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The Short and Variable Lags of Russian Monetary Policy*

Abstract

This paper assesses empirically the lag between changes in money supply and inflation in Russia during the economic transition. In line with the previous literature, we find that money supply changes affect inflation with a fairly short lag. In addition to this, we find tentative evidence for some lengthening of the lag as the transition has progressed. However, these results are not very robust, and the lags that are found to be significant are generally shorter than those found in the earlier literature.

Keywords: Inflation, monetary policy, Russia

* We wish to thank Jouko Vilmunen and Matti Virén for helpful comments. All remaining errors and omissions are naturally ours.

1 Introduction

The purpose of this paper is to assess the length of the lags between money growth and inflation for the period of economic transition in Russia and whether they have changed. Previous findings have generally suggested that changes in monetary aggregates (usually M2) impact inflation with a lag of three to four months, sometimes even more quickly. Our results differ somewhat from these findings in that for the whole period we find the strongest links from money growth to inflation at lags of one and four months, although there appears to be some evidence that the lags have indeed lengthened as the transition has progressed.

The present study begins with a brief summary of Russian monetary policy and inflation performance during last six years. This is followed by a brief survey of some of the previous empirical work on inflation in Russia and then a presentation of our empirical findings.

2 Brief chronology of Russian monetary policy

The recent history of Russian monetary policy is closely connected with the overall transition to a functioning market economy. As prices were mainly controlled by authorities before January 1992, this period serves as a convenient starting point for the analysis. Price liberalization was seen as an integral part of the economic stabilization effort, and about 90 per cent of retail prices were freed in January 1992. The resulting shift in the price level reduced the excessive amount of liquidity in the economy - monetary overhang[1] - and enabled the realignment of relative prices closer to those that would prevail in a market economy. However, after the initial burst of inflation following the price liberalization, inflation in Russia has responded to changes in the money supply roughly as predicted by the traditional quantity theory of money. The demand for money in Russia has been quite unstable, most likely reflecting the volatile inflation and shifts in expectations. These factors have also led to widespread use of foreign currencies (mostly US dollars) as both media of exchange and stores of value.

During years 1992 - 1994 the stance of Russian monetary policy altered between reasonably tight and very loose.[2] After the price liberalization, the M2 monetary aggregate grew at a rate of about 10 per cent per month. However, in June the monthly growth rate jumped to almost 30 per cent and stayed at this lofty level for five months. The result was an almost immediate spike in the monthly inflation rate and, after a few months of lower inflation, the monthly inflation rate was rarely under 20 per cent between October 1992 and October 1993. After that, the M2 monthly growth rate became more erratic, recording wide month-to-month variations. At the start of 1995 there was a concerted effort to tighten monetary policy, as it had become quite clear to even the most optimistic observer that very expansionary monetary policy did not have any positive effects on the economy, quite the contrary. In the first half of 1995 the average monthly growth rate for M2 was lower than it has been to date since the start of the transition. This tightening of monetary policy was followed by a clear deceleration in monthly inflation rates starting at February 1995, when it was 11 per cent. By the end of 1995 it had reached 3.2 per cent, and the average monthly rate for 1996 was 1.7 per cent, down from 7.3 per cent in 1995. During the first half of 1997 there was some acceleration in the growth of M2, but so far this has not been accompanied by a pickup in inflation. It has been generally argued that the new regime of lower inflation has increased the demand for roubles with the result that real rouble balances have

[1] Some have suggested that the monetary overhang was close to 20 per cent of GDP at the end of 1990. For an overview of the problems related to monetary overhang in transition economies, see Rautava (1993).

[2] For a comprehensive survey of the conduct of Russian monetary, see Baliño et al (1997). For an account of the political economy of Russian inflation and reforms in general, see Schleifer & Treisman (1998).

increased. Monthly inflation rates and monthly changes in M2 are presented in Figure 1.

The primary reason for the early failures to contain inflation can be found on the fiscal side. The Russian central bank was forced to extend credit to the government and to give directed cre dits to enterprises via commercial banks. These credits were priced clearly below market interest rates, and their allocation was decided on political bases. According to the EBRD (1997) the general government deficit was 7.6 per cent of GDP in 1993, 10.1 in 1994, 4.9 in 1995, and 7.7 in 1996. In 1992 the deficit had been almost 20 per cent of GDP! Preliminary data indicate that in 1997 the deficit was about 8 per cent of GDP. In the early years of transition the local securities markets were not sufficiently well developed to allow the Russian Federation to borrow from domestic sources, and Russia=s external creditworthiness was quite low. Thus the inflation tax became an important source of federal revenue. Moreover, the Russian central bank was not legally independent but rather subordinate to the government. However, the situation changed somewhat in 1995. A new law gave the central bank some degree legal independence from the government. These institutional changes may explain at least part of the notable slowdown in the rate of monetary expansion and subsequent inflation. One could perhaps also argue that the de facto exchange rate regime - a crawling peg against USD since July 1995 - has served as an anchor for inflation expectations and hence improved the prospects for disinflation. Russia's greater reliance on borrowing from both international and domestic capital markets has naturally reduced the need for central bank financing of the government.

As a practical matter, the conduct of monetary policy in Russia has been hampered by widespread dollarization of the economy. Empirical estimates of Russian dollarization are at best imprecise because one cannot directly observe the stock of foreign currency in use in a particular country. Usually some data are available on the amount of foreign currency-denominated deposits in domestic banks (if allowed) and sometimes on residents= foreign currency-denominated assets held abroad (if allowed). However, these data do not cover holdings of foreign cash, which probably comprise a substantial part of Russians= foreign currency-denominated assets. For example, when new USD 100 bills were introduced in February 1996, the Russian central bank estimated that there was about USD 20 billion worth of US currency in circulation in Russia, most of it in USD 100 bills (Daily Telegraph, 27 Jan 1996). The total value of Russian M2 was then about USD 50 billion. High and volatile inflation has induced Russians to keep a substantial share of their wealth in foreign currency-denominated assets, and this in turn has increased the volatility of observed money demand and velocity.

3 Some previous empirical studies on inflation in Russia

Most studies on inflation in Russia agree that inflation has reacted to growth in money (usually M2) fairly quickly. Given the fact that Russian inflation has been quite high for much of the transition period, this is not very surprising. For example, Koen and Marrese (1995) find that when monthly inflation is regressed on lags 1 - 5 of monthly M2 growth, the strongest influence on inflation comes from lags 2 and 3. They also tried other monetary aggregates in place of M2 but obtained broadly similar results. Hoggarth (1996) finds lags 3 and 4 of M2 growth to be statistically significant in explaining inflation over the same time frame, but he also finds some evidence that the lags have lengthened for the latter part of the sample. In Korhonen (1996) three lags of money growth were found to be statistically significant in explaining inflation in an error correction framework with data spanning the years 1992 - 1995.

All in all, experience to date seems to indicate that growth in monetary aggregates (usually M2) translates into inflation fairly quickly, ie in about two or three months. However, it is probably safe to say that all empirical economic work with Russian data is fraught with problems. The time series are quite short, and thus obtaining statistically significant estimates is difficult. In addition to this, the regime shift from a command economy to a more market-oriented economy has probably changed the

behaviour of economic agents to a great extent, and this complicates the interpretation of the data, especially for the early stages of the transition.

4 An empirical model of money supply and inflation in Russia

This section presents an empirical study on the relationship between money creation and inflation in Russia. The aim is to assess how well inflation in Russia is explained by growth in the money supply. Particular attention is paid to the investigation of the short-run dynamics in order to reveal any changes in the transmission of money to prices.

The time period considered is January 1992 to October 1997. Starting with a monthly inflation rate of over 20 per cent, following price liberalization at the start of 1992, inflation had gradually slowed to less than 2 per cent per month by October 1997. During the same time period, the Russian financial markets and the role and instruments of the central bank were subject to ongoing change, which may have lead to substantial changes in the money-to price-level transmission mechanism.

4.1 Data description and model formulation

The study was conducted using data published by Russian Economic Trends, which consist of monthly observations of the consumer price index and the rouble broad money supply (*M2*). Before running any regressions, the time series characteristics of the two variables were examined. As usual, the results of unit root tests indicated that the series for the logarithms of the consumer price index and money supply are nonstationary, and in order to obtain stationary series we used the first differences of these variables.

The time series graphs of the first differences of the two variables are presented in Figure 1.

Visual inspection reveals the downward trend in both inflation and money supply growth. It might also be pointed out that the monthly inflation rate has been fairly low and stable since mid-1995, while money supply growth seems to have stabilized somewhat later.

Furthermore, a comparison of the graphs in Figure 1 reveals that the growth rate of the money supply has fluctuated more than inflation, implying that monetary shocks have not given rise to similar variations in the inflation rate. This important feature of the money series seems to have caused some difficulties in the analysis. However, the variation in the money supply appears to contain a seasonal component: the growth rate jumps up in December and down in January. The seasonal fluctuation was handled by adding two dummy variables. The fit of these two dummies is illustrated in Figure 2, in which we have fitted a trend, a constant and the two dummies.

The use of a narrower monetary aggregate (*M0*) was also considered, but it proved to have even greater variation. We also tried to use a modified money series that excluded the seasonal variation. The results nonetheless remained essentially unchanged, with no significant improvement in model diagnostics.

The hypothesized relationship between money supply growth and inflation is presented in equation (1).

$$(1) \qquad \Delta p_t = \alpha + \sum_{j=0}^{n} \beta_j \Delta m_{t-j} + \gamma \Delta p_{t-1} + \varepsilon_t ,$$

where Δp denotes the inflation rate and Δm the growth in the money supply. α, β, and γ are the parameters to be estimated. Subscript t denotes the current time period and n the maximum number of lags. ε is the error term.

The equation states a causal relationship between money and inflation: the dependent variable, inflation, is explained by growth in money supply. The lag structure represents the time that elapses before the impact of money growth is felt in prices. Inclusion of the lagged

Figure 1 Monthly inflation and M2 growth

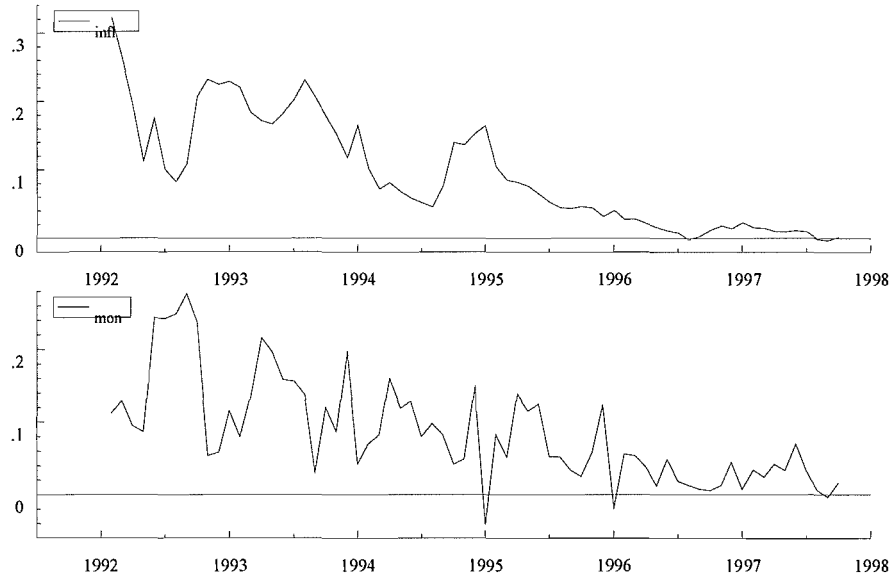
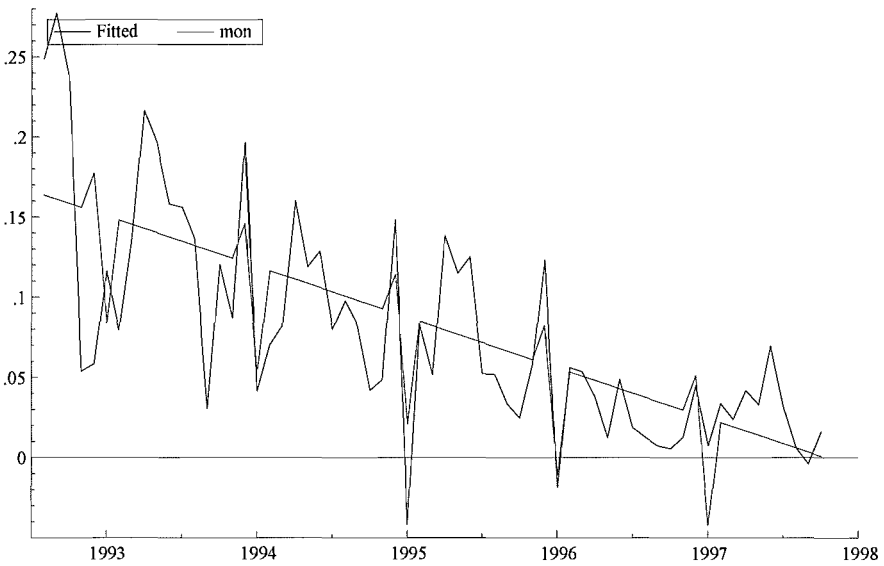


Figure 2 The Fit of the Seasonal Dummies



value of the endogenous variable as explanatory variables reflects an attempt to capture possible price inertia. As already mentioned, we used changes in the consumer price index and growth in rouble *M2* as the empirical counterparts of the two basic variables in the equation..

In order to study causality, we ran Granger causality tests, the results from which support the view that money creation does cause inflation. However, we could not reject the reverse hypothesis of a causal link running from inflation to money supply growth.

Calculation of the long-run static solution of the model yielded the following results:

infl = -0.03891 + 1.398 mon,
(SE) (0.02433) (0.2316),

where *infl* denotes inflation and *mon* growth in the money supply (the same notation as in the figures). The standard errors (SE) of the coefficients are given in parentheses, and the 95 per cent confidence interval is defined by +/- 2SE. Thus the null hypothesis that the money coefficient equals one is not rejected at the 5 per cent significance level. It should be noted that this result is in line with the quantity theory of money, giving further support to the view that inflation in Russia is a monetary phenomenon.

4.2 Estimation and specification of the model

The single equation model presented in equation (1) was estimated using OLS. In order to take into account seasonal variation in the money supply, we added two dummy variables, one for December (*D12*) and one for January (*D1*), as noted earlier. The number of lags was six in the general form of the model ($n = 6$). The results of diagnostic testing performed at this point did not suggest any major econometric problems at the 5 five per cent significance level.

Model simplification was carried out by sequentially dropping statistically insignificant or only weakly significant variables, namely lags 5 and 6 and the contemporaneous money supply. The insignificance of the omitted variables was confirmed by Wald tests.

The parsimonious form of the model and the estimates of the regression coefficients are presented in Table 1.

The OLS estimate of the coefficient of the lagged inflation is 0.76, which indicates persistence for inflation shocks. Furthermore, the coefficient for lag 1 of the money supply is 0.18, with a significant t-ratio, which indicates that a large part of inflation is explained by an increase in the money supply in the previous period, ie one month earlier. The results also reveal that there is a clear link between growth in money supply and inflation four months hence (coefficient 0.14). All these three variables proved highly statistically significant in explaining inflation. The fit of the model and its general diagnostics can be evaluated graphically by examining Figure 3.

The model fits the data reasonably well. The coefficient of determination is 0.95 and the standard error of the equation is 0.0182. According to the graphs presented above, there seems to be some serial correlation in the residuals, which could be due to fluctuations in the money supply. However, the diagnostic test results do not reject the assumption of uncorrelated residuals at the five per cent significance level. Moreover, the graphs and the diagnostic statistics indicate that the residuals deviate somewhat from the normal distribution. One might particularly note the large residual for October 1994, which may have resulted from the high volatility in the value of the rouble in September and October 1994.

Figure 3 Inflation model performance

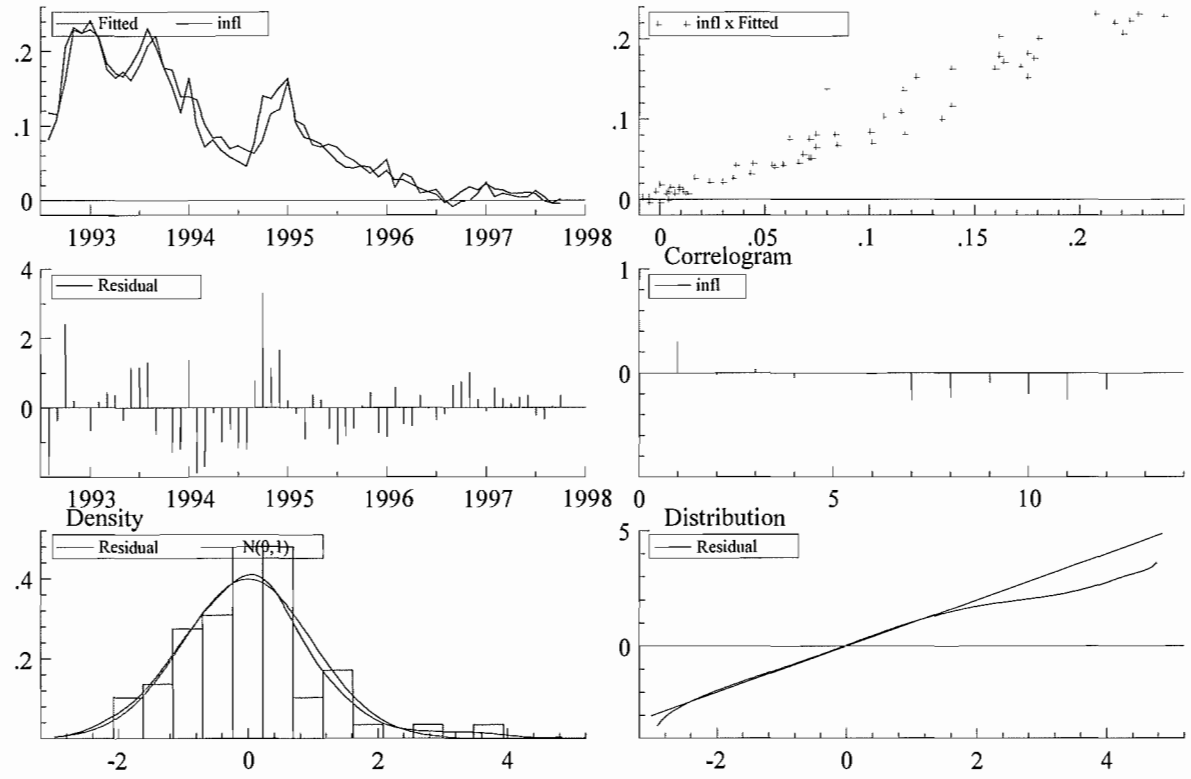


Table 1 Estimation period: 1992 (8) to 1997 (10)

Variable	Coefficient	t-value	t-prob
Constant	-0.013	-3.099	0.0031
Infl_1	0.759	16.393	0.0000
Mon_1	0.180	3.921	0.0002
Mon_2	-0.040	-0.816	0.4179
Mon_3	0.077	1.679	0.0989
Mon_4	0.141	3.077	0.0033
D12	0.005	0.543	0.5895
D1	-0.018	-1.983	0.0523

Model performance

R^2 = 0.9478
F(7,55) = 142.79 [0.0000]
\sigma = 0.0182
DW = 1.36
RSS = 0.018126

Diagnostics

AR 1- 5 F(5, 50) = 1.2772 [0.2885]
ARCH 5 F(5, 45) = 0.9769 [0.4423]
Normality Chi^2(2) = 7.3893 [0.0249] *
Xi^2 F(12, 42) = 1.3006 [0.2542]
Xi*Xj F(30, 24) = 0.5258 [0.9520]

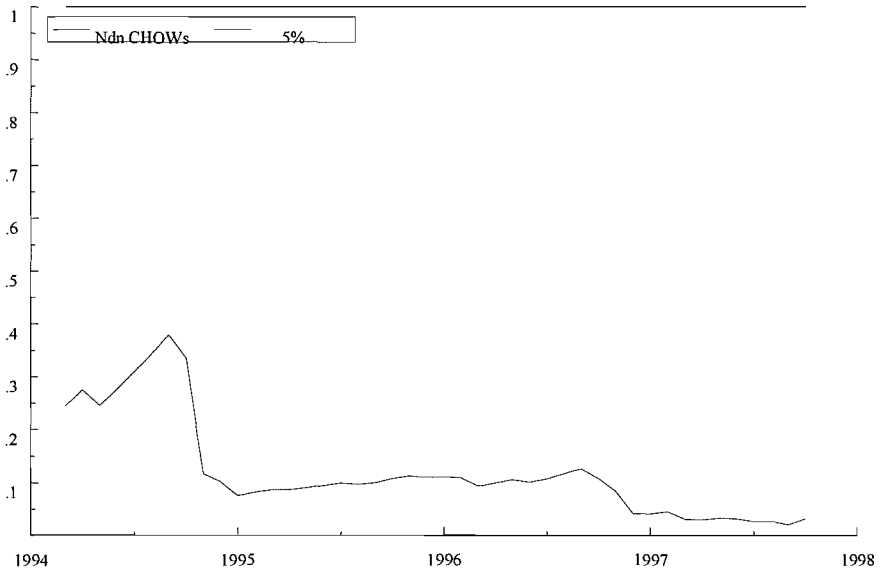
RESET F(1, 54) = 1.6311 [0.2070]

4.3 Short-run dynamics

One of the purposes of this study was to consider whether developments in the Russian economy and financial markets have had an effect on the transmission of money to prices. In order to discover the possible effects, the model was first re-estimated recursively. The possibility of a structural break was examined by performing a Chow test. However, no breaks were detected at the five percent significance level (Figure 4).

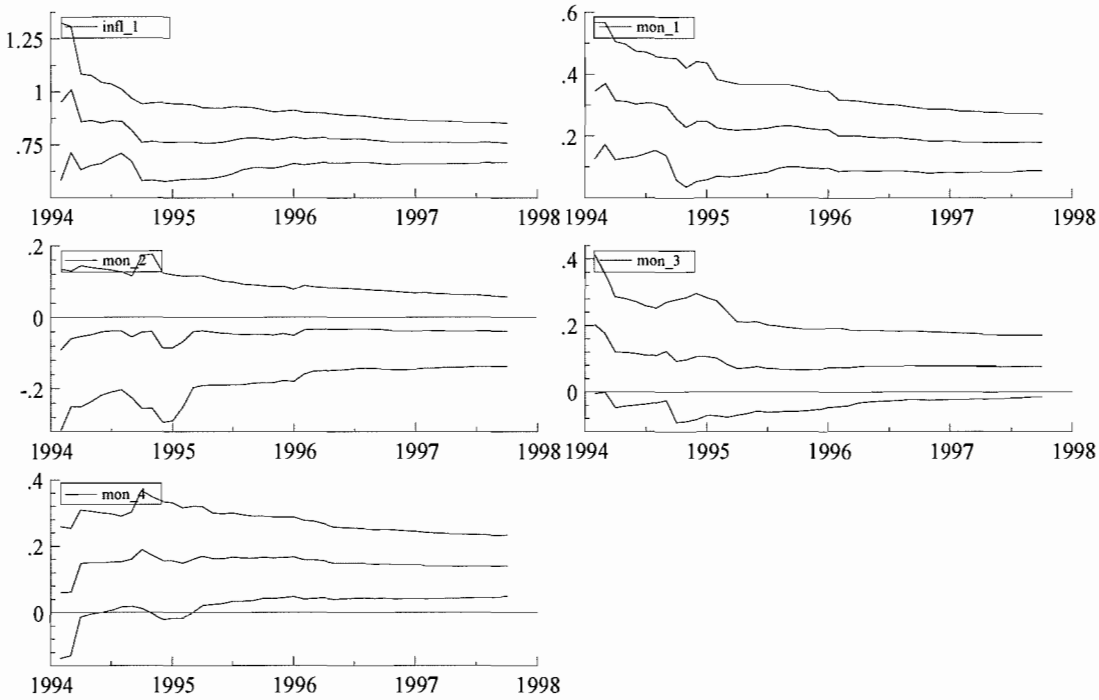
Recursive estimation allows one to observe how the coefficients change as the equation is re-estimated after each new observation, the purpose being to study the stability of the estimated coefficients. Figure 5 presents the coefficient estimates at each point in the sample, with 95 per cent confidence intervals. Looking at the time paths of the recursive OLS estimates of the coefficients of the lagged money variables, one

Figure 4 Result of the brak-point Chow test



can conclude that the coefficients of lags 1 and 4 of the money supply have decreased. Moreover, the coefficient of lag 2 has slightly increased, while that of lag 3 has remained about the same (note, however, that zero is included in the 95 per cent confidence intervals for these two coefficient estimates). These results thus seem to suggest that the lag between money growth and inflation has tended to increase. The link between money growth and inflation one month later has clearly weakened. Furthermore, after summing up the figures, one might argue that there appears to be an overall shift away from lags 1 - 4 to longer lag lengths.

Figure 5 Recursive graphics of the estimated coefficients



Next, the estimation period was divided into two subperiods and the model was fitted separately for both. The first estimation period is August 1992 - December 1994 and the second January 1995 - October 1997. The equation estimates are presented and compared in the Table 2.

These results lend additional support to the view that the lag between money growth and inflation has lengthened. The coefficient of lag 1 is significantly smaller for the later time period (0.25 vs 0.11). There is also a reduction in the coefficient of lag 4, from 0.16 to 0.07. Furthermore, the persistence of inflation has slightly increased in the second period. It should also be noted that the sum of the money coefficients is substantially smaller in the later period. In sum, the short-run dynamics are quite different in the two subperiods, implying a change in the transmission of money to prices.

5 Concluding remarks

The empirical results reveal that growth in money supply is statistically significant in explaining inflation in Russia for the period 1992 - 1997, as expected. Specifically, by using the general-to-specific approach in obtaining the final preferred model, we found supporting evidence that most of the impact of money growth on inflation is felt one to four months later. Thus inflation seems to respond fairly quickly to changes in monetary policy.

The question arises whether the relationship between money creation and inflation has remained stable, as it is generally argued that the length of the lag between money growth and prices tends to increase as inflation decreases. Investigation of the short-run dynamics reveals that the lag length has indeed increased. It turns

out that the link between money growth and inflation one month later has clearly weakened and the main impact may have gradually shifted from lags 1 - 4 to longer lag lengths. This result in turn suggests that the speed at which inflation responds to growth in the money supply has decreased.

Table 2 **Estimation period: 1992 (8) to 1994 (12)**

Variable	Coefficient	t-value	t-prob
Constant	-0.023	-1.295	0.0293
Inf_1	0.762	8.203	0.0000
Mon_1	0.248	2.549	0.0187
Mon_2	-0.085	-0.809	0.4278
Mon_3	0.107	1.128	0.2719
Mon_4	0.157	1.762	0.0926
D12	0.012	0.680	0.5040
D1	-0.020	-0.934	0.3609

Model performance

R^2	= 0.8605
F(7,21)	= 18.512 [0.0000]
\sigma	= 0.0264
DW	= 1.29
RSS	= 0.014597

Diagnostics

AR 1-5 F (5,16)	= 0.4905 [0.7786]
ARCH 5 F (5,11)	= 0.1198 [0.9852]
Normality Chi^2(2)	= 2.4603 [0.2922]
Xi^2 F(12, 8)	= 0.1703 [0.9966]
RESET F(1, 20)	= 0.4524 [0.5089]

Estimation period: 1995 (1) to 1997 (10)

Variable	Coefficient	t-value	t-prob
Constant	-0.000	-0.169	0.8672
Infl_1	0.807	21.695	0.0000
Mon_1	0.107	3.167	0.0039
Mon_2	-0.087	-2.689	0.0124
Mon_3	-0.031	-0.960	0.3458
Mon_4	0.066	2.245	0.0335
D12	-0.006	-1.150	0.2606
D1	-0.013	-2.541	0.0174

Model performance

R^2	= 0.9717
F(7,26)	= 127.34 [0.0000]
\sigma	= 0.0068
DW	= 1.73
RSS	= 0.001198

Diagnostics

AR 1- 5 F(5, 21	= 1.3325 [0.2891]
ARCH 5 F(5, 16)	= 0.9711 [0.4645]
Normality Chi^2(2)	= 0.5766 [0.7495]
Xi^2 F(12, 13)	= 1.4624 [0.2529]
RESET F(1, 25)	= 2.6053 [0.1191]

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