable shocks to money are incorporated in inflation risk premia, that is the excess domestic over foreign real interest rates.

Domestic real money demand function is prescribed as

$$m_t - p_t = c_t - d_1(r_t + \hat{p}_{t,t+t}) \tag{2}$$

As all variables are stated in logs, m_t reflects a percentage change in the money stock M_t, p_t denotes the percentage change in the price level, and r_t is the real interest rate. The nominal interest rate is $r_t + \hat{p}_{t,t+t} = i_t$ and $d = {b}/{\overline{p} - b}$.

The corresponding foreign demand function (with foreign variables denoted by the asterisk) is

$$m_t^* - p_t^* = c_t^* - d_2(r_t^* + \hat{p}_{t,t+t}^*) \tag{3}$$

In both functions, the consumption variable c_t can be viewed in broader terms as a transactions variable, reflecting all transactions affecting total nominal income, and not only consumer demand.

Policy-makers in a converging economy need to take into consideration not only domestic but also foreign real money demand conditions, thus they may wish to devise a single money rule combining equations (2) and (3). A possible link between both equations can be provided by assuming that the spot exchange rate (expressed as a log of domestic currency value of a foreign currency unit) strictly follows the relative purchasing power parity condition in a flexible exchange rate regime and a free-trade policy framework, thus

$$s_t = p_t - p_t^* \tag{4}$$

A combination of (2), (3) and (4) allows for establishing a forward-looking, relative-to-abroad money growth rule that is outlined by

$$\hat{m}_{t,t+t} - \hat{m}_{t,t+t}^* - s_t = c_t - c_t^* - d_1(r_t + \hat{p}_{t,t+t}) + d_2(r_t^* + \hat{p}_{t,t+t}^*) \tag{5}$$

As implied above, a converging country adopts the domestic inflation target that is identical with the foreign inflation forecast. This identity is specified as

$$\bar{p}_t = \hat{p}^*_{t,t+t} \qquad (6)$$

Taking into consideration the identity between the domestic inflation target and the foreign inflation forecast that under credible policy is identical with the foreign inflation target, a forward-looking money growth process for the economy converging to a common currency system can be stated as

$$\hat{m}_{t,t+t} - \hat{m}^*_{t,t+t} = g_0 + g_1(c_t - c^*_t) - g_2(i_t - \bar{p}_t - r^*_t) + g_3 s_t + x'_t \qquad (7)$$

This functional form investigates the difference between the projected domestic and foreign money growth rates in response to the contemporaneous change in the relative-to-abroad transactions variable c_t, the inflation risk premium, and the spot exchange rate. The term $(i_t - \bar{p}_t - r^*_t)$ denotes a relative-to-abroad inflation risk premium. The coefficient g_1 measures the degree of responsiveness of the relative money growth to the differential in the transactions variable and it depends directly on the degree of expansion of domestic credit as well as on the relationship between a home versus foreign product bias.[6] A strong foreign product bias will increase the difference between c_t and c^*_t, and given the growth in domestic consumption being financed by credit expansion, the demand for money in future periods will grow at an accelerated rate, thus g_1 will be positive.

The relationship prescribed by (7) can be interpreted as a forward-looking money demand function. It measures an expected change in domestic versus foreign money demand expressed as a function of the relative-to-abroad change in the transactions variable, the inflation risk premium and the exchange rate. The inflation target is built into the inflation risk premium and thus the monetary convergence process implies that the domestic nominal interest rate is initially higher than the sum of the inflation target and the foreign real interest rate. As the convergence progresses, the positive inflation risk premium is likely to disappear. In essence, the money rule prescribed by equation (7) is a feedback rule, as the forecast of the relative money growth feeds back to the policy target (built into the relative inflation risk premium) and is conditional upon the exchange rate.

IV. Co-movements between Money, Inflation and Exchange Rates

It has been widely argued in the literature that a plausible application of a money-based policy rule depends on a stable, long-run relationship between the key components of money demand. Thus an assertion can be made that the evidence of established dynamic interactions between real money, income, real interest rates and, in an open economy framework, exchange rate would allow for a safe introduction of achievable money growth targets[7].

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[6] A noteworthy examination of the impact of a home product bias on different policy scenarios can be found in Warnock (2003). One can assume that the transition economies have experienced a gradual, dynamic shift from a foreign to a home product bias in consumption, particularly those that enacted deep economic reforms based on price and trade liberalization. The initial liberalization caused an influx of superior foreign goods that have been gradually replaced by quality domestic products, particularly those produced by a growing number of subsidiaries of foreign companies. However, the magnitude of this phenomenon deserves to be empirically investigated.

[7] Evaluation of a long-run dynamic relationship between the components of money demand based on cointegration tests was given a formal treatment in Johansen and Juselius (1990). If such long-run relationship

It seems sensible to claim that realistic money rules shall depend on a stable relationship between money growth, inflation and exchange rate in the economies converging to a common currency system. By assumption, policy-makers in these economies are likely to apply an inflation targeting regime in which domestic inflation needs to be aligned with the foreign inflation target and the exchange rate remains fully flexible. Therefore, an introduction of a sensible money growth rule depends on a stable long-run relationship between money (as a policy indicator variable) and inflation, possibly supplemented with a stable exchange rate (viewed as target variables). If policy-makers assign a predominant weight on achieving the inflation goal and allow the exchange rate to freely fluctuate, a plausible money rule will strictly depend on a co-movement between money and inflation. Under such policy conditions, other components of an open-economy money demand function such as output and the exchange rate can be disregarded.

It can be therefore argued that in NMS aspiring to join the eurozone, realistic money growth rules ought to depend on a dynamic tendency of money growth and inflation to move together. If time series of both variables are non-stationary but there is a long-run linear combination between their movements, these variables are believed to be cointegrated. In addition, some attention has to be given to the co-movement of money and the exchange rate, because the candidate countries can be reasonably expected to converge smoothly to the eurozone, meaning that minimizing the volatility of the domestic currency value against the euro cannot be excluded as an important policy objective. Assuming that the converging countries will focus their monetary policy on containing inflation and disregard a possible increase in output volatility, a long-run stability of all the components of money demand is not necessary to be achieved; specifically, it is not indispensable to have a stable relationship between money and output.

For the above stated reasons, the empirical section of this study examines cointegration between money growth, inflation and exchange rates in the three selected NMS by employing the Johansen trace procedure, as well as short run adjustments to the dynamic cointegrating relationships inspected with the vector error correction (VEC) test. In order to demonstrate money growth response to the target variables of inflation and exchange rates, the following model specification is constructed:

$$M_t = b_0 p_t + b_1 S_t + e_t \qquad (8)$$

The model assumes a long-run association between the level variables of money stock, inflation and the spot value of the euro in national currency terms and the e_t term denotes a zero mean, stationary process.

Before conducting cointegration tests for the selected variables it is necessary to confirm that all variables of the above model are suitable for inclusion in such tests. It is because cointegration procedures by their design produce meaningful results only if the tested variables alone are non-stationary, but there is a stationary linear combination between them in the long-run.

takes place, money targeting is in principle fully consistent with inflation targeting, as argued by von Hagen (1995). Cointegration tests have been applied for examination of stability of money demand in transition economies as well. In a noteworthy study on this subject Cziráky and Gillman (2003) examine long-run stability of money demand and output in Croatia.

Stationarity between money, inflation and the exchange rate in the three selected countries is examined by employing the Augmented Dickey-Fuller (ADF) test. The estimation results are shown in Table 2.

….. insert Table 2 around here …..

The obtained results based on the ADF t -statistics indicate that all variables for all three countries are non-stationary at their levels, with the exception of Poland's CPI inflation. They become stationary when stated in their first difference terms, except for the Hungarian M2 money stock that becomes stationary only in its second differenced term. Interestingly, medium range money M2 is stationary both in Poland and the Czech Republic when stated in logs. In sum, the obtained t -statistics show that it is appropriate to use the selected variables stated at their levels for cointegration testing since all of them are non-stationary. The cointegration analysis can also include Poland's inflation, the stationarity of which does not appear to be very strong.

In order to assess properly the dynamic cointegrating relationships between these variables it is necessary to carefully choose a set of specific assumptions for the data generating process (DGP) for each of the three examined NMS. Specific options for controlling the optimization process have been chosen after conducting a series of cointegration tests of money, inflation and exchange rate variables during the January 1995-December 2003 sample period. [8] Specifically, linear deterministic trends are included in the level data for Poland but not the Czech Republic and Hungary. In addition, cointegrating equations have intercept and no trend in all three cases, test VAR (vector auto-regression) has trend only in the case of Poland, up to four lag intervals are applied for Poland and Hungary, and only two for the Czech Republic. Cointegration tests based on Johansen trace statistics are reported for these countries in Tables 3-5. It shall be noted that Johansen maximum eigenvalue statistics are not shown here because their results in terms of the number of cointegrating vectors are identical to those implied by the trace statistics.

The results of the Johansen trace cointegration test for Poland are shown in Table 3. The test is aimed at identifying the number of meaningful cointegrating vectors in the model reflecting responses of M2 money to inflation and the Polish zloty (PLN) per euro exchange rate. The number of hypothesized cointegrating equations is denoted by r. The null hypotheses assume for each row of numbers: zero, at least one, and at least two cointegrating equations. The alternative hypothesis states one, two and three cointegrating equations respectively for each row. As long as trace statistics exceed critical values at five or one percent, the alternative hypothesis is accepted.

….. insert Table 3 around here …..

The results from the hypothesis testing for Poland reveal that there are three cointegrating equations at five percent and one equation at one percent level. When a single cointegrating vector (cointegrating equation) for the long-run estimation is applied, the normalized coefficients are given as follows: [9]

[8] The earlier data series are excluded because of the serious distortions of monetary indicators and trends caused by the policies based on hard currency pegs. The rigid currency pegs have been relaxed in the three examined countries only since 1995.
[9] All estimations are obtained with EViews 4.0.

$$M_t = -35.850 S_t - 14.245 p_t \quad (9)$$
$$(35.158) \quad (1.376)$$

Asymptotic standard errors for the identified parameters are reported in parentheses. The cointegrating vectors imply a significant long-run relationship between the M2 money and inflation, however, with a counterintuitive opposite sign. Without doubt, the growth of monetization has been coupled with disinflation in Poland during the sample period, although a similar inverse relationship is unlikely to hold true in the future since the process of 'catching up' monetization now appears to be completed.

Similar reactions are obtained from a system of two cointegrating equations. The normalized coefficients reflecting a long-run relationship between money, inflation and the exchange rate in this case are

$$M_t = -12.917 p_t \quad (10a)$$
$$(0.964)$$

and

$$S_t = -0.037 p_t \quad (10b)$$
$$(0.009)$$

In the system of two cointegrating equations, there is a significant cointegration between the exchange rate and inflation, yet again, it appears to be counterintuitive. Although both normalized coefficients for this model from the two cointegrating vectors are significant, their signs do not support a presumed long-run direct relationship between inflation and money supply, as well as inflation and the spot exchange rate. The coefficients imply that disinflation has been coupled with money growth during the sample period, which is a special case attributable to the process of expanding monetization. In addition, disinflation has been accompanied by the PLN depreciation (increasing S_t) that likely stems from the system of crawling devaluation that prevailed in Poland until April 2000. Moreover, the cointegrating vector of inflation and the exchange rate embodied in the long-run relationship (10b) seems to dismiss any significance of a transmission mechanism of currency depreciation into higher inflation. In sum, the past record of long-run interactions between these monetary variables in Poland does not support the endorsement of sensible money rules for monetary policy for the future eurozone convergence period.

Similar results are obtained from the cointegration analysis for the Czech Republic. The test statistics shown in Table 4 suggest that there is a single equation cointegrating M2 money with inflation and the Czech Koruna value of the euro at both five and one percent critical value. The trace statistics is in fact larger than the corresponding critical values.

…... insert Table 4 around here …..

The long-run relationship corresponding to the single cointegrating vector in the normalized form is estimated as

$$M_t = 15.149 S_t - 40.104 p_t + 1629.457 \quad (11)$$
$$(54.055) \quad (29.398) \quad (1787.28)$$

The interactions between the examined variables are similar to those for Poland. The sign of the vector cointegrating inflation and M2 money is also negative in the Czech case, implying a long-run dynamic combination of disinflation and money expansion and this relationship appears to be significant. In addition, the co-movement between the exchange rate and money is not significant, which is a bit surprising, considering the previously indicated exposure of the Czech financial system to large capital inflows. It shall be further noted that the proximity of the dynamic interactions between the tested variables in Poland and the Czech Republic is not surprising, considering the fact that during a larger part of the sample period monetary authorities of both countries have applied similar monetary policy regimes based on direct inflation targeting with flexible exchange rates.

A somewhat different long-run relationship between the examined variable can be detected from the cointegration test for Hungary. The results of the Johansen trace test shown in Table 5 imply that there are two cointegrating equations at the five percent level, although only one is suggested at a one percent level.

….. insert Table 5 around here …..

The single cointegrating equation is given by

$$M_t = -42.734S_t - 253.249\boldsymbol{p}_t + 10359.18 \quad (12)$$
$$(57.551) \quad (213.034) \quad (15955.80)$$

The relationship does not indicate meaningful, statistically significant results. Yet a different message transpires from a system of two cointegrating vectors in normalized forms. The corresponding long run relationships to the two-vector system are

$$M_t = -405.047\boldsymbol{p}_t + 11.753 \quad (13a)$$
$$(161.924) \quad (3418.96)$$

and

$$S_t = 3.552\boldsymbol{p}_t + 242.134 \quad (13b)$$
$$(2.240) \quad (49.293)$$

The vector cointegrating M2 and inflation shows a dynamic inverse relationship between both variables, which, as in the cases of Poland and the Czech Republic, suggests a combination of disinflation and expanding monetization over the course of economic transition. In addition, a fairly significant effect is implied by (13b). The positive sign of the vector cointegrating inflation and the exchange rate indicates a direct long-run relationship between both variables. This effect stems from a strong impact of the crawling devaluation of the Hungarian forint (HUF) on contemporaneous inflation and inflation expectations. It further implies the active role of the exchange rate channel of monetary policy transmission that is based on pass-through effects of the forint depreciation on inflation, as it has been also confirmed in the analysis of the Hungarian monetary policy transmission channels by Golinelli and Rovelli (2002). In addition, the cointegrating relationship (13b) suggests that the implied long-run equilibrium exchange rate is approximately equal to 242 HUF per euro (which is a bit stronger than its actual value of 266 at the end of 2003). The weaker actual rate of the HUF than the dynamic convergence rate is certainly understandable. The actual rate would be reduced to the implied convergence rate if inflation in Hungary was brought down to a zero level.

The above analysis of long-run cointegration relationships between M2 money, inflation and exchange rate suggest that the link between money and the two monetary policy target variables has been disconnected by the transition-related processes. Nevertheless, it needs to be explored whether there is a dynamic short-run adjustment process that is bringing the fluctuations in money and inflation closer together. An answer to this inquiry can be provided by the empirical analysis utilizing a VEC procedure. In general terms, a VEC model is a restricted VAR that is designed for testing short-run adjustment dynamics in non-stationary series known to be cointegrated. In this analytical exercise, a VEC model allows to investigate the short-run dynamics in the relationship between money, inflation and the exchange rate.

The main purpose of the presented VEC testing is to investigate usefulness of short-run dynamics in M2 money movements for the assessment of the inflation process. Therefore, the model takes into consideration a change in CPI inflation as a function of lagged changes in money supply and inflation in preceding periods along with a contemporaneous change in the exchange rate. The DGP assumptions for the VEC test are identical for all three countries. They include consideration of M2 money stock and CPI inflation as endogenous variables, and the spot value of the euro in national currency terms as an exogenous variable. In addition, endogenous variables have two lag intervals and there are no imposed cointegration restrictions. Based on these assumptions, the estimated equation of the VEC model is specified as

$$\Delta p_t = a_0 + g_0 \Delta M_{t-1} + g_1 \Delta M_{t-2} + g_2 \Delta p_{t-1} + g_3 \Delta p_{t-2} + a_1 (M_{t-1} + b_0 + b_1 p_{t-1}) + a_2 S_t + m'_t \quad (14)$$

The most informative component of the VEC equation is the cointegrating equation $(M_{t-1} + b_0 + b_1 p_{t-1})$ and its coefficient a_1. A pivotal message about the actual convergence of M2 money and inflation toward equilibrium is provided by the sign of the estimated a_1 coefficient. In a desirable policy scenario, if the parameter has a negative sign and money supply 'overshoots' the adjusted inflation in the previous period ($M_{t-1} > b_1 p_{t-1}$), an active convergence of money supply toward equilibrium does in fact take place. The estimated value of a_1 denotes the speed of adjustment toward equilibrium – the adjustment is faster when the absolute value of the coefficient is larger.

The estimation representations of the VEC test (equation 14) for the cointegrating equations specified above for Poland, Hungary and the Czech Republic are shown in Table 6. The reported results of the short-run vector error correction to the long-run cointegrating relationship between M2 money, inflation and the exchange rate are meaningful. In general terms, these results suggest that changes in M2 play in fact a stronger role in the determination of inflation within the short-run error correction process than that implied by the long-run cointegration.

….. insert Table 6 around here …..

In all three cases, the negative signs of the mean of the dependent variable Δp affirm a successful disinflation process. Most importantly, the estimated error correction coefficients a_1 are all negative and statistically significant, although their absolute values are not very strong. The negative and significant coefficients of the estimated equilibrium error demonstrate an active use of the error correction mechanism. This effect is more apparent in The Czech Republic and Hungary than in Poland, as the statistical significance of the coefficient for the first two countries is greater. It can be therefore argued that the error correction mechanism has in fact contributed to disinflation in all three countries. As the mechanism is based on a vector connecting M2 money and inflation, both lagged by one-period, strong, positive and statistically significant b_1 parameters suggest that a possible surge in inflation in a previous period above the level implied by the money stock clearly drives up the actual inflation in all three countries.

Diverse conclusions are derived from the estimated a_2 coefficients. In the error correction process, a positive value of this coefficient means that currency depreciation quickly adds pressure to inflation. This is clearly the case in the Czech Republic, but in Poland this effect is rather ambiguous. In contrast, the estimated value of a_2 for Hungary is negative, which can be explained by a strong influence of the crawling devaluation mechanism that remained effective in Hungary for a larger part of the examined sample period.

As it could be fully expected, the predominant role in the vector error correction mechanism prescribed by equation (14) is played by the one-period lagged inflation. In all three cases, the estimated g_2 coefficients are positive and statistically significant. Noticeably, the correction process of the lagged inflation takes a bit longer in the Czech Republic than in Hungary and Poland. The meaningful impact lag extends in the Czech case into at least two periods as it is implied by the high and significant estimated value of the g_3 coefficient.

In sum, the overall impact of the error correction process seems to be moderately acceptable for all three countries. The estimated R^2 determination coefficients are not very high, although both the Akaike and the Schwartz information criteria are brought down to the acceptable levels. In general terms, the error correction process shows that money is an active component of the VEC cointegrating equation. Therefore, short-term fluctuations in money balances have some impact on changes in inflation in all three examined countries. This is somewhat encouraging from the standpoint of the proposition of introducing money as a policy indicator variable. A long-run relationship between money and policy target variables has not been established yet. The cointegration tests indicate that the dynamic interactions between money, inflation and exchange rates have been biased by the transition related institutional processes, such as the growing monetization or financial intermediation.

V. Concluding Remarks

The main argument underlying this study is that actual rates and predetermined targets of money growth can be applied as monetary policy indicator variables in the economies converging to the eurozone. Necessary conditions for such application include a full completion of the ‘catching-up’ monetization, as well as relatively well established price stability. If these prerequisites are satisfied, a stable, dynamic link between money growth and inflation can be observed. Completion of the monetization process depends on the institutional advancement of the financial sector, including financial intermediation, bank competitiveness and the overall efficiency of the financial system. On the other hand, price stability is a function of improving credibility of monetary authorities, the ability to maintain fiscal discipline and the institutional resilience against external and internal inflationary shocks.

The empirical section of this study reaffirms that the link between money, inflation and exchange rates is yet to be established in Poland, Hungary and the Czech Republic. However, there are some encouraging signs from the VEC tests that at least short-run changes in M2 money have some bearing on inflation. Although it is not plausible to determine sensible money growth targets on the basis of the long-run cointegration relationships between these variables, policy-makers may consider giving more attention to the actual and projected money growth trends. It is because the above-mentioned transition-related processes are believed to be almost completed; therefore, the link between money and monetary policy target variables can be expected to become stronger in the future, during the period of active convergence to the eurozone.

In essence, money growth can be utilized as an important indicator variable in the preferred monetary policy framework of inflation targeting with a high degree of exchange rate flexibility (that is fundamentally consistent with the ERM II system based on a broad plus-minus 15 percent band around a central parity rate).

Moreover, the experience of monetary policies in the examined countries proves that it is not always absolutely necessary to establish a considerable degree of monetary stability in order to introduce more advanced, autonomous monetary policy regimes. For instance, inflation targeting was introduced in Poland in 1999 in spite of some warnings that such a move could be premature. Among others, Christofferssen and Wescott (1999) claimed that Poland was not fully prepared for inflation targeting as the actual inflation could not reach single digit levels and interest rates as well as other policy variables were still extremely volatile. Yet, the new monetary policy regime has proven to be very successful in terms of containing inflation and generating sustainable stability of key monetary variables (Jonas and Mishkin, 2003). If policy-makers are fully convinced that a new policy regime will be successful in the future, their commitment to a new policy strategy is perhaps more critical for its overall success than the initial economic instability and institutional imperfections.

In hindsight, monitoring and targeting money growth is likely to provide useful guidance for monetary authorities in the countries aspiring to join the eurozone in the future. Information about the actual interactions between the changes in money balances and in policy instrument variables (interest rates) can provide valuable signals for projecting the degree of achievement of inflation and exchange rate stability targets.

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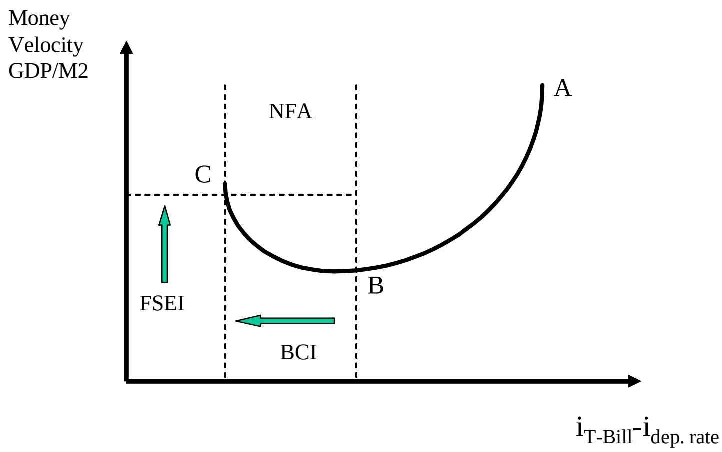
Figure 1: Money Velocity and Opportunity Cost of Holding Money: A Dynamic Economic Transition Perspective



NFA = not feasible area, FSEI = financial system efficiency improvement, BCI = bank competition increase

A to B = catching up monetization
B to C = further institutional improvements, money rules are feasible only in this phase

Table 1: Indicators of Money Stability

	Poland				Czech Republic				Hungary			
	M2V	OCM	IEMD	DoM	M2V	OCM	IEMD	DoM	M2V	OCM	IEMD	DoM
1992	2.796	6.2	na	35.8	na	Na	na	na	1.761	-1.7	na	56.8
1993	2.786	-0.8	0.99	35.9	1.463	-0.4	na	68.3	1.804	1.5	1.82	55.4
1994	2.912	-4.6	1.13	34.3	1.409	-0.1	0.80	71.0	1.943	6.6	1.56	51.5
1995	2.952	-1.2	1.05	33.9	1.273	0.0	0.61	78.6	1.662	7.6	0.18	60.2
1996	2.838	0.3	0.86	35.2	1.356	5.1	2.02	73.7	2.078	5.4	2.09	48.1
1997	2.678	2.2	0.77	37.3	1.430	3.5	4.19	69.9	2.151	3.2	1.19	46.5
1998	2.507	0.9	0.71	39.9	1.515	2.4	2.74	66.0	2.203	3.4	1.17	45.4
1999	2.334	1.9	0.60	42.8	1.526	1.2	1.30	65.5	2.146	2.8	0.82	46.6
2000	2.422	2.4	1.31	41.3	1.373	1.9	0.29	72.8	2.206	1.5	1.24	45.3
2001	2.216	0.2	0.36	45.1	1.353	2.1	0.86	74.0	2.131	2.4	0.78	46.9
2002	2.344	-0.5	0.97	42.7	1.324	0.5	0.68	75.5	2.120	1.5	0.96	47.2

Notes: M2V is M2 money velocity (=nomGDP/M2), OCM is the opportunity cost of holding money defined as a difference between 3months T-bill rates and the average bank deposit rates, IEMD is income elasticity of money demand computed as arc elasticity (% change in nominal GDP/ % change in M2 money), DoM is the degree of monetization (M2/nomGDP in %).

Source: own calculations based on the data from International Monetary Fund: International Financial Statistics – Statistical Yearbook 2003.

Table 2: Unit Root Augmented Dickey-Fuller (ADF) Test Results (*t* values)
(January 1995 – December 2003 monthly data)

Variables at their:	Level	1st Difference	Log
Poland:			
M2 money	-2.364	-12.325*	-6.881*
CPI Inflation (year-on-year)	-3.705*	-6.204*	-1.588
PLN per EUR (nominal rate)	-1.930	-7.582*	-2.037
Czech Republic:			
M2 money	-1.455	-10.092*	-3.019*
CPI Inflation (year-on-year)	-1.304	-7.319*	-0.218
CKR per EUR (nominal rate)	-1.011	-8.453*	-0.986
Hungary:			
M2 money	+1.594	-2.187 (-10.425* at 2nd dif.)	-2.871
CPI Inflation (year-on-year)	-1.238	-6.174*	-0.888
HUF per EUR (nominal rate)	-2.671	-8.228*	-3.223*

Notes: the asterix indicates stationary series (at 5%); McKinnon critical values are -2.889 at five percent and -3.493 at one percent. For the period preceding the inception of the euro in January 1999, domestic currency values of the German mark times the fixed conversion rate of 1.95583 are applied.

Source: own calculations generated with EViews 4.0, based on The National Bank of Poland, The Czech National Bank and The National Bank of Hungary data.

Table 3: Johansen Cointegration Test Results for M2 Money, Inflation and Exchange Rate in Poland (based on the January 1995-December 2003 sample period)

Unrestricted Cointegration Rank Test. DGP assumptions are: the level data have a linear deterministic trend, CEs and test VAR have only intercept and no trend, one-to-four lag intervals (in the first differenced terms) are specified.

Null hypothesis	Alternative hypothesis	Eigenvalue	Trace statistics	5 percent critical value	1 percent critical value
r=0	r=1	0.2407	**44.096**	29.68	35.65
r 1	r=2	0.0911	**16.008**	15.41	20.04
r 2	r=3	0.0596	**6.270**	3.76	6.65

Notes: Trace statistics are L-R statistics LR(n), they are asymptotically ÷^{2}(n) variates under the null hypothesis H_0 . Number of cointegration equations (CEs) is denoted by r. The above table presents trace statistics only, maximum eigenvalue statistics are not reported as they provide the same results in terms of the number of CEs.

Source: as in Table 2.

Table 4: Johansen Cointegration Test Results for M2 Money, Inflation and Exchange Rate in The Czech Republic (January 1995-December 2003 sample period)

Unrestricted Cointegration Rank Test. DGP assumptions are: the level data have no linear deterministic trends, CEs have only intercept and no trend, test VAR no intercept, one-to-two lag intervals (in the first differenced terms) are specified.

Null hypothesis	Alternative hypothesis	Eigenvalue	Trace statistics	5 percent critical value	1 percent critical value
r=0	r=1	0.2689	**42.037**	34.91	41.07
r 1	r=2	0.0491	**9.775**	19.96	24.60
r 2	r=3	0.0435	**4.586**	9.24	12.97

Notes: see Table 3.

Source: as in Table 2.

Table 5: Johansen Cointegration Test Results for M2 Money, Inflation and Exchange Rate in Hungary (January 1995-December 2003 sample period)

Unrestricted Cointegration Rank Test. DGP assumptions are: the level data have no linear deterministic trends, CEs have only intercept and no trend, test VAR has no intercept, one-to-four lag intervals (in the first differenced terms) are specified.

Null hypothesis	Alternative hypothesis	Eigenvalue	Trace statistics	5 percent critical value	1 percent critical value
r=0	r=1	0.2209	**45.261**	34.91	41.07
r 1	r=2	0.1286	**20.301**	19.96	24.60
r 2	r=3	0.0633	**6.534**	9.24	12.97

Notes: see Table 3.

Source: as in Table 2.

Table 6: Estimation Representations of VEC (equation 14) for Cointegrating Relationships Specified for Poland, Czech Republic and Hungary.

	Poland	Czech Rep.	Hungary
Error correction coefficients:			
a_0	-1.235 (1.041) [-1.185]	-2.499 (1.121) [-2.229]	1.287 (1.079) [1.193]
a_1	-0.0003 (0.0002) [-1.554]	-0.0005 (0.0002) [-2.660]	-0.0002 (0.0000) [-2.141]
a_2	0.273 (0.274) [0.998]	0.069 (0.032) [2.146]	-0.006 (0.005) [-1.294]
g_0	0.010 (0.017) [0.602]	0.003 (0.003) [0.750]	-0.0004 (0.0007) [-0.591]
g_1	-0.006 (0.017) [-0.355]	0.002 (0.003) [0.691]	-0.0001 (0.0007) [-0.140]
g_2	0.403 (0.099) [4.080]	0.286 (0.098) [2.933]	0.359 (0.086) [4.159]
g_3	0.008 (0.095) [0.082]	0.175 (0.099) [1.773]	0.085 (0.085) [0.998]
Cointegrating equation coefficients:			
b_0	-874.123	-2128.701	-10618.56
b_1	58.778 (15.986) [3.667]	144.393 (40.263) [3.586]	414.897 (101.284) [4.096]
R^2	0.358	0.202	0.262
AIC	1.680	2.043	1.675
SIC	1.858	2.222	1.855
Mean Δp	-0.303	-0.089	-0.223

Notes: AIC denotes the Akaike information criterion, SIC is the Schwartz information criterion, standard errors are reported in parentheses and t-statistics in brackets.

Source: as in table 2.

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