IMF Working Paper

WP/97/108

INTERNATIONAL MONETARY FUND

European II and Research Departments

Explaining and Forecasting the Velocity of Money in Transition Economies, with Special Reference to the Baltics, Russia and other Countries of the Former Soviet Union

Prepared by Mark De Broeck, Kornélia Krajnyák, and Henri Lorie[1]

September 1997

Abstract

The paper identifies a number of stylized facts on the behavior of key macroeconomic variables during high inflation and stabilization in countries in transition. To examine the extent to which these stylized facts conform to the predictions of standard open economy monetary theory, the paper develops a simple monetary model of the exchange rate incorporating price stickiness and inflation inertia, and carries out an econometric analysis of the behavior of real money balances during inflation stabilization. The paper concludes by assessing the prospects for velocity developments in countries in transition, including the likely pace of remonetization.

JEL Classification Numbers: E10; F00

Keywords: Stabilization; Income velocity of money; Transition economies.

Authors' E-Mail Addresses: mdebroeck@imf.org, kkrajnyak@imf.org, hlorie@imf.org

---

[1]The authors would like to thank Jahangir Aziz, Gérard Bélanger, Graham Hacche, Nadeem Haque, John Odling-Smee, Peter Quirk, Anthony Richards, Phillip Swagel, and especially Jeromin Zettelmeyer for their comments and remarks. Alex Keenan provided outstanding research assistance.

TABLE OF CONTENTS

Figures

Annex

SUMMARY

This paper examines monetary developments in countries in transition, with a focus on the Baltics, Russia, and other countries of the former Soviet Union. The paper first identifies a number of stylized facts regarding the behavior of key macroeconomic variables, such as velocity, inflation, and interest and exchange rates, during high inflation and stabilization. The paper next develops a simple theoretical model, which incorporates price stickiness and inflation inertia into a standard monetary model of the exchange rate. The model can explain stylized facts such as the increase in velocity and the tendency for the exchange rate to overshoot in the initial stages of inflation stabilization programs. An econometric analysis of the behavior of real money balances further illustrates how standard methods can be used to gain insights into monetary developments in countries in transition. The empirical results support the significance of the level of real economic activity and the rate of inflation as explanatory variables for the behavior of the real money stock, in line with money demand theory. However, the results fail to establish the significance of the rate of depreciation of the exchange rate and the price homogeneity property of money demand, which may indicate that the complex adjustment dynamics during inflation stabilization programs are not fully captured by the exercise.

The theoretical analysis and econometric exercise indicate that the process driving real money balances changes once inflation stabilization has been achieved, and past monetary developments are therefore of limited value for prediction purposes. On the basis of anticipated developments in inflation, the real exchange rate, and financial sector reform, velocity is expected to follow a downward trend. The process of rebuilding real money balances is, however, likely to be protracted and unlikely to fully reverse the demonetization that accompanied high inflation any time soon.

I. Introduction

By the end of 1996, the Baltics, Russia and most other countries of the former Soviet Union (the exceptions being Belarus, Tajikistan, Turkmenistan, and Uzbekistan) had achieved a significant degree of macroeconomic stabilization, with year-on-year inflation averaging less than 20 percent. Both the time it took to get there, and the virulence of the inflation since the start of market reforms at the beginning of 1992 varied substantially across countries. The experience of these countries with inflation stabilization also contrasts with the relatively rapid success in many central and eastern European countries. Given the rather similar initial conditions in the Baltics, Russia and other countries of the former Soviet Union, this diversity offers a unique opportunity to review the impact of the initial inflation and subsequent disinflation process on both the macroeconomy and the monetary system. The goal is not only to understand better the disinflation process itself in these countries, but also to gain some insights for formulating financial programs and policies in these countries in coming years.

The paper is organized as follows. Section II reviews monetary developments in the Baltics, Russia and other countries of the former Soviet Union prior to, during, and subsequent to stabilization, focusing on the relationship between velocity, inflation, and interest and exchange rates. It highlights the commonality of stabilization phases across countries, including the movements in the above key macroeconomic variables. The paper also notes that varying country experiences show the lasting implications of the intensity and duration of the inflation episode for the level of velocity. There appears to be a "ratchet" effect in the level of velocity; that is, once velocity has risen because of previous inflationary policies, it tends to remain high, independent of subsequent success in reducing inflation. Section III presents a simple monetary model of the exchange rate incorporating price stickiness and inflation inertia to explain the observed monetary developments, including the tendencies for the exchange rate to overshoot early in the implementation of an inflation stabilization program, and for velocity to increase before declining. Section IV carries an econometric analysis of the behavior of the real money stock and its determinants during the implementation of an inflation stabilization program. The empirical results support the strong significance of the level of economic activity and the rate of inflation as explanatory variables for the behavior of real money balances during stabilization programs. A negative correlation between real money and the (expected) depreciation of the exchange rate cannot, however, be conclusively established; this is not surprising given the complex exchange rate dynamics predicted by the theory. The results also fail to establish homogeneity with respect to the price level in the period considered, which reflects the complex short-run dynamics during stabilization programs. The prospects for velocity developments over the medium term are then assessed in the concluding Section V. It is suggested that the process of rebuilding financial wealth is likely to be protracted, notwithstanding the scope for a reflow of capital held by domestic residents abroad.

II. VELOCITY DEVELOPMENTS: AN OVERVIEW

In reviewing monetary developments in countries in transition, the analysis focuses on the income velocity of circulation of money, seen as a useful summary expression to study the complex interaction between factors influencing supply and demand for money.[2] Velocity developments in these countries display features that are similar across countries and over time (Tables 1 and 2). In discussing these features, three periods are broadly distinguished: (i) the period preceding the introduction of a stabilization program, where a program is defined as a set of policies which manages to bring 12-month inflation down from high levels to below 40 percent; (ii) the period in which such a program is implemented; and (iii) the period following stabilization, where stabilization is defined as being achieved in the first month when 12-month inflation falls below 40 percent.[3]

Velocity developments in the period preceding the introduction of inflation stabilization programs in the Baltics, Russia and countries of the former Soviet Union have been described in detail by Anderson and Citrin (1995). The level of velocity at the end of this period was shown largely to reflect the combined effects of the length of the period and cumulative inflation during it (Table 3). Increases in velocity prior to the introduction of stabilization programs have been much more pronounced in Russia and other countries of the former Soviet Union than in central and eastern Europe. The demonetization induced by the inflation stabilization sequence also has substantially differed across Russia and other countries of the former Soviet Union themselves. In some countries, Armenia and Georgia for instance, the stock of broad money in relation to GDP had fallen to very low levels when stabilization programs were introduced.

Velocity developments in the course of stabilization programs and following stabilization, as shown in annual data, can be summarized in four stylized facts. First, velocity has a general tendency to *increase* early on in the implementation of stabilization programs. Second, in most countries, following stabilization, velocity starts to *gradually decrease*. The latter process was most evident in Croatia, the Czech Republic, Romania, and Slovenia, as well as to some extent in Poland, among the countries of central and eastern Europe, and in the Kyrgyz Republic, Moldova, and to varying degrees in Armenia and Georgia. Third, velocity movements during stabilization programs were substantial; these movements have

---

[2]Velocity is the income velocity of circulation of money, defined as the ratio of nominal GDP over broad money, either including or excluding foreign currency deposits.

[3]This benchmark number is based upon the work of Bruno and Easterly (1997). Examining 127 countries during 1962-92, they find substantial output costs of inflation only when year-on-year inflation exceeds 40 percent.

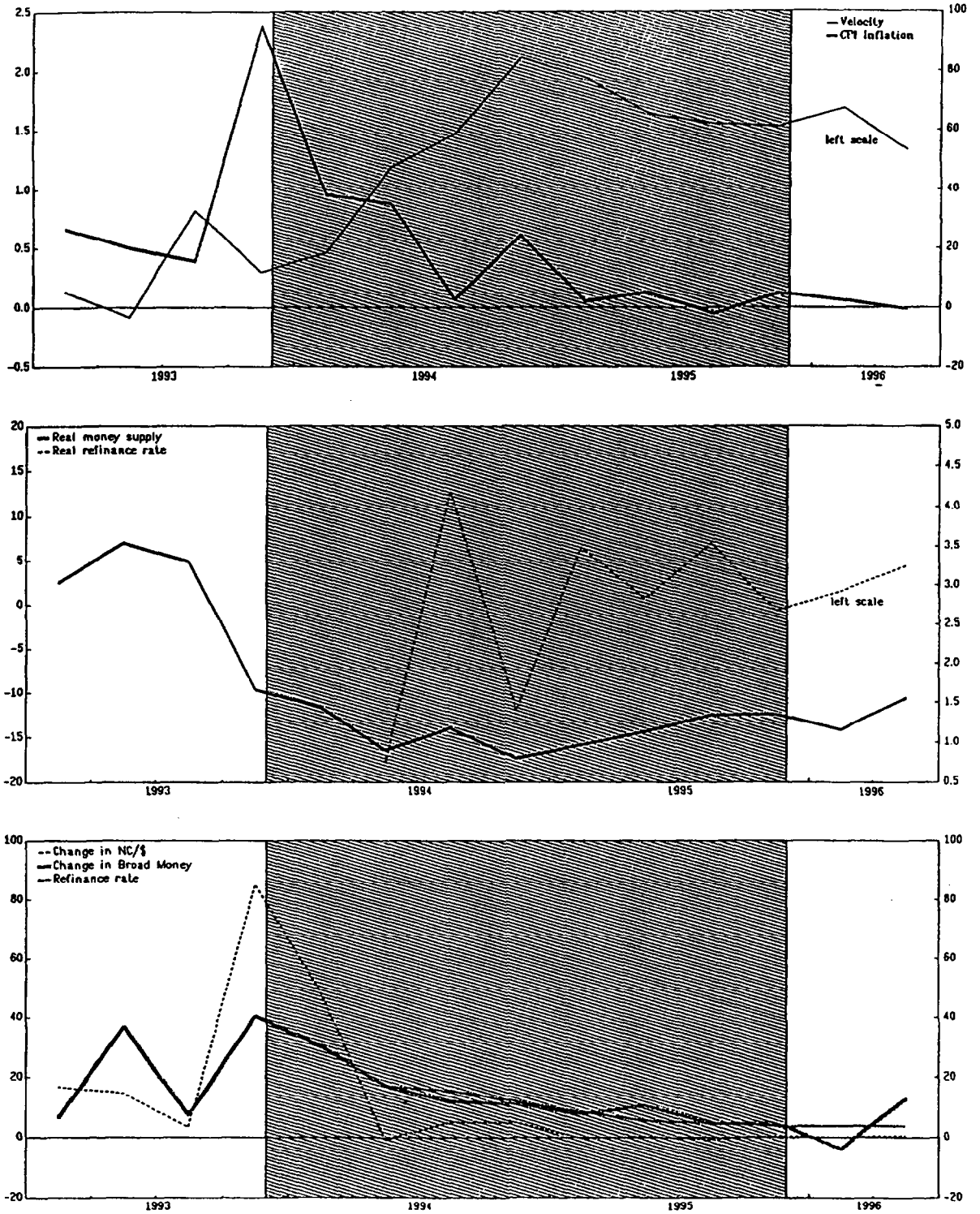
been much sharper in Russia and other countries of the former Soviet Union than in central and eastern Europe. Fourth, the velocity levels at the time stabilization was achieved substantially differed across Russia and other countries of the former Soviet Union, much more so than they did across central and eastern European countries. In countries such as Armenia, Azerbaijan, and Kazakstan, velocity was still at very high levels at the time of stabilization.

Quarterly velocity data for Russia and a selected number of other countries of the former Soviet Union that qualify as having stabilized by the end of 1996 confirm the pattern observed in the annual data (Figures 1a-1f): a sharp increase in the level of velocity during the initial stages of the stabilization programs, followed by a period of moderate changes and, in some cases, an incipient decline once stabilization has been achieved. In addition, the quarterly data also reveal substantial short-term fluctuations in velocity.

In line with these stylized facts on velocity, the dynamic adjustment while a stabilization program is implemented can be characterized as follows. First, the bulk of the reduction in inflation is achieved within the first six months of the stabilization program; this is also when velocity increases substantially. Further reductions in inflation are more gradual, and velocity movements also become smoother. Second, both the rate of depreciation of the domestic currency in exchange markets and the nominal interest rate decrease in line with the reduction in inflation. Typically, the fall in the rate of depreciation leads the reduction in inflation, while the drop in the nominal interest rate lags. In the initial phase of the stabilization program, the decline in the rate of depreciation of the exchange rate often exceeds the reduction in inflation leading to real appreciation of the exchange rate. Subsequently, and reflecting the lagged decline in the nominal interest rate, the real interest rate increases sharply and turns strongly positive. Finally, the longer-term decline in inflation is in line with the reduction in the rate of growth of the money supply over the program period as a whole. However, the short-run correlation between the two variables is much weaker, as the short-run behavior of monetary aggregates is in many cases substantially more volatile than that of inflation.

Velocity is a variable useful for studying the interaction between factors influencing supply and demand for money. To the extent the real output elasticity of money demand differs from unity and real output movements are substantial, further insights can be gained by examining the dynamics of real money balances in addition to velocity. The evolution of real money balances typically exhibits a U-shaped pattern over the course of a stabilization program. In the periods of high inflation before the introduction of a stabilization program and during the initial phases of such a program, real balances decline. Once some progress in the stabilization program has been achieved, real balances start to rise again; however, in most

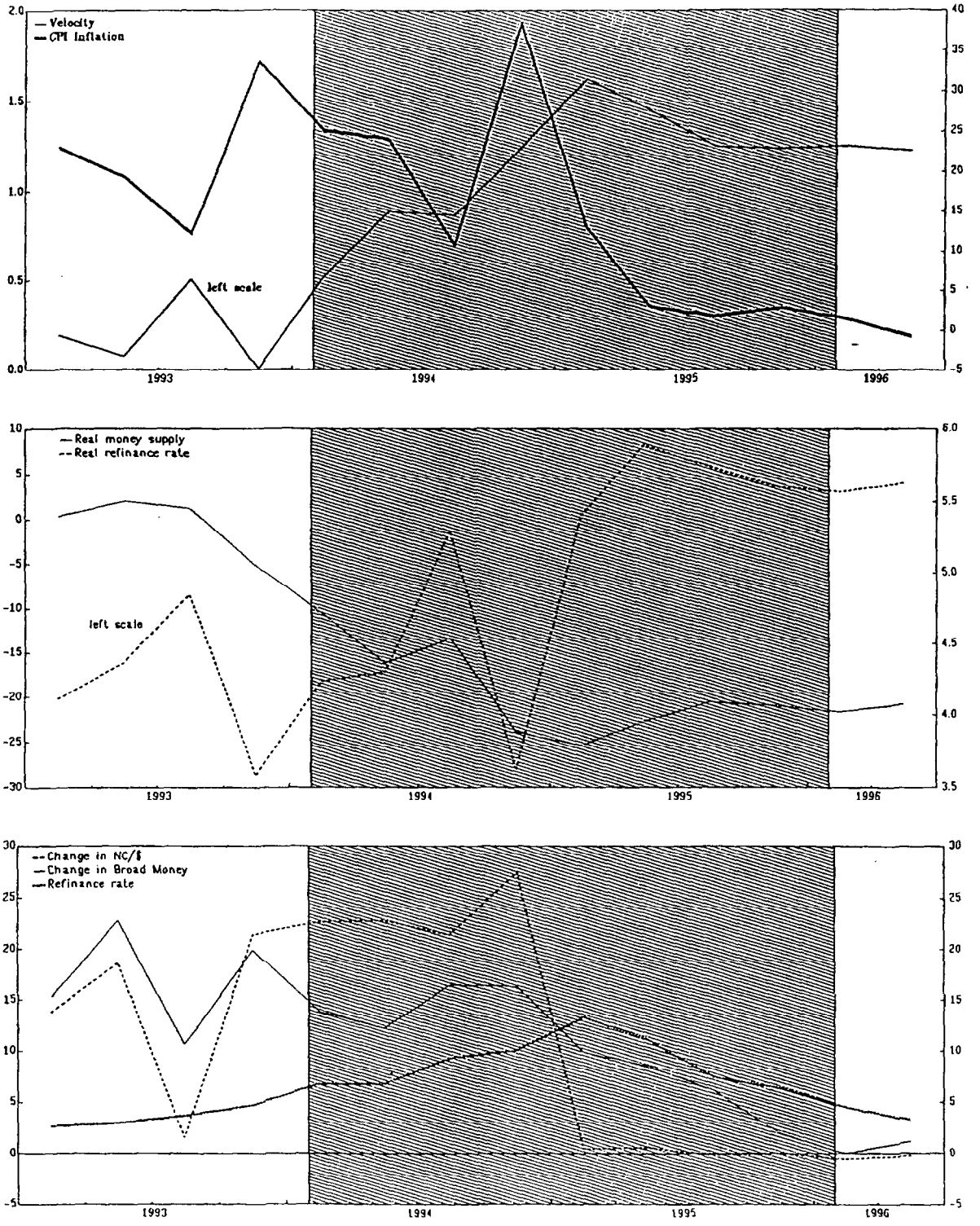
Figure 1a. Armenia: Velocity and Inflation 1/ 2/



Source: EU2 Centralized database.

1/ All variables have been defined in log terms.
2/ The shaded area refers to the sample period covered by the econometric analysis in Section IV.

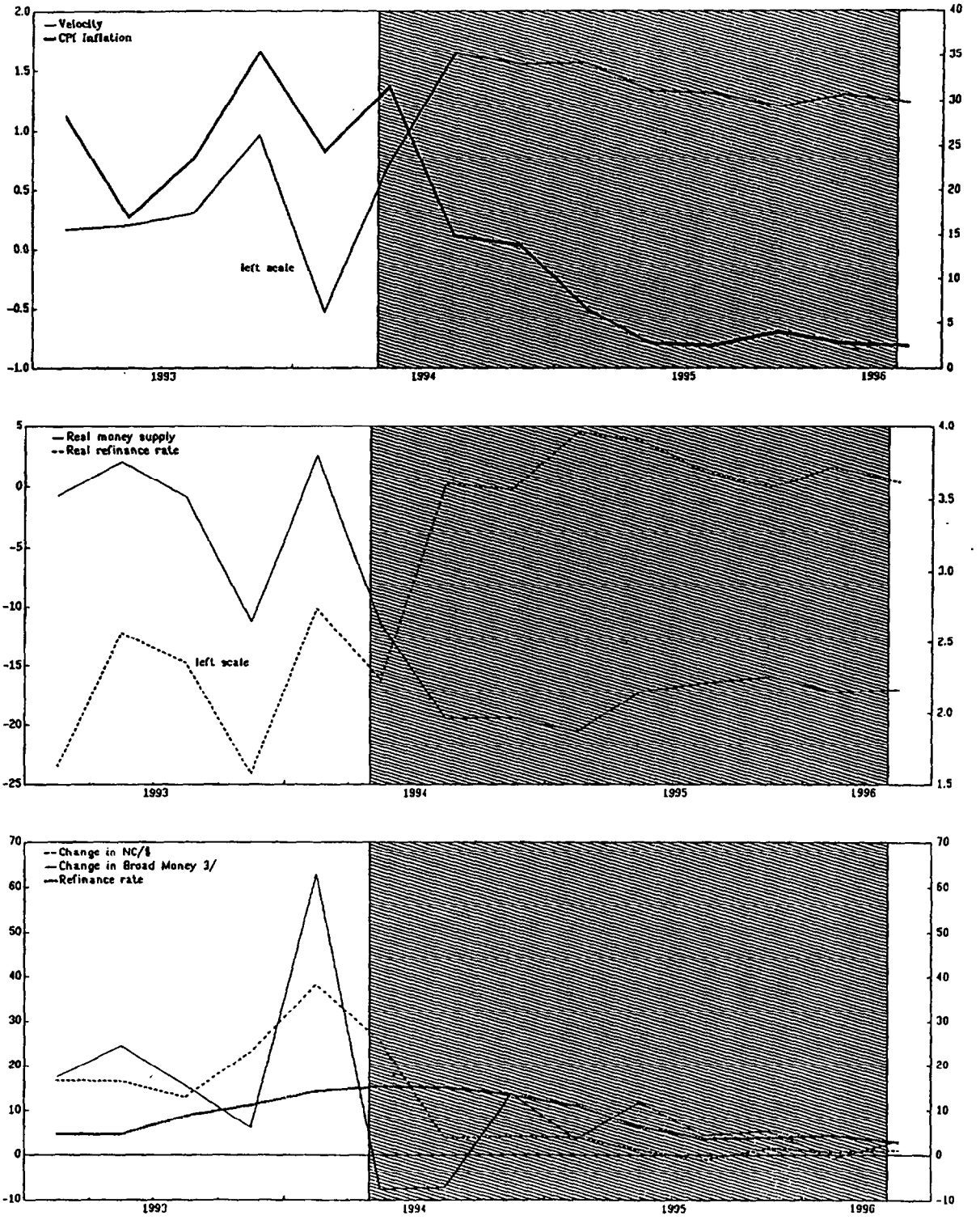
Figure 1b. Azerbaijan: Velocity and Inflation 1/ 2/



Source: EU2 Centralized database.

1/ All variables have been defined in log terms.
2/ The shaded area refers to the sample period covered by the econometric analysis in Section IV.

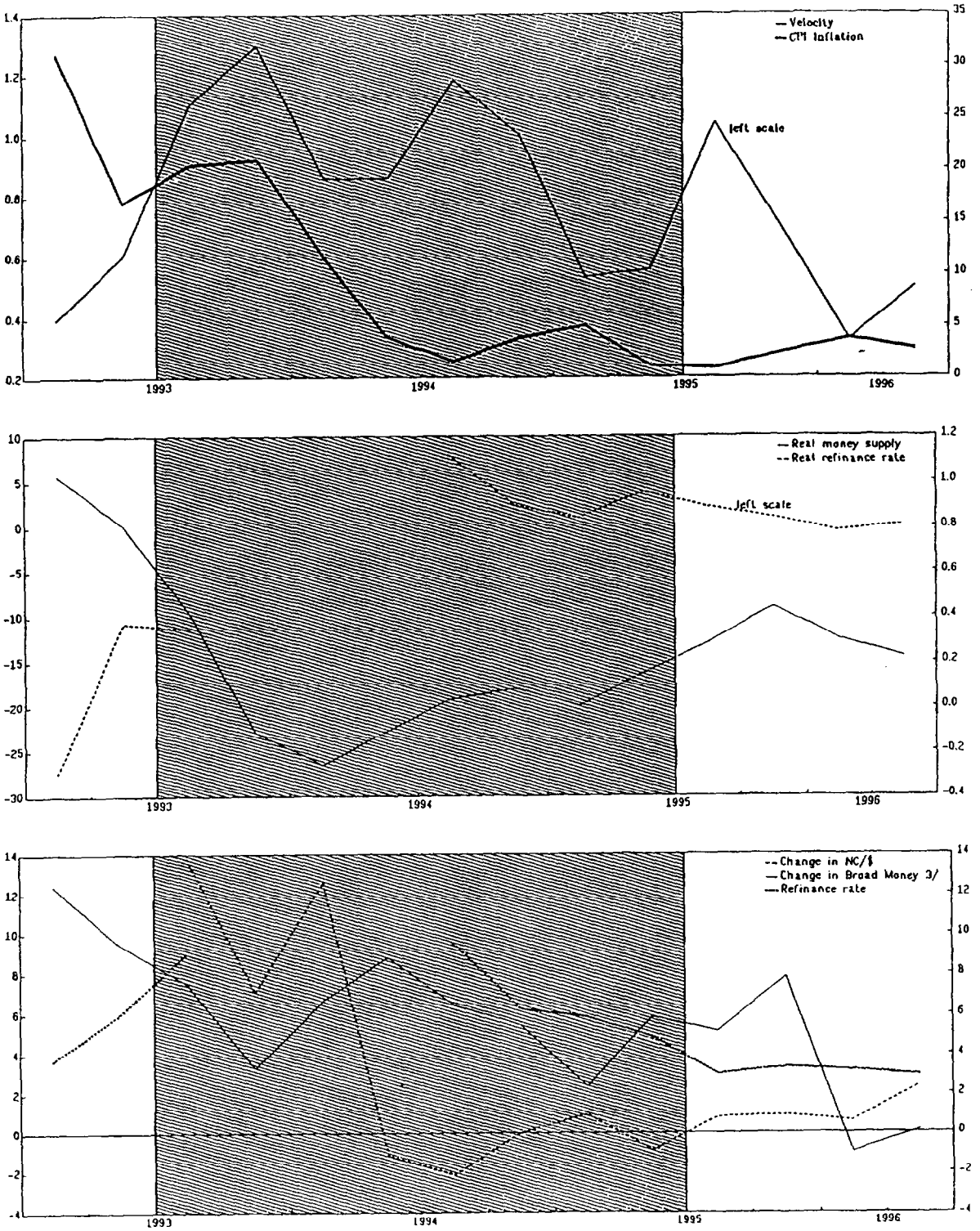
Figure 1c. Kazakstan: Velocity and Inflation 1/ 2/



Source: EU2 Centralized database.

1/ All variables have been defined in log terms.
2/ The shaded area refers to the sample period covered by the econometric analysis in Section IV.
3/ Artificially low due to one time adjustment to money stock related to settlement of arrears.

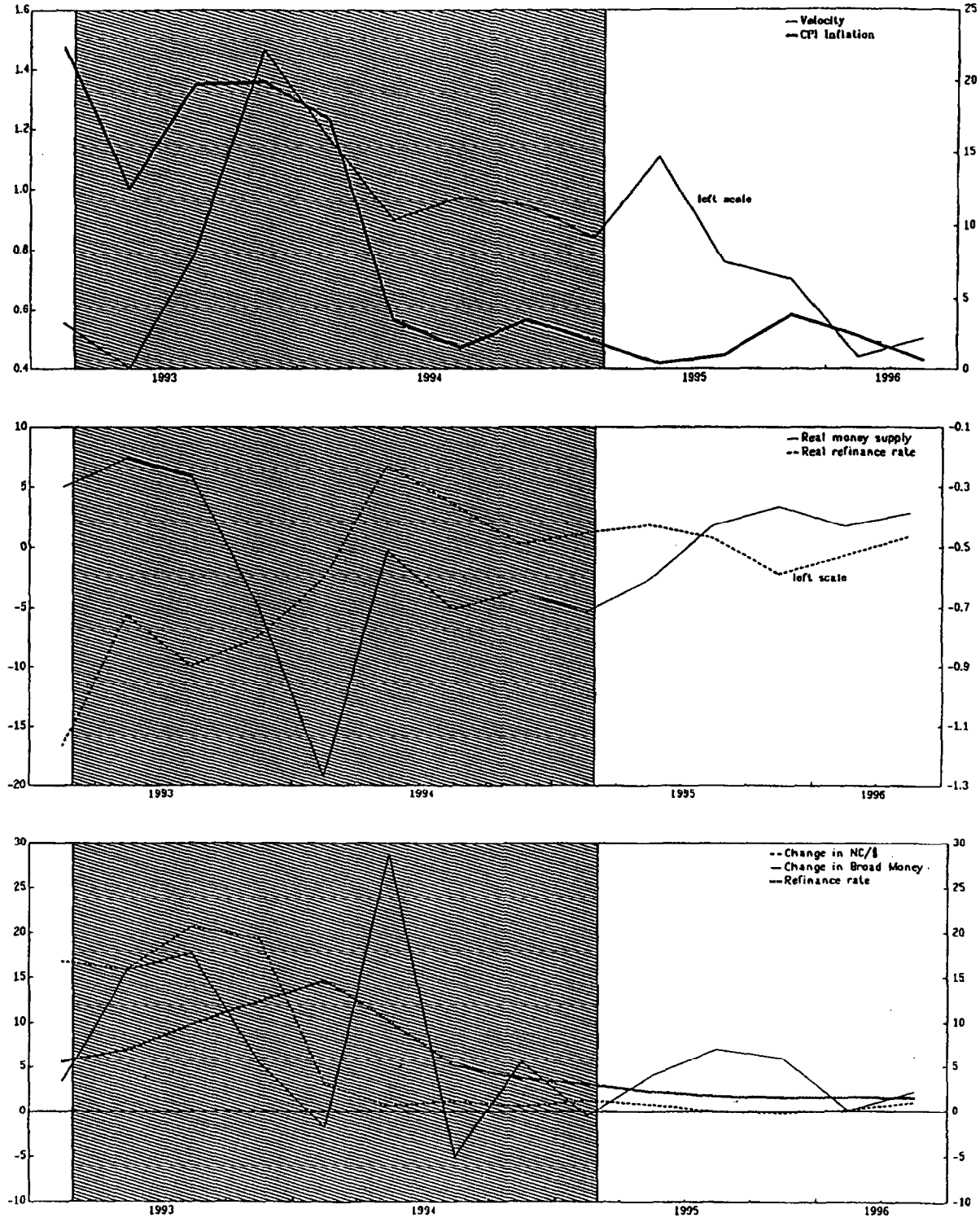
Figure 1d. Kyrgyz Republic: Velocity and Inflation 1/ 2/



Source: EU2 Centralized database.

1/ All variables have been defined in log terms.
2/ The shaded area refers to the sample period covered by the econometric analysis in Section IV.

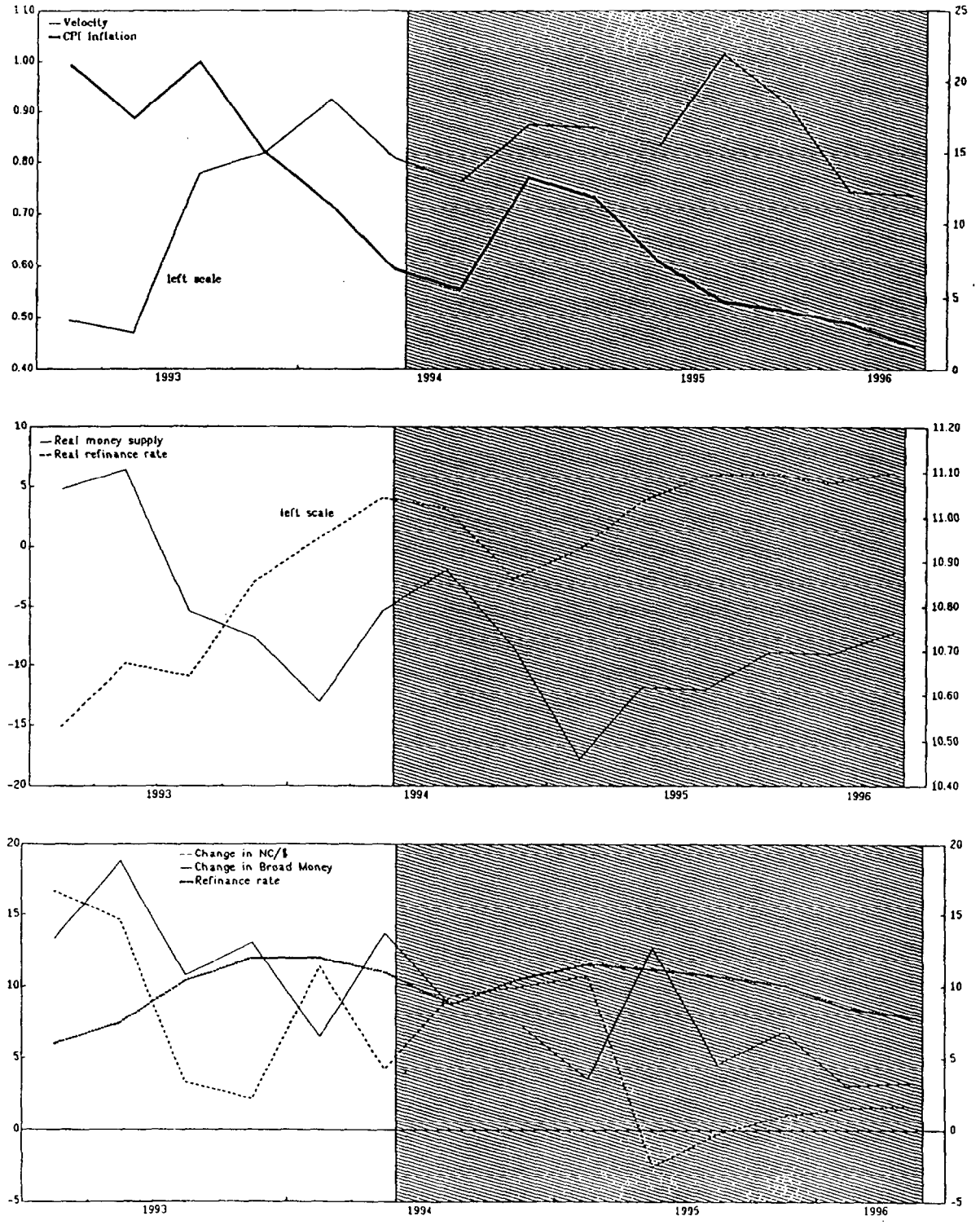
Figure 1e. Moldova: Velocity and Inflation 1/ 2/



Source: EU2 Centralized database.

1/ All variables have been defined in log terms.
2/ The shaded area refers to the sample period covered by the econometric analysis in Section IV.

Figure 1f. Russia: Velocity and Inflation 1/ 2/



Source: EU2 Centralized database.

1/ All variables have been defined in log terms.
2/ The shaded area refers to the sample period covered by the econometric analysis in Section IV.

cases the rate of increase in this period of remonetization is smaller than the rate of decrease during the demonetization period, so that the U-shaped pattern is not symmetric.[4]

The following two sections analyze the stylized facts on monetary and inflationary developments using first a theoretical model and then an econometric exercise. The quality of the data does not allow a detailed study of developments in the period before the introduction of stabilization programs. The underlying economics determining these developments probably have been as follows: continued high inflation was *in part unanticipated,* and most economic agents had to *learn how to protect themselves from inflation.* As a result, and with only limited scope for reducing their consumption, these agents saw their *real wealth dramatically cut by high inflation,* the *more so the higher and more protracted was inflation*; particularly affected was the real value of their monetary assets.[5]

While the analysis in the following two sections does not focus on developments during the initial period, it does not ignore its importance. *Cumulative inflation* in the period preceding the inflation stabilization program is an important determinant of the *level of real money* at the time the program is introduced. Countries that started to stabilize early in the transition and avoided a protracted period of very high inflation managed to limit the rise in velocity. There is no indication that velocity would decrease more rapidly in countries that started their stabilization program at a higher level of velocity: to the extent that the level of velocity had risen more during the period preceding the introduction of an inflation stabilization program, it tended to remain higher during the program and following stabilization.

---

[4]Different statistical series are available to measure inflation, the nominal interest rate, and the monetary aggregates. For instance, inflation can be measured in terms of the CPI or GDP deflator; the nominal interest rate selected may be the deposit rate, refinance rate, or the loan rate; and the monetary aggregates may or may not include foreign currency deposits. Such different measures tend to move closely together in the long term. There are, however, substantial short-term divergences; particularly noticeable are the divergences between broad money aggregates that include or exclude foreign currency deposits.

[5]Naturally, the loss for many was a gain for a few. Besides the government moved into foreign currencies (which collected the inflation tax), economic agents that were net debtors and those who moved into foreign currencies were the main gainers. Demonetization and financial disintermediation were also among the negative effects of high inflation.

III. ANALYZING MONETARY DYNAMICS AND VELOCITY

This section develops a simple model to explain the above empirical observations about monetary dynamics during stabilization programs in the Baltics, Russia and other countries of the former Soviet Union.

A. Model and its Solution

Open economy money demand theory offers a coherent framework to analyze the effects of a reduction in the growth rate of the money supply, provided frictions in the price mechanism are taken into account. The focus here is on the portfolio choice between domestic money and alternative interest bearing domestic and foreign currency assets.

The model highlights (i) a money market clearing relationship to derive exchange rate behavior; and (ii) a reduced form price equation that reflects the interaction between demand and supply on the goods market in the context of a small open economy, and exhibits both price "stickiness" and inflation "inertia."

Specifically, continuous money market clearing is defined by:

$$lnM - lnP = k\, lny - n\,(r + E\{de/e\}) \qquad (1)$$

where M = nominal domestic money stock
P = price level
y = real output
r = nominal foreign currency interest rate
$E\{de/e\}$ = expected rate of depreciation of the domestic currency (e is defined as the domestic currency price of the U.S. dollar);
de stands for time derivative of e
k, n = positive parameters

The left-hand side of Equation (1) represents the (log of) real money supply. The money supply process is exogenous, and is characterized by a constant rate of money growth. The right-hand side represents the (log of) real money demand; the latter increases with real output and declines with domestic interest rates (whether government bonds or bank deposits other than those included in the definition of the money stock). Under uncovered interest

arbitrage, nominal domestic interest rates are equal to foreign interest rates (assumed constant) plus the expected rate of depreciation of the domestic currency.[6]

The process of price inflation, which incorporates frictions in the price and inflation mechanisms is characterized as follows:

$$dP/P = \varphi + c\,[lnP^* - (lnP - lne)] \qquad c > o \tag{2a}$$

$$d\varphi = b\,[u - \varphi] \qquad b > o \tag{2b}$$

According to (2a), the rate of price inflation reflects a term capturing the perceived trend in price increases, φ, plus additional price pressures whenever the real exchange rate is "undervalued", that is whenever, in foreign currency terms, domestic prices are lower than foreign prices (presumably leading to excess demand on the goods market); the smaller the parameter c, the greater is price "stickiness." According to (2b), trend inflation displays "inertia" and adjusts adaptively to the constant growth rate of money, u (which will also be the steady state rate of inflation). The smaller the parameter b, the greater is inflation inertia;[7] such inertia can reflect either "menu costs" when adjusting prices or the lack of credibility of monetary policy changes.

Following Frankel (1979), expectations of the rate of depreciation are assumed to follow the following mechanism:[8]

$$E\{de/e\} = -a\,[lne - ln\bar{e}\,] + u \qquad a > 0, \tag{3}$$

which says that the expected rate of depreciation is the sum of a trend rate equal to the constant growth rate of money/steady state rate of inflation u, and of a term which is an

---

[6]Alternatively, when no domestic currency assets bearing market-determined interest rates are available, this would be the opportunity cost of holding domestic currency.

[7]This specification is a variant of mechanisms explored by Frankel (1979), and Buiter and Miller (1984). The implication of assuming no inflation inertia (i.e., $\varphi = u$), as in Frankel, is discussed below.

[8]The rate of money growth abroad and foreign price inflation are assumed to be zero.

increasing function of the extent to which the current *spot* market exchange rate is lower (more appreciated) than its "equilibrium" value, $\bar{e}$.[9]

The equilibrium value, $\bar{e}$, of the exchange rate differs from the *spot* exchange rate which satisfies the current money market equilibrium condition (1). It is the result of a thought experiment which considers what the current money market equilibrium would be if (i) purchasing power parity were to hold, i.e., $lnP = lne + lnP^*$, and (ii) the expected rate of depreciation were equal to the rate of money growth, i.e., $E\{de/e\}=u$, given the current values of the nominal money stock, real output, and foreign currency interest rate. Replacing $E\{de/e\}$ by u and lnP by $lne + lnP^*$ in Equation (1) and solving for lne, the equilibrium value $\bar{e}$ is given by:

$$ln\bar{e} = (lnM - lnP^*) - (k\, lny - n(r + u)) \tag{4}$$

The associated, purchasing power parity based, "equilibrium" price level is $ln\,\bar{P} = ln\bar{e} + lnP^*$. Equation (4) can be used in conjunction with Equation (3) to eliminate $E\{de/e\}$ in Equation (1) and solve for the spot market exchange rate as:

$$lne = lnP - lnP^* + (1 + 1/na)\,[lnM - lnP - (k\, lny - n\,(r + u))] \tag{5}$$

Interpretation of Equation (5) is straightforward: the spot market exchange rate will be *more appreciated* than its purchasing power parity level[10] to the extent that current real money balances are below their "equilibrium" level.[11] Subtracting side by side Equation (4) from (5), one can also write:

$$lne - ln\bar{e} = (1/na)\,[lnM - lnP - (k\, lny - n\,(r + u))] \tag{6}$$

with a similar interpretation.

---

[9]In an inflationary environment, "equilibrium" values are, of course, moving targets.

[10]This is a short-run purchasing power parity level, *i.e., given P* as well as M, P^*, and u; it may differ from the long-run equilibrium level associated with M, P^*, and u alone.

[11]That is the level of real money demand when $E\{de/e\} = u$.

Turning to the behavior of *prices*, substituting the value of the spot exchange rate *lne* from (5) into the price Equation (2a), gives:

$$dP/P = \varphi + c\,(1 + 1/na)\,[lnM - lnP - (k\,lny - n\,(r + u))] \qquad (7)$$

which implies that the rate of inflation is below trend when the real money stock is below equilibrium real money demand.

The change in the (log of) real money stock is then governed by:

$$dln(M/P) = u - dP/P = (u - \varphi) - (1 + 1/na)\,[lnM - lnP - (k\,lny - n\,(r + u))] \qquad (8)$$

One can verify by differentiating (8) that, *ceteris paribus*, a decline in the rate of money growth u will have a *negative* impact on the *change* in real money stock in the short run, provided $c\,(n + 1/a) < 1$.[12] The latter will always hold for a sufficiently high degree of price sluggishness (i.e., small value for c), which will be assumed from now on.

B. Monetary dynamics under stabilization

The above model and its solution can be used to trace the monetary dynamics associated with a regime change permanently reducing the rate of monetary expansion, say from *u=10 percent* to *u=3 percent*. First, the *steady state*[13] of the macroeconomic model defined by Equations (1)–(4) for any fixed rate of monetary expansion u must, clearly, be characterized by:

$$u = de/e = dP/P = \varphi \; ; \; P^* = P/e \qquad (9)$$

---

[12]As discussed below, a decline in the rate of money growth, by raising the long run real demand for money, will have a positive effect on the long-run level of the real money stock.

[13]Steady state refers to the dynamic properties of the model in the long run once it is no longer influenced by initial conditions. Along the steady state, the spot exchange rate and price level coincide with their "equilibrium" values.

From Equation (1), the (log of) long-run real money stock is then given by $k\ lny - n\ (r + u)$, which increases as u declines. Hence, a regime change permanently reducing the rate of monetary expansion from $u = 10$ percent to $u = 3$ percent, will in the long run reduce both the rate of inflation and the rate of depreciation to 3 percent, which would also be fully expected; and the real money stock will increase—or velocity decline.

Analyzing the *impact effect and short-run dynamics* between two steady state equilibria as monetary policy is tightened provides additional insights.

The *impact effect* of a permanent decline in the rate of monetary expansion on the exchange rate and rate of inflation can be described as follows.[14] Equations (4) and (5) imply that both the "equilibrium" and the spot exchange rate instantaneously appreciate, that is they *jump*; Equation (6) makes it clear that the spot exchange rate in fact overshoots (i.e., appreciates more than) the equilibrium exchange rate. As indicated by Equation (3), only then is it possible for the expected rate of depreciation of the exchange rate to remain at the initial 10 percent. The latter is required for continued money market clearing under condition (1); recall that with price stickiness, on impact, the real money stock is unchanged and thus still the one associated with the old steady state equilibrium at $E\{de/e\} = u = 10\ percent$.

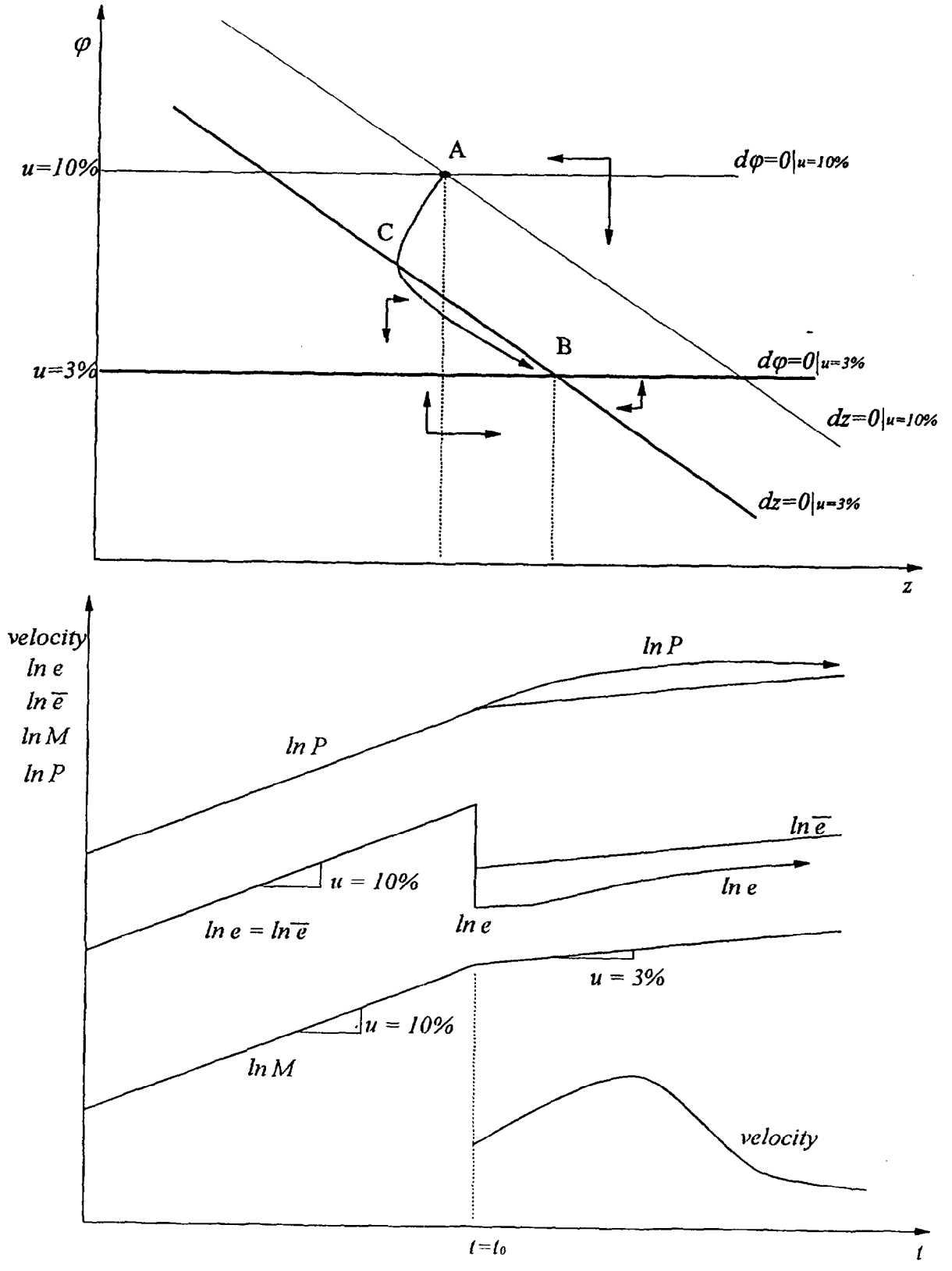
As regards inflation, with trend inflation φ fixed (at 10 percent) in the short run, Equation (7) implies that, on impact and provided c is sufficiently small, inflation will adjust downward only partially in response to the lowering in the rate of monetary expansion. As a result, as shown by Equation (8), the *change* in the real money stock on impact is negative, i.e., the real money stock will move further away from a long-run level that eventually will be higher. Therefore, velocity initially tends to *increase* following monetary tightening.

Following impact, in particular with the jump in the exchange rate, purchasing power parity and the expectation condition $E\{de/e\} = u$ are not satisfied, and *short-run dynamics* are generated. These dynamics are illustrated in Figure 2 and discussed further in Annex I. In addition to the overshooting on impact of the spot exchange rate beyond its "equilibrium" value, the *rate of depreciation* of the spot exchange rate itself initially overshoots (i.e., is lower than) the new steady state rate. Therefore, since the rate of nominal depreciation of the exchange rate is less than the rate of inflation for some time after impact, the real exchange rate correspondingly appreciates. The real appreciation creates an excess supply on the goods market and sets in motion a deflationary process. This deflationary process, in combination with downward revisions of perceived trend inflation, is the mechanism which allows the

---

[14]It is assumed that the *initial conditions* are those associated with the steady state equilibrium for $u = 10\ percent$. It is also assumed that the change in the money growth rate was fully unanticipated upon impact.

Figure 2. Monetary Dynamics



economy to achieve the new steady state inflation rate. Clearly, during the adjustment process, the inflation rate must temporarily fall below the new steady state rate in order for the real money stock to increase back to its initial level and beyond, since the new steady state real money stock under lower inflation will be higher than the one prevailing initially.

C. Model Predictions and Stylized Facts on Velocity

The monetary dynamics during stabilization programs as predicted by the model are consistent with the empirical observations on adjustment dynamics, as discussed above. In particular, the model can account for both the initial increase in velocity and the exchange rate overshooting observed during stabilization programs.

The model, in Equation (2b), incorporates an inflation "inertia" assumption, and the question has to be addressed how important this assumption is in empirically validating the model. While inflation "inertia" is not essential to derive the overshooting type exchange rate dynamics, it is essential to explain the salient observations regarding velocity. It can be easily verified that imposing $\varphi = u$ at all times would imply a *monotonic* convergence to a higher real money stock after monetary tightening.

However, adopting the inflation inertia assumption has implications, for the model-consistency or "rationality" of the expectation mechanism for exchange rate movements defined in Equation (3). Rational expectations require $E\{de/e\}$, as governed by Equation (3), to be such that $E\{de/e\} = de/e$. Beyond impact, the actual rate of change of the spot market exchange rate, de/e, is governed by the time derivative of Equation (6). Following Frankel, op. cit., it is shown in Annex II that model-consistent exchange rate expectations hold when the parameter a in the expectation mechanism (3) takes specific values determined by other parameters of the model (specifically the interest elasticity of the demand for money, n, and the speed of price adjustment, c), but this only when $\varphi = u$ at all times. Adaptive behavior with regard to trend inflation, therefore, prevents exchange rate expectations from being model-consistent, although such behavior performs better in explaining our key observations regarding velocity.

IV. Estimating Money Demand

To further explore how the monetary developments observed in the Baltics, Russia and other countries of the former Soviet Union during stabilization programs can be explained within the framework of open economy macroeconomic theory, this section empirically investigates the behavior of real money balances by estimating money demand equations for a sample of these countries. The diversity of experience with stabilization, as well as the

difference in timing before stabilization was achieved suggest, a priori, the need for careful delineation of data. This is done in sub-section A below; sub-section B motivates the econometric specification; sub-section C presents model selection and results; and sub-section D discusses interpretation of the results and comparison with eastern Europe.

A. Data

The selection of the data sample is based on the following two considerations.[15] First, the observations are pooled. Since these countries started the transition process with broadly similar financial infrastructures and, presumably, similar preferences, it is reasonable to assume that the behavior of observed real money balances can be described by the same relationship. Second, the data are examined in "stabilization time" to capture the fact that these economies have been undergoing similar shocks and innovations in the financial system since stabilization programs were initiated. As mentioned, the date of stabilization is defined as the first month when 12-month inflation falls below 40 percent, and 24 months preceding this date are considered.[16]

The above data selection procedure yields a sample of eleven countries: the Baltics, Armenia, Azerbaijan, Georgia, Kazakstan, the Kyrgyz Republic, Moldova, Russia and Ukraine.[17] Georgia and Ukraine had to be dropped from the sample because of data problems, while the Baltic states, which operated under fixed exchange rate regimes during the period under consideration, are also excluded from the analysis so as to avoid pooling observations referring to different exchange rate regimes. The data sample used in the further analysis therefore consists of six countries.

---

[15]The sources of the raw data are: centralized database of European II Department of the IMF (for broad money, inflation, exchange rate), OECD Transition Economies Indicators and CIS Goskomstat database (for index of industrial production).

[16]The 24-month period is meant to capture the period between the time an inflation program is introduced and the time stabilization, as defined, is achieved. To avoid an unbalanced panel, the same length of period is taken for all six sample countries. For three fast stabilizing countries—Azerbaijan, Armenia and Russia—the 24-month period partly overlaps with the period preceding the introduction of a stabilization program.

[17]According to the above criterion, Belarus, Turkmenistan and Uzbekistan had not yet achieved stabilization as of early 1997; the available data do not allow the criterion to be verified for Tajikistan.

B. Econometric Specification

The econometric specification is based upon the money demand side of Equation (1) in the previous section's model, but considers a broader choice of alternative assets by including goods in addition to domestic currency and foreign currency assets as alternative.[18] Following linearization, the demand for domestic real balances is taken to depend on (i) the volume of real transactions;[19] (ii) the expected rate of inflation, and (iii) the expected rate of depreciation of the domestic currency as follows:[20]

$$lnM - lnP = \alpha_1 lny + \alpha_2 E\{dP/P\} + \alpha_3 E\{de/e\} + \alpha_4 \quad (10)$$

The presumption is that $\alpha_1 > o; \alpha_2 < o; \alpha_3 < o$. In the empirical literature, it is a standard assumption that Equation (10) represents a long-run relationship.[21] In the long-run, the expected and actual values of the variables determining money demand will coincide, and Equation (10) can therefore be rewritten in terms of the actual rate of inflation, π in short, and the actual rate of depreciation, δ in short.

$$lnM - lnP = \alpha_1 lny + \alpha_2 \pi + \alpha_3 \delta + \alpha_4 \quad (11)$$

There are good reasons to believe that real money and real output are nonstationary, and that the order of integration could be one.[22] Hence,

---

[18]The further analysis does not focus on interest-bearing domestic financial assets as an alternative choice. In some sample countries, interest rates on such assets were not market determined for at least part of the sample period.

[19]The volume of real transactions is proxied by the index of industrial production.

[20]Foreign interest rates are implicitly assumed constant.

[21]For an extensive discussion of this literature and the methodological aspects of estimating money demand, see Hoffman and Rasche (1996).

[22]Given the short time period considered, the results of any formal unit root test should be considered highly tentative. However, panel and country by country unit root tests do not

(continued...)

$$\Delta \ ln\ (M/P) = \alpha_1 \Delta\ ln\, y + \alpha_2 \Delta\ \pi + \alpha_3 \Delta\ \delta \qquad (12)$$

rather than Equation (11) would describe a relationship between stationary variables.

The short-run dynamics of real money balances have to be captured by adding an adjustment mechanism. Additional variables in a short-run money demand would then generally include lags of both the dependent and the explanatory variables in Equation (12) and, in addition, the levels of all these variables. Equation (12) is thus augmented to

$$\Delta \ ln\ (M/P) = \alpha_1 \Delta\ ln\, y + \alpha_2 \Delta\ \pi + \alpha_3 \Delta\ \delta\ + \alpha_4 x \qquad (13)$$

where x is the vector of a subset of variables enumerated above.

Equation (11) assumes that in the long-run nominal money demand is homogeneous of degree one in prices that is, varies proportionately with the price level other things being equal. However, to the extent, that the dynamics specified in Equation (13) do not fully capture the complex short-run dynamics during the implementation of stabilization program, real money balances may in the short run depend upon the price level. The homogeneity restriction therefore should not be imposed on the short-run specification: the right-hand side of Equation (13) is augmented to include an inflation term.

As noted earlier, the evolution of real money balances exhibits a U-shaped pattern for all countries in the sample. Real money balances decline during the first year of the sample period, but approximately 12 months prior to stabilization, they start increasing. The period of declining real money balances coincides with high but rapidly declining inflation, while the increase in real money balances is accompanied by relatively stable, moderate inflation rates. This suggests that the *possibility of a structural break* must be considered in the empirical analysis. In particular, it is assumed that (i) the relationship between $\Delta\ ln\ (M/P)$ and π may differ across regimes; and (ii) the country-specific drift in $\Delta\ ln\ (M/P)$ may vary. In certain specifications, the "deviation term" (to be defined later) is also allowed to have a regime-specific coefficient.

The above considerations lead to the following econometric specification:

---

[22](...continued)
seem to reject this hypothesis; see Im, Pesaran and Shin (1995) on testing for unit roots in a panel setup.

$$\Delta \ ln\ (M/P)\ (i,t) = \alpha_{1pre}\ \pi(i,t) + \alpha_{1past}\ \pi(i,t) + \alpha_2\ \Delta\ ln\ y(i,t) + \alpha_3\ \Delta\ \pi(i,t) +$$
$$+\alpha_4\ \Delta\ \delta\ (i,t) + \alpha_5\ x(i,t) + \alpha_{6\ pre}\ country\ dummy(i,t) +$$
$$+\ \alpha_{6\ past}\ country\ dummy(i,t) + \epsilon\ (i,t) \qquad (14)$$

where *i* refers to country i and *t* to stabilization time, ϵ represents a Gaussian error process, x is a vector of variables capturing some features of the short-run adjustment mechanism, and the subscripts 'pre' and 'post' refer to two 12-month subperiods of the total sample period.[23]

C. Model Selection and Results

Given the sample size constraints, the data do not allow us to meaningfully estimate the long-run relationship embodied in Equation (11) and to establish the existence of a cointegrating relationship. Instead, we *postulate* the existence of a shorter-run equilibrium relationship between observed real money balances, the price level, and the right-hand side variables in Equation (1) for all countries in their stabilization time of the form

$$ln\ (M/P)(i,t) = a_1\ ln\ P(i,t) + a_2\ ln\ y(i,t) + a_3\pi(i,t) + a_4\delta(i,t) + a_5(i) + \epsilon(i,t) \qquad (15)$$

This assumption is equivalent to saying that real money balances are generated by the same underlying stochastic process for *all* observations in the sample, irrespective of country or calendar time. This amounts to making the assumption that—abstracting from possible differences in short-run dynamics—the relationship between real money and the right-hand side variables in Equation (15) is common[24] for all countries throughout the whole sample period.[25]

---

[23]As Figure 1 shows, the pattern of real money and inflation behavior appears to change about 12 months prior to the date of stabilization.

[24]The country-specific constants $\alpha_5(i)$ merely filter out the effect of different currency units and/or differences in the base period of CPI and should not be interpreted as indicators of different behavioral relationships.

[25]Country-by-country estimates of Equation (15) do not exhibit a great degree of similarity except for the impact of the price level, but this may be explained away by the high volatility in the output and inflation indicators combined with the tiny sample size. Estimating

(continued...)

Assuming an equilibrium relationship of the form (15) exists, short-run deviations from this equilibrium still have to be considered. The reduced form capturing short-term dynamics is taken to be of the form:

$$\Delta ln(M/P)(i,t) = \gamma_{1pre}\Delta lnP(i,t)+\gamma_{1post}\Delta lnP(i,t) +\gamma_2\Delta lny(i,t)+\gamma_3\Delta\pi(i,t)+\gamma_4\Delta\delta(i,t)+ \gamma_5\Delta lny(i,t-1)+\gamma_6\Delta\pi(i,t-1)+\gamma_7\Delta\delta(i,t-1)+ \gamma_8\Delta lny(i,t-2)+\gamma_9\Delta\pi(i,t-2)+\gamma_{10}\Delta\delta(i,t-2)+ \gamma_{11}\Delta ln(M/P)(i,t-1)+\gamma_{12}\Delta ln(M/P)(i,t-2)+\gamma_{13pre}DE(i,t)+\gamma_{13post}DE(i,t)+ \gamma_{14pre}(i)+\gamma_{14post}(i)+\epsilon(i,t) \quad (16)$$

where $DE(i,t)$ are terms capturing deviations from equilibrium Equation (15), obtained as the residuals from estimating Equation (15).[26] The subscripts 'pre' and 'post' refer to the two 12-month subperiods of the sample, as before.

Only two lags were considered because of sample size limitations. The coefficients on the lags of $\Delta ln(M/P)$ proved to be insignificant. Dropping them did not significantly influence the results. Numerical estimates are reported in the first column of Table 4, followed by diagnostic tests presented in Table 5.[27] The differences in coefficients across regimes proved to be statistically insignificant, hence Equation (16) was re-estimated imposing the restriction of constant parameters throughout the sample period. This means assuming that the same

---

[25](...continued)
recursively, on the other hand, does suggest remarkable stability of the relationship. Thus, the data do not seem to reject the possibility of an equilibrium relationship, as postulated in Equation (15).

[26]For an analysis in the same spirit applied to Russia, see Korhonen (1996).

[27]Based on the Bera-Jarque $\chi^2(2)$ test, the null hypothesis of normality of the residuals could not be rejected at the 5 percent level for any specification. No evidence of serial correlation was found. Given the large number of variables, only a simple form of heteroscedasticity could be tested. The test statistics are based on the joint significance of the slope coefficients in a regression of the squared residuals on a set of country dummies and on the squared fitted values of the dependent variable. The data did not reject the null hypothesis of homoscedastic residuals at the 5 percent level for any specification. Functional form misspecification was tested using a RESET test with second, third and fourth powers of the dependent variable. The test procedure yielded no evidence of misspecification.

short-run adjustment mechanism prevailed during the entire stabilization episode. Column 2 of Table 4 presents the numerical result. The data did not reject the hypothesis of equal country dummies, hence the final specification (presented in column 3 of Table 4) is estimated with a constant term. Imposing this restriction means assuming the same short run adjustment mechanism was operational in all six countries of the sample.

None of the cumulated sum of squared residuals (CUSUMQ) series suggests that the residuals become significantly smaller or larger over time. Table 6 reports results from estimating the relationship first for Armenia, then for larger samples including more and more countries. Parameter estimates for the coefficients on ΔlnP, Δlny, the deviation term and the constant remain remarkably stable throughout the procedure. Recursive estimation has also been performed, starting from a sample for periods 1 through 10; the numerical estimates appear reasonably stable.

Since the existence of an equilibrium relationship of the form (15) was not established, but rather assumed, Equation (16) capturing the short-run deviations from this equilibrium may not be correctly specified. Therefore, the analysis has been duplicated using Equation (16) without the terms measuring deviations from equilibrium. As Tables 7 and 8 indicate, the effect previously captured by these terms is now mopped up by the coefficients on $\Delta\pi(t-1)$ and $\Delta\pi(t-2)$. Apart from this change, the results are strikingly similar. This indicates that the findings related to the short-run adjustment of real money balances are robust in the sense that they *do not depend critically* on the assumption of the existence of a longer-run equilibrium relationship.[28]

---

[28]The above econometric analysis is based on carefully chosen data set. To further examine the robustness and plausibility of the empirical findings, the analysis was extended to the Baltics and other countries of the former Soviet Union. The larger sample consists of the maximum possible number of observations after the introduction of national currencies. Data availability restricts the number of countries in the sample to 12. Countries included are: Armenia, Azerbaijan, Belarus, Estonia, Kazakstan, the Kyrgyz Republic, Latvia, Lithuania, Moldova, Russia, Ukraine, and Georgia; numerical results are reported in Table 9. The estimated equations do not exhibit satisfying statistical properties. They perform badly in diagnostic tests: in addition to strong indications of nonnormality of the residuals, there is evidence of serial correlation, heteroscedasticity and functional form misspecification. Even though the rejection of normality of the residuals makes statistical inference dubious, if not impossible, the point estimates of the parameters suggest a picture qualitatively similar to the one obtained by using the smaller sample—namely, short-run movements in real money balances are closely related to developments in prices, and to some extent, to developments in real activity. There is also some indication of a closer link between the exchange rate and real

(continued...)

D. Interpretation of the Results, and Comparison with Eastern Europe

Interpretation

The regression results confirm that the short-run dynamics of real money balances are closely related to the *dynamics of prices and inflation.* First, they show that, as changes in real money balances are negatively related to the rate of inflation, real money balances are negatively related to the price level; these results indicate that money supply and inflation movements during the implementation of stabilization programs were partly unanticipated. Viewed in this way, the correlation between real money balances and the price *level* entirely reflects the complex short-run dynamics in the sample period and should not be interpreted as evidence of an (otherwise hardly explicable) nonhomogenous demand for money. These results are also in line with the findings in the previous section, where it was argued that the observed velocity patterns can better be accounted for by assuming that inflationary expectations do not immediately and fully incorporate changes in monetary growth rates.[29]

Second, the empirical results also indicate that changes in real money balances are negatively related to changes in the rate of inflation. These results are in line with standard money demand theory.

Third, changes in economic activity are accompanied and followed by larger changes in real money balances. This finding is also not surprising—the function of money as a means of exchange is likely to establish a close relationship between the volume of real transactions and real money balances even in the short run.

Fourth, there is no clear association between changes in real money balances and changes in the rate of depreciation of the exchange rate. The implication that the link between these two variables might be more complex is all the more likely since in the short run real money balances are linked to the *expected* depreciation rate, and, furthermore, the linearization underlying the money demand specification in Equation (10) may fail to capture what may be highly nonlinear dynamics.[30]

---

[28](...continued)
money balances.

[29]For a similar conclusion, see Easterly and Wolf (1996).

[30]The model in Section III suggests that the dynamics for both the expected and actual depreciation rates are highly nonlinear.

The presence of a significant positive *constant* in both specifications (with and without the deviation term) is *not* indicative of a positive underlying growth rate for real money balances. It merely suggests that *short-term developments during the sample period* in real money balances are better described if a positive drift is added to the equation.

Finally, for the interpretation of the coefficient on the *deviation term*, one has to accept and use all the assumptions made; the negative sign indicates that observed real money balances have a tendency to converge towards "desired" real balances.[31]

Comparison with Central and Eastern Europe

For comparison purposes, an analysis similar to the above was conducted for *moderate inflation* transition economies of central and eastern Europe. Six countries (the Czech Republic, Hungary, Poland, the Slovak Republic, Slovenia, and Czechoslovakia) are included based on data availability.[32]

Arguably, in the sample period these countries possessed a more developed financial system than the Baltics, Russia and other countries of the former Soviet Union countries two years before stabilization. This implies that an empirical investigation of the behavior of real money balances cannot ignore domestic interest rates. Therefore, deposit interest rates were included alongside the other rates of return (inflation and depreciation rates) in all specifications. The deposit rate proxies for the opportunity cost of holding narrow money rather than other domestic assets.

---

[31]In addition to problems with data quality, the analysis presented above suffers from several drawbacks that need to be kept in mind when interpreting the results. *First*, the presence of *sample selection bias* is fairly obvious. If sample selection biases the results, it does so in a rather complex way and without clear implications. *Second*, since no attempt is made to *identify money demand*, the estimated equations are convolutions of money demand and supply. Hence, they should not be interpreted as behavioral relationships, but rather as reduced form equations describing the behavior of observed real money balances. Any demand side interpretation should be taken with great caution. *Third*, the *direction of causality* has not been established between real money and other variables. It is therefore preferable to refrain from causal interpretations.

[32]Raw data are from the IMF and the OECD; for similar analyses, see Begg, Hesselman and Smith (1996) and IMF Staff Country Reports on Croatia, the Czech Republic, Hungary Poland and Slovenia.

In contrast to the finding in the previous analysis, the *data do not reject the homogeneity assumption;* since the analysis for the central and eastern European countries covers the post-stabilization period, it is plausible that monetary developments were already more in line with anticipations. At the same time, the considerations leading to distinguishing two 'regimes' in the previous sample do not apply here, hence the parameters were assumed to remain constant throughout the sample period.

The assumption of an equilibrium relationship as in Equation (15) yields findings that suggest an equilibrium positive association between real money balances and real activity, and a negative relationship between domestic interest rates and real money as well as between the inflation rate and real money—all of which is as expected based upon standard money demand theory. The rate of exchange rate depreciation, however, does not appear strongly related to developments in real money, but it seems that substantial differences exist between countries in this respect.

Turning to the *short-run dynamics,* the results reported in Table 10 are qualitatively similar except that changes in the depreciation rate seem to be more strongly associated with real money. It is noteworthy that positive changes in the depreciation rate coincide with larger changes in real money. Similarly to the findings for the Baltics, Russia and other countries of the former Soviet Union sample, this also suggests a nontrivial dynamic relationship between exchange rates and real money. It should be noted that the results do not seem to change substantially no matter whether a deviation term is included in the specification or not.

Finally, diagnostic tests and results of sequential estimation as presented in Table 10 suggest that there are cross-country differences in the short-run adjustment mechanism of real money balances. The country dummies differ significantly and the point estimates are also quite sensitive to the sample choice, both of which suggests heterogeneity. Even though there is no evidence of serial correlation or heteroscedasticity in the residuals, the functional specification cannot be regarded as fully satisfactory since normality of the residuals is rejected.

V. Conclusions

This paper has examined the behavior of the velocity of money during the transition to a market economy, with a focus on the Baltics, Russia and other countries of the former Soviet Union region. Based upon an analysis of velocity developments before, in the course of, and following stabilization programs, the paper identified and interpreted a number of key stylized facts. The paper's retrospective insights at the same time offer direction for some prospective reflections on monetary developments to be anticipated in the next few years.

The paper's main insights can be summarized as follows. First, high and protracted inflation during the period preceding the introduction of stabilization program substantially eroded real money balances. The historical path of cumulative inflation in this period has resulted in strong cross-county differences in velocity levels at the outset of the stabilization programs.

Second, standard open economy money demand theory and econometric methods can be used to gain insights into monetary developments during the transition process. When taking into account price stickiness and inflation inertia, standard analysis can largely explain key empirical observations for the Baltics, Russia and other countries in the former Soviet Union, such as (i) the increase in velocity at the onset of monetary tightening; (ii) the tendency for exchange rate movements to lead inflation movements; and (iii) the tendency for exchange rate movements to overshoot the long-run equilibrium path in the initial stages of the inflation stabilization process.

Third, analyzing velocity behavior during the period when stabilization program is implemented and until stabilization has been achieved appears to be of limited value for prediction purposes. Comparing the estimates for the Baltics, Russia and other countries of the former Soviet Union with results for central and eastern European economies suggests that the process driving real money balances changes once inflation stabilization has been achieved, that is, once moderate inflation is established; in particular, the price homogeneity property of money demand is restored. Prospects for velocity over the next few years in the Baltics, Russia and other countries of the former Soviet Union should therefore be based upon a number of economic developments expected to take place as the transition process progresses. Tentatively, the following can be expected.

On the basis of expected developments in inflation, the real exchange rate, and the financial system, velocity should follow a downward trend in the next few years. In particular, once inflation subsides and the growth rate of income becomes significantly positive, economic agents should slowly start rebuilding their real money balances. The process is, however, likely to be protracted and the available evidence does not suggest that the process of demonetization which accompanied high inflation will be fully reversed or that levels of velocity will converge across countries. Again, the historical path of experience with inflation and its impact on velocity cannot be ignored once stabilization is achieved.[33]

---

[33]A. Ghosh (1996), on the basis of an analysis of a large sample of developing countries, has found that the process of remonetization when inflation falls is quite different from the demonetization during high inflation periods. He concluded that money demand functions based on periods of demonetization may seriously over-estimate the impact of declining

(continued...)

Capital reflows or inflows, to the extent that they coincide with shifts in the demand for money, could, however, speed up the process, provided the right incentives and environment are in place. At the same time, the short-term behavior of the monetary aggregates is expected to remain volatile in the foreseeable future, resulting in short-run and largely unpredictable velocity fluctuations.

The convergence of the domestic price level and of domestic relative prices (in particular, the price of nontraded relative to traded goods) to international comparators should be accompanied by a slowdown in the observed tendency toward *real* appreciation of the domestic currency. To the extent that this movement is anticipated, it should make the holding of domestic money balances more attractive, relative tot he accumulation of real assets—in particular nontraded goods—than before; and as a result, velocity should be expected to decrease.[34]

Finally, the process of structural reform in the financial sector and the establishment of an efficient market-based banking and payment system, should induce an increase in the degree of monetization of economic transactions and make holding wealth in liquid form more attractive and therefore be reflected in a downward movement of velocity.[35] At the same time, the composition of broad money should be expected to change, with an increase in the share of domestic currency bank deposits compared to the shares of cash and foreign currency deposits.[36]

---

[33](...continued)
inflation on real money demand.

[34]This argument highlights the choice between domestic goods and money rather than between domestic and foreign financial assets. It is not inconsistent with the existence of an inverse relationship between real money demand and the (expected) rate of *nominal* depreciation.

[35]In further stages of the process of structural reform in the financial sector and establishment of an efficient market-based banking and payment system, the need to use cash and domestic currency deposits may be reduced again. Empirical studies suggest that, in many countries, velocity tends to follow a U-curve pattern. Increased use of money in transactions and development of the banking system lead to velocity first falling; financial sophistication eventually causes it to increase.

[36]In some cases, structural reform measures in the financial sector are a response to an imminent banking crisis. The liquidity squeeze which in general accompanies such a crisis

(continued...)

Dynamics of the Model

To analyze the dynamic adjustment path from the time of impact of lower money growth to the new long-run equilibrium, note first that Equations (8) and (2b) in the main text form a system of differential equation which can be rewritten, defining $z = ln\ M - ln\ P$, as:

$$dz = (u - \varphi) - c\ (1 + 1/na)\ [z - (ky - n\ (lr + u))] \quad \text{(A1)}$$

$$d\varphi = b\ [u - \varphi] \quad \text{(A2)}$$

The associated phase diagram is shown in Figure 2 of the main text. The downward rather that upward shift of $dz=0$ when $u = 3\ percent$ rather than $u = 10\ percent$, and the ensuing non-monotonic path for $Z = lnM - lnP$ depends on $c(n + 1/a) < 1$, which holds for a sufficiently small value for c.

The path for the rate of depreciation of the exchange rate can be analyzed taking first the time derivative of Equation (6) of the main text to find:

$$de/e = dP/P + (1 + 1/na)\ [u - dP/P] \quad \text{(A3)}$$

Replacing dP/P by its value from Equation (8) of the main text, (A3) reduces to

$$de/e = (1 + 1/na)\ u - (1/na)\ \varphi - (1/na)\ c\ (1 + 1/na)\ [z - (ky - n\ (lr + u))] \quad \text{(A4)}$$

The path for de/e is thus generated by Equation (I.4) where φ and z are given by the solution of Equations (A1)–(A2); it is illustrated in the bottom half of Figure 2 in the main text. On impact, following a permanent reduction in the rate of money growth, the rate of depreciation of the exchange rate (and not just its level) jumps downward, in this case to below 3 percent.[37] With $d\varphi<0$, $dz<0$ along the portion AC of the path AB in Figure 2, it

---

[36](...continued)
results in a sharp increase in velocity, as for instance recently observed in Latvia and Lithuania. The occurrence of banking crises may disturb the predicted negative correlation between the degree of structural reform in the financial sector and the level of velocity.

[37]One verifies that if, initially, $z = ky - n\ (lnr + 10\ percent)$, and $\varphi = 10\ percent$, de/e from (A4) when $u = 3\ percent$ reduces to $de/e = 3\ percent - (1/na)\ [1 - c\ (n + 1/a)]\ (10\ percent - 3\ percent)$, which is *less* than *3 percent* under previous assumptions relating to

follows from (A4) that *de/e* must rise; this rise will continue after C is reached since then $d\varphi$ is still negative. The maximum rate of depreciation will be reached somewhere along the path CB. Thereafter, with the positive influence (i.e., toward exchange rate appreciation) of $d\varphi<0$ on *de/e* being more and more offset by the negative influence of $dz>0$ on de/e, the rate of depreciation decline until the long-run equilibrium at $de/e = u = 3$ *percent* is reached.[38]

---

[37](...continued)
c.

[38]In general, oscillatory behavior towards the steady state should be expected.

Model Consistency of Exchange Rate Expectations

Using Equation (6) of the main text to replace $lne - ln\bar{e}$ in the exchange rate expectation mechanism (3), one obtains:

$$E\{de/e\} = -1/n\ [ln\ M - ln\ P - (ky - n\ (r + u))] + u \qquad (B1)$$

The actual rate of depreciation of the spot exchange rate is given by Equation (A4) of Annex I, reproduced below

$$de/e = (1 + 1/na)\ u - (1/na)\varphi - (1/na)\ c\ (1 + 1/na)\ [z - (ky - n\ (lr + \bar{u}))] \qquad (B2)$$

where φ is a time-dependent variable. Only if $u = \varphi$ at all times are the right-hand sides of Equations (B1) and (B2) of the same form, and can relations between model parameters yield $E\{de/e\} = de/e$. Specifically with $u = \varphi$ rational expectations hold for values of parameters satisfying

$$(1/na)c\ (1 + 1/na) = 1/n \qquad (B3)$$

or

$$na^2 - n\ ac - c = o \qquad (B4)$$

Solving for a, one obtains values that would ensure model consistency in the exchange rate expectation mechanism (only the positive root makes economic sense).

Table 1: Velocity 1/
(excluding foreign currency deposits)

	1991	1992	1993	1994	1995	1996
Armenia	...	3.2	5.6	17.4	21.4	18.4
Azerbaijan	...	4.5	5.0	9.9	15.8	13.9
Belarus 2/	1.7	5.7	6.8	11.4	13.5	10.1
Estonia 2/	2.4	6.5	5.0	4.7	5.1	3.5
Georgia 2/	0.9	3.0	18.4	73.5	77.4	31.0
Kazakstan	...	5.0	6.4	12.5	14.3	14.2
Kyrgyz Republic	...	5.9	10.0	10.7	7.7	7.6
Latvia	...	7.8	6.0	4.8	5.4	7.2
Lithuania	...	...	10.6	8.2	8.6	5.0
Moldova 2/	2.0	4.2	9.7	11.0	9.0	5.6
Russia 2/	1.6	6.3	7.7	9.3	11.3	9.9
Tajikistan	...	3.5	2.4	3.1	5.1	18.8
Turkmenistan	...	7.1	8.6	21.1	18.7	20.1
Ukraine 2/	1.5	5.3	6.3	6.4	11.2	13.2
Uzbekistan	...	...	3.6	6.0	8.9	8.1
Albania	1.5	2.4	3.1	2.6	2.6	2.2
Bulgaria	2.0	1.7	1.6	1.9	2.0	2.6
Croatia	4.3	4.0	10.5	10.5	9.2	7.0
Czech Republic	1.6	1.5	1.4	1.3	1.3	1.3
Hungary	2.5	2.3	2.5	2.8	3.2	3.1
Poland	4.1	3.7	3.9	3.8	3.4	3.2
Romania	2.2	4.0	6.3	6.0	5.2	4.8
Slovakia	1.6	1.7	1.6	1.7	1.6	1.6
Slovenia	5.7	6.9	6.1	4.8	4.5	4.2

1/ Annual velocity for the Baltics, Russia and other countries of the former Soviet Union is based on quarterly average.
2/ 1991 is based on Q4 data

Table 2: Velocity 1/
(including foreign currency deposits)

	1991	1992	1993	1994	1995	1996
Armenia	...	3.0	4.3	8.9	15.7	14.4
Azerbaijan	...	4.5	3.7	5.7	9.4	10.8
Belarus 2/	1.7	5.0	4.9	6.2	8.4	7.6
Estonia 2/	1.0	3.9	4.8	4.3	4.5	3.1
Georgia 2/	0.9	2.9	13.4	27.5	48.6	26.2
Kazakstan	...	4.9	4.9	9.2	11.3	11.7
Kyrgyz Republic	...	5.7	8.8	10.0	7.1	7.1
Latvia	...	5.6	4.1	3.5	3.8	4.9
Lithuania	...	...	6.5	6.2	6.1	3.7
Moldova 2/	2.0	4.1	8.8	9.9	7.9	5.0
Russia 2/	1.3	4.3	4.9	6.9	9.0	9.9
Tajikistan	...	3.5	2.4	3.1	5.1	15.0
Turkmenistan	...	5.6	7.6	20.2	17.5	15.7
Ukraine 2/	1.5	5.2	5.1	5.5	7.9	10.5
Uzbekistan	...	...	3.4	5.0	7.4	7.1
Albania	1.4	1.9	2.5	2.2	2.1	1.8
Bulgaria	1.3	1.3	1.3	1.3	1.5	1.3
Croatia	2.7	2.6	4.2	4.9	3.8	2.8
Czech Republic	1.5	1.3	1.3	1.2	1.2	1.2
Hungary	2.1	2.0	2.0	2.2	2.3	2.3
Poland	3.1	2.8	2.8	2.7	2.7	2.7
Romania	2.1	3.3	4.5	4.7	4.0	3.7
Slovakia	1.6	1.6	1.5	1.5	1.5	1.4
Slovenia	2.9	3.8	3.3	3.0	2.8	2.6

1/ Annual velocity for the Baltics, Russia and other countries of the former Soviet Union is based on quarterly average.
2/ 1991 is based on Q4 data

Table 3: Baltics, Russia, and Other Countries of the Former Soviet Union: Stabilization and Velocity

	Last quarter before stabilization program	Cumulative inflation 1/	Velocity 2/		First quarter of stabilization	Cumulative inflation 1/	Velocity 3/
Armenia	1994Q4	29,267.9	17.4		1996Q1	38,656.2	18.4
Azerbaijan	1994Q4	4,399.6	9.9		1996Q1	8,545.0	13.9
Estonia	1992Q2	5.5	7.3		1995Q1	20.7	5.1
Georgia	1994Q4	63,738.0	73.5		1996Q4	112,184.4	...
Kazakstan	1994Q1	1,444.0	5.8	4/	1996Q3	15,995.0	13.6
Kyrgyz Rep.	1993Q2	41.5	6.6		1995Q3	276.9	7.2
Latvia	1993Q4	14.3	6.0		1994Q4	17.0	4.9
Lithuania	1994Q1	40.6	10.5		1995Q3	61.0	9.5
Moldova	1993Q3	118.2	6.7		1995Q2	492.5	8.5
Russia	1995Q2	1,227.7	10.3		1996Q3	1,846.2	9.9
Ukraine	1995Q3	25,070.7	11.2		1997Q1	42,453.9	...

1/ Cumulative inflation since December 1991 (Dec. 1991=1).

2/ Average quarterly velocity in the last four quarters before the introduction of a stabilization program.

3/ Average quarterly velocity in the first four quarters of stabilization.

4/ Artificially low due to one time adjustment to money stock related to settlement of arrears.

Table 4. Dependent variable: log change in real money balances
Sample: pooled data for 6 FSU countries in stabilization time

Variable 1/	Specification 2/ 3/ 4/ (1)	(2)	(3)
d log price level, pre	-0.836 *	-	-
	(8.32)		
d log price level, post	-0.971 *	-	-
	(10.98)		
d log price level	-	-0.720 *	-0.694 *
		(12.14)	(11.97)
d log real output	0.086 *	0.095 *	0.096 *
	(3.34)	(4.01)	(3.71)
dd log exchange rate	-0.012	0.002	0.000
	(0.18)	(0.04)	(0.00)
dd log price level	0.221 *	0.125	0.099
	(2.41)	(1.58)	(1.29)
d log real output (-1)	0.059	0.055 *	0.058 *
	(2.32)	(2.32)	(2.41)
dd log exchange rate (-1)	0.002	0.036	0.036
	(0.03)	(0.47)	(0.48)
dd log price level (-1)	-0.093	-0.128	-0.155 *
	(0.93)	(1.83)	(2.17)
d log real output (-2)	0.042 *	0.043	0.046 *
	(2.04)	(2.14)	(2.34)
dd log exchange rate (-2)	-0.092	-0.074	-0.077
	(1.75)	(1.27)	(1.29)
dd log price level (-2)	-0.081	-0.113 *	-0.131 *
	(1.18)	(2.01)	(2.34)
deviation term, pre	-0.179	-	-
	(1.00)		
deviation term, post	-0.223 *	-	-
	(4.46)	-0.194 *	-0.178 *
deviation term	-	(3.98)	(3.91)
Armenia, pre	0.094 *	-	-
	(4.63)		
Azerbaijan, pre	0.109 *	-	-
	(4.40)		
Kazakstan, pre	0.071	-	-
	(1.88)		
Kyrgyz Republic, pre	0.039	-	-
	(1.62)		
Moldova, pre	0.071	-	-
	(1.67)		
Russia, pre	0.057 *	-	-
	(2.84)		
Armenia, post	0.072 *	-	-
	(5.41)		
Azerbaijan, post	0.050 *	-	-
	(3.88)		
Kazakstan, post	0.041 *	-	-
	(3.46)		
Kyrgyz Republic, post	0.052 *	-	-
	(4.44)		
Moldova, post	0.059 *	-	-
	(3.74)		
Russia, post	0.054 *	-	-
	(3.83)		
Armenia	-	0.063 *	-
		(6.16)	
Azerbaijan	-	0.058 *	-
		(4.85)	
Kazakstan	-	0.042 *	-
		(3.24)	
Kyrgyz Republic	-	0.035 *	-
		(3.16)	
Moldova	-	0.050 *	-
		(2.73)	
Russia	-	0.043 *	-
		(3.73)	
constant	-	-	0.047 *
			(7.36)

1/ All variables are measured in logs. "d" preceeding a variable name indicates first difference, while "dd" refers to second difference. Lags are indicated in parenthesis after the variable name.
2/ All specifications include 2 dummies for outlier observations for Moldova.
3/ t-statistics based on White-corrected standard errors in parenthesis.
4/ Asterisks indicate significance at the 5% level.

Table 5. Model selection and diagnostic tests; dependent variable: log change in real money balances.
Sample: pooled data for 6 FSU countries in stabilization time

	Specification 1/ (1)	(2)	(3)
No. of observations	127	127	127
Adjusted R-square	0.747	0.748	0.754
Bera-Jarque normality 2/	chi2=4.77 p-value=0.09	chi2=3.16 p-value=0.21	chi2=3.69 p-value=0.16
RESET for 4 powers of the dependent variable 3/	F(3,88)=1.00 p-value=0.39	F(3,104)=0.56 p-value=0.64	F(3,110)=1.96 p-value=0.12
Equality of coefficients across regimes 4/			-
d log price level	F(1,100)=1.89 p-value=0.17		
deviation term	F(1,100)=0.07 p-value=0.78		
Armenia dummy	F(1,100)=1.12 p-value=0.29		
Azerbaijan dummy	F(1,100)=4.96 p-value=0.03		
Kazakstan dummy	F(1,100)=0.57 p-value=0.45		
Kyrgyz Rep. dummy	F(1,100)=0.20 p-value=0.65		
Moldova dummy	F(1,100)=0.08 p-value=0.77		
Russia dummy	F(1,100)=0.02 p-value=0.89		

1/ The null of no first-order serial correlation was not rejected for any of the specifications.
2/ Null hypothesis: the residuals are normal.
3/ Null hypothesis: the functional form is correctly specified.
4/ F-statistics are based on White-corrected standard errors.

Table 6. Sequential estimation; dependent variable: log change in real money balances.
Sample: pooled data in stabilization time
Specification: (4)

Variable	Countries included 1/ 2/ 3/ 4/					
	(1)	(1)-(2)	(1)-(3)	(1)-(4)	(1)-(5)	(1)-(6)
d log price level	-0.807 *	-0.606 *	-0.628 *	-0.681 *	-0.677 *	-0.694 *
	(7.53)	(8.	(8.	(9.30)	(12.17)	(11.97)
d log real output	0.067 *	0.068 *	0.089 *	0.079 *	0.098 *	0.096 *
	(4.56)	(4.76)	(4.68)	(3.69)	(3.82)	(3.71)
dd log exchange rate	-0.052	0.100	0.064	0.055	0.024	0.000
	(0.54)	(1.46)	(0.92)	(0.87)	(0.47)	(0.00)
dd log price level	0.155 *	0.058	0.075	0.156	0.093	0.099
	(2.80)	(0.81)	(0.97)	(1.92)	(1.19)	(1.29)
d log real output (-1)	0.024 *	0.022	0.035 *	0.030	0.061 *	0.058 *
	(2.23)	(1.93)	(2.21)	(1.76)	(2.52)	(2.41)
dd log exchange rate (-1)	-0.124	0.041	0.038	-0.015	0.062	0.036
	(1.25)	(0.52)	(0.44)	(0.17)	(0.82)	(0.48)
dd log price level (-1)	-0.093 *	-0.097	-0.070	-0.063	-0.151 *	-0.155 *
	(2.54)	(1.66)	(0.92)	(0.79)	(2.08)	(2.17)
d log real output (-2)	0.029 *	0.013	0.025 *	0.026	0.048 *	0.046 *
	(2.39)	(1.06)	(1.83)	(1.85)	(2.42)	(2.34)
dd log exchange rate (-2)	-0.189 *	-0.107 *	-0.111	-0.139 *	-0.073	-0.077
	(7.15)	(2.11)	(1.90)	(2.47)	(1.18)	(1.29)
dd log price level (-2)	-0.172 *	-0.188 *	-0.125	-0.131 *	-0.124 *	-0.131
	(3.82)	(4.69)	(2.43)	(2.59)	(2.16)	(2.34)
deviation term	-0.203 *	-0.175 *	-0.228 *	-0.211 *	-0.183 *	-0.178 *
	(3.56)	(3.02)	(3.88)	(3.84)	(3.91)	(3.91)
constant	0.063 *	0.048 *	0.046 *	0.046 *	0.046 *	0.047 *
	(4.96)	(5.49)	(5.77)	(6.62)	(6.71)	(7.36)
No. of observations	22	44	64	86	108	118
Adjusted R-square	0.904	0.866	0.791	0.761	0.769	0.747
Bera-Jarque normality 5/	chi2=2.83	chi2=0.38	chi2=1.26	chi2=.97	chi2=2.56	chi2=1.03
	p-value=.02	p-value=.83	p-value=.53	p-value=.61	p-value=.28	p-value=0.59
RESET for 4 powers of the	F(3,6)=3.46	F(3,28)=2.34	F(3,48)=1.12	F(3,70)=0.51	F(3,90)=0.05	F(3,101)=1.93
dependent variable 6/	p-value=.09	p-value=.09	p-value=.35	p-value=.67	p-value=0.99	p-value=0.13

1/ All specifications include 2 dummies for outlier observations for Moldova.
2/ t-statistics based on White-corrected standard errors in parenthesis.
3/ Asterisks indicate significance at the 5% level.
4/ The list of countries is Armenia (1), Azerbaijan (2), Kazakstan (3), Kyrgyz Republic (4), Moldova (5), and Russia (6).
5/ Null hypothesis: the residuals are normal.
6/ Null hypothesis: the functional form is correctly specified.

Table 7. Dependent variable: log change in real money balances
Sample: pooled data for 6 FSU countries in stabilization time

Variable 1/	Specification 2/ 3/ 4/ (1)	(2)	(3)	(4)
d log price level, pre	-0.741 *	-0.675 *	-0.664 *	-
	(7.96)	(11.07)	(11.64)	
d log price level, post	-0.779 *	-0.769 *	-0.737 *	-
	(9.	(8.81)	(8.64)	
d log price level	-	-	-	-0.665 *
				(11.54)
d log real output	0.065 *	0.061 *	0.066	0.069 *
	(2.39)	(2.23)	(2.30)	(2.46)
dd log exchange rate	-0.010	0.002	-0.001	-0.003
	(0.17)	(0.04)	(0.03)	(0.06)
dd log price level	0.015	-0.003	-0.017	-0.032
	(0.18)	(0.04)	(0.19)	(0.41)
d log real output (-1)	0.057 *	0.054 *	0.058 *	0.056 *
	(2.21)	(2.08)	(2.12)	(2.10)
dd log exchange rate (-1)	0.033	0.052	0.051	0.056
	(0.45)	(0.69)	(0.68)	(0.73)
dd log price level (-1)	-0.272 *	-0.286 *	-0.296 *	-0.295 *
	(3.84)	(3.99)	(4.18)	(4.25)
d log real output (-2)	0.039 *	0.034	0.039	0.039
	(2.09)	(1.70)	(1.85)	(1.90)
dd log exchange rate (-2)	-0.088	-0.064	-0.069	-0.072
	(1.70)	(1.21)	(1.24)	(1.29)
dd log price level (-2)	-0.218 *	-0.212 *	-0.219 *	-0.226 *
	(4.00)	(4.12)	(4.02)	(4.29)
Armenia, pre	0.058 *	-	-	-
	(3.			
Azerbaijan, pre	0.089 *	-	-	-
	(3.50)			
Kazakstan, pre	0.069 *	-	-	-
	(2.39)			
Kyrgyz Republic, pre	0.029	-	-	-
	(1.15)			
Moldova, pre	0.044	-	-	-
	(1.09)			
Russia, pre	0.047 *	-	-	-
	(2.39)			
Armenia, post	0.062 *	-	-	-
	(4.06)			
Azerbaijan, post	0.036 *	-	-	-
	(2.40)			
Kazakstan, post	0.033 *	-	-	-
	(2.15)			
Kyrgyz Republic, post	0.048 *	-	-	-
	(4.80)			
Moldova, post	0.049 *	-	-	-
	(2.44)			
Russia, post	0.044 *	-	-	-
	(3.37)			
Armenia	-	0.057 *	-	-
		(4.58)		
Azerbaijan	-	0.051 *	-	-
		(3.83)		
Kazakstan	-	0.046 *	-	-
		(3.01)		
Kyrgyz Republic	-	0.037 *	-	-
		(3.24)		
Moldova	-	0.041 *	-	-
		(2.09)		
Russia	-	0.042 *	-	-
		(3.55)		
constant	-	-	0.044 *	0.042 *
			(6.25)	(6.28)

1/ All variables are measured in logs. "d" preceeding a variable name indicates first difference, while "dd" refers to second difference. Lags are indicated in parenthesis after the variable name.

2/ All specifications include 2 dummies for outlier observations for Moldova.

3/ t-statistics based on White-corrected standard errors in parenthesis.

4/ Asterisks indicate significance at the 5% level.

Table 8. Model selection and diagnostic tests; dependent variable: log change in real money balances.
Sample: pooled data for 6 FSU countries in stabilization time

	Specification 1/			
	(1)	(2)	(3)	(4)
No. of observations	127	127	127	127
Adjusted R-square	0.714	0.716	0.726	0.728
Bera-Jarque normality 2/	chi2=3.11 p-value=0.21	chi2=2.95 p-value=0.23	chi2=3.69 p-value=0.16	chi2=3.25 p-value=0.20
RESET for 4 powers of the dependent variable 3/	F(3,99)=1.30 p-value=0.28	F(3,105)=0.76 p-value=0.52	F(3,101)=1.01 p-value=0.39	F(3,111)=0.27 p-value=0.85
Heteroscedasticity 4/, 5/	F(12,114)=2.14 p-value=0.02	F(6,120)=1.73 p-value=0.12	F(6,120)=1.52 p-value=0.18	F(6,120)=1.53 p-value=0.18
Equality of coefficients across regimes 4/				
d log price level	F(1,102)=0.21 p-value=0.65	F(1,108)=1.62 p-value=0.21	F(1,113)=0.87 p-value=0.35	-
Armenia dummy	F(1,102)=0.04 p-value=0.85			
Azerbaijan dummy	F(1,102)=3.80 p-value=0.06			
Kazakstan dummy	F(1,102)=1.32 p-value=0.25			
Kyrgyz Rep. dummy	F(1,102)=0.58 p-value=0.45			
Moldova dummy	F(1,102)=0.01 p-value=0.92			
Russia dummy	F(1,93)=0.03 p-value=0.86			

1/ The null of no first-order serial correlation was not rejected for any of the specifications.
2/ Null hypothesis: the residuals are normal.
3/ Null hypothesis: the functional form is correctly specified.
4/ F-statistics are based on White-corrected standard errors.
5/ The F-statistics reported test the joint significance of the slope coefficients in a regression of the squared residuals on a set of country dummies and squares of the fitted values.

Table 9. Dependent variable: log change in real money balances
Sample: pooled data for 11 FSU countries

Variable	Specification 1/ 2/ (1)	(2)
d log price level	-0.568	-0.333
	(6.15)	(5.36)
d log real output	0.091	0.095
	(2.52)	(2.63)
dd log exchange rate	0.235	0.291
	(2.63)	(3.30)
dd log price level	-0.408	-0.596
	(3.15)	(5.03)
d log real output (-1)	0.076	0.076
	(2.03)	(2.05)
dd log exchange rate (-1)	0.037	0.094
	(0.39)	(1.02)
dd log price level (-1)	-0.571	-0.705
	(5.03)	(6.56)
d log real output (-2)	0.033	0.039
	(1.00)	(1.17)
dd log exchange rate (-2)	0.221	0.265
	(2.90)	(3.53)
dd log price level (-2)	-0.247	-0.315
	(2.82)	(3.68)
country 1	0.039	-
	(1.71)	
country 2	0.016	-
	(1.36)	
country 3	0.023	-
	(2.86)	
country 4	0.002	-
	(0.55)	
country 5	0.001	-
	(0.27)	
country 6	0.004	-
	(1.06)	
country 7	-0.001	-
	(0.21)	
country 8	0.103	-
	(0.40)	
country 9	0.468	-
	(1.96)	
country 10	0.377	-
	(1.79)	
country 11	0.430	-
	(2.09)	
No. of observations	307	307
Adjusted R-square	0.34	0.34

1/ All specifications include a dummy for an outlier observations for Kazakstan.
2/ t-statistics in parenthesis.

Table 10. Sequential estimation; dependent variable: log change in real money balances.
Sample: pooled data, Eastern European countries

Variable	Countries included 1/ 2/ 3/ 4/ (1)	(1)-(2)	(1)-(3)	(1)-(4)	(1)-(5)	(1)-(6)
d log real output	0.001	0.041 *	0.043 *	0.021	0.014	0.009
	(0.03)	(1.91)	(2.13)	(1.17)	(0.88)	(0.63)
d log interest rate	-1.026	-0.469	-0.108	-0.165	-0.049	-0.053
	(0.43)	(1.42)	(0.46)	(0.69)	(0.92)	(1.04)
dd log exchange rate	0.296	0.054	0.081	0.102	0.089	0.054
	(1.89)	(0.63)	(1.09)	(1.73)	(1.93)	(1.23)
dd log price level	-3.170 *	-1.189 *	-1.190 *	-1.270 *	-1.300 *	-1.290 *
	(6.47)	(7.66)	(9.56)	(9.99)	(9.84)	(9.87)
d log real output (-1)	0.021	0.040 *	0.046 *	0.048 *	0.054 *	0.052 *
	(1.06)	(2.09)	(2.38)	(2.70)	(3.26)	(3.26)
d log interest rate (-1)	-5.842 *	-0.169	-0.459	-0.419	0.039	0.039
	(3.06)	(0.43)	(1.86)	(1.48)	(0.67)	(0.69)
dd log exchange rate (-1	0.279	0.181 *	0.205 *	0.242 *	0.212 *	0.169 *
	(1.45)	(2.01)	(2.56)	(3.75)	(3.89)	(3.16)
dd log price level (-1)	-2.117 *	-1.043 *	-0.925 *	-0.933 *	-0.967 *	-0.940 *
	(3.11)	(5.43)	(6.13)	(6.07)	(6.69)	(6.51)
d log real output (-2)	-0.002	0.039	0.035	0.025	0.023	0.031 *
	(0.07)	(1.98)	(1.87)	(1.53)	(1.59)	(2.06)
d log interest rate (-2)	-3.621	-0.041	-0.081	-0.089	-0.068	-0.065
	(2.04)	(0.12)	(0.35)	(0.38)	(1.36)	(1.29)
dd log exchange rate (-2	0.186	0.073	0.122 *	0.156 *	0.132 *	0.089 *
	(1.30)	(1.05)	(1.99)	(2.95)	(2.95)	(2.00)
dd log price level (-2)	-1.830 *	-0.574 *	-0.547 *	-0.601 *	-0.615 *	-0.589 *
	(3.11)	(3.06)	(3.68)	(3.85)	(4.08)	(4.05)
Czech Republic	0.009 *	0.009 *	0.009 *	0.009 *	0.009 *	0.009 *
	(3.38)	(2.74)	(2.74)	(2.91)	(2.91)	(2.91)
Hungary	-	-0.001	-0.001	-0.001	-0.001	-0.001
		(0.57)	(0.53)	(0.49)	(0.40)	(0.41)
Poland	-	-	0.001	0.002	0.004	0.003
			(0.45)	(0.53)	(1.32)	(1.24)
Slovak Republic	-	-	-	0.005	0.005	0.005
				(1.28)	(1.35)	(1.35)
Slovenia	-	-	-	-	0.016 *	0.015 *
					(5.35)	(5.38)
Czechoslovakia	-	-	-	-	-	-0.002
						(0.31)
No. of observations	37	93	122	159	190	208
Adjusted R-square	0.41	0.54	0.54	0.49	0.50	0.47
Bera-Jarque normality	chi2=1.21	chi2=7.93	chi2=10.42	chi2=18.71	chi2=23.05	chi2=25.87
	p-value=.54	p-value=.02	p-value=.01	p-value=.00	p-value=.00	p-value=.00
RESET for 4 powers of	F(3,21)=1.47	F(3,75)=11.93	F(3,103)=2.86	F(3,139)=1.73	F(3,169)=0.28	F(3,186)=0.39
dependent variable 6/	p-value=.25	p-value=.00	p-value=.04	p-value=.16	p-value=0.84	p-value=0.76

1/ All specifications include a dummy for an outlier observations for Hungary.
2/ t-statistics based on White-corrected standard errors in parenthesis.
3/ Asterisks indicate significance at the 5% level.
4/ The list of countries is the Czech Republic (1), Hungary (2), Poland (3), the Slovak Republic (4), Slovenia (5), and Czechoslovakia (6).
5/ Null hypothesis: the residuals are normal.
6/ Null hypothesis: the functional form is correctly specified.

REFERENCES

Jonathan Anderson, and Daniel Citrin, 1995, "The Behavior of Inflation and Velocity," in *Policy Experiences and Issues in the Baltics, Russia, and Other Countries of the Former Soviet Union*, ed. by Daniel Citrin and Ashok Lahiri (Washington: International Monetary Fund, December) pp.44-62.

Begg, David, Linda Hesselman, and Ron Smith, 1996, "Money in transition economies: Do We Know Much Yet? Evidence from Central and Eastern Europe" (mimeo; Washington: International Monetary Fund).

Bruno, Michael, and William Easterly, 1997, "Inflation Crises and Long-Run Growth," (mimeo; Washington: World Bank).

Buiter, Willem, and Miller, Marcus, 1984, "Real Exchange Rate Overshooting and the Output Cost of Bringing down Inflation: Some Further Results," in: *Exchange Rates and International Macroeconomics*, ed. by Jacob Frenkel (Chicago: University of Chicago Press), pp. 317-65.

Easterly, William, and Holger Wolf, "The Wild Ride of the Ruble," International Journal of Finance and Economics, Vol. 1, pp. 251-62.

Frankel, Jeffrey, 1979, "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials," American Economic Review, Vol. 69 (September), pp. 610-22.

Ghosh, Atish, 1996, "De-Monetization and Re-Monetization," (mimeo; Washington: International Monetary Fund).

Hoffman, Dennis, and Robert Rasche, 1996, *Aggregate Money Demand Functions* (Boston: Massachusetts, Kluwer).

Im, Kyung So, Hashem Pesaran, and Yongcheol Shin, 1995, "Testing for Unit Roots in Heterogeneous Panels," Department of Applied Economics, University of Cambridge Working Paper No. 9526.

Korhonen, Iikka, 1996, "An Error Correction Model for Russian Inflation," Bank of Finland Review of Economies in Transition (May).

International Monetary Fund, Staff Country Reports, Croatia (forthcoming).

——, Staff Country Reports, Czech Republic, Report No. 95/85.

——, Staff Country Reports, Hungary, Report No. 96/109.

——, Staff Country Reports, Poland, Report No. 96/19.

——, Staff Country Reports, Slovenia, Report No. 96/120.