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Wealth effects and Russian money demand

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Abstract

We examine wealth effects for Russian money demand in a cointegrated vector autoregressive framework. We find that an aggregate wealth variable, as well as the components housing and equity prices included separately, significantly enter the long-run money demand relationship. There are feedback effects from money to wealth. However, the remonetization process lead to high income elasticities even when wealth is included in the model. System instability coincides with the arrival of the global financial crisis in late 2008.

Keywords: Money demand, wealth effects, financial crisis, Russia
JEL classification: E21, E41.

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Aaron Mehrotra and Alexey A. Ponomarenko

Wealth effects and Russian money demand

Tiivistelmä

Tutkimuksessa tarkastellaan varallisuusvaikutuksia rahan kysynnässä Venäjällä käyttämällä yhteisintegroituvaa vektoriautoregressiivistä mallia. Sekä kokoava varallisuusmuuttuja että sen komponentit asunto- ja osakehinnat ovat merkittäviä pitkän ajanjakson rahan kysyntäfunktiossa. Rahasta on palautevaikutuksia varallisuusarvoihin. Remonetisaatio saa kuitenkin aikaan sen, että tulojoustot ovat suuria myös varallisuusarvot sisältävässä mallissa. Maailmanlaajuinen talouskriisi johti estimoidun systeemin epävakauteen vuoden 2008 lopulla.

Avainsanat: Rahan kysyntä, varallisuusvaikutukset, talouskriisi, Venäjä.

1 Introduction

Wealth creation is an integral part of the transition of a planned economy to a market economy. Here, we examine the importance of wealth effects for money demand in a large transition economy − Russia. Our wealth measures cover the housing and equity markets, both of which have seen substantial price increases since the 1998 financial crisis. There has also been a rapid increase in private ownership share of houses and apartments.

Money demand merits study as it provides a link between the monetary and real sectors of the economy. While New-Keynesian general equilibrium models of monetary policy have generally attributed a limited role to money (e.g. Woodford, 2003), the current financial crisis has increased interest in monitoring monetary and credit developments.[4] An interest in money demand is obvious in Russia's case, where reference values for M2 are announced in conjunction with the government's inflation target.

The fact that omission of wealth variables for money demand can lead to high income elasticities is probably enough in itself to justify their inclusion. If wealth increases faster than GDP, and the money-holding sector keeps a constant share of its wealth in money form, then the demand for money increases proportionally faster than income. However, there may also be an important feedback loop from money to wealth, especially if modeled in terms of asset prices as we do below. Excess liquidity in the economy can drive up housing and equity prices. Indeed, the low interest rates by central banks are now generally thought to have contributed to the current global financial crisis.[5]

Previous research on Russian money demand often points to instability in the demand for the ruble money stock (e.g. Bahmani-Oskooee and Barry, 2000; Oomes and Ohnsorge, 2005). However, Korhonen and Mehrotra (2010), focusing exclusively on post-1998 data, show a stable money demand relation. Oomes and Ohnsorge (2005) also observe stable money demand system when foreign currency deposits are included in the monetary aggregate. Granville and Mallick (2006) suggest a relationship among real money, interest and exchange rates changes in 1998. Ponomarenko (2007) estimates an error-correction money demand system with domestic absorption as the income variable. Notably, none of the mentioned studies here consider the importance of wealth in a systems framework for Russian money demand. While Ponomarenko (2007) provides tentative

[4] Trichet (2009) mentions the benefits of the European Central Bank's monetary analysis during a time of financial imbalances and asset price misalignments.
[5] See e.g. Taylor (2009) and Bernanke's response (2010).

evidence about the importance of wealth, his study is conducted in a single-equation framework and does not report impulse response dynamics. Thus, feedback effects from money to wealth are not considered.

Modeling wealth effects has gained popularity in recent years as a way to augment money demand functions and explain the rapid monetary expansion. Greiber and Setzer (2007), for example, add housing variables (prices and stock) into money demand functions for the US and the euro area. Using a vector error correction model, they identify a bidirectional link between housing and money. Similarly, Yoo (2008) finds a significant effect of house price growth on money demand in Korea. Hall et al. (2007a) employ a time-varying coefficients modeling technique to obtain a stable money demand function for the euro area. Employing a wealth variable based on a stock price index, they argue its inclusion in a money demand function is crucial for the analysis of recent monetary developments. Boone et al. (2004) and Dreger and Wolters (2009) model money velocity for the euro area and find the wealth variable to be an important determinant. The Boone study uses a weighted geometric average of residential and commercial property prices and stock prices as the wealth variable, while the work of Dreger and Wolters tests for alternative specifications with stock and house prices. Sekine (1998) estimates a money demand function for Japan, employing a wealth variable based on SNA definition. He concludes that allowing for the wealth effect helps to obtain a stable money demand function throughout the "boom-and-bust" period of the Japanese economy. All these studies provide evidence of a significant positive effect of wealth on money demand. Conversely, Avouyi-Dovi et al. (2006) find that an increase in wealth affects money demand negatively and the results by Bruggeman et al. (2003) suggest an insignificant wealth effect.

Estimates of wealth effect on money demand have also been conducted for emerging market economies. For example, Adam (2000) estimates a money demand function for Chile that contains an indicator of financial wealth. Money demand functions augmented with stock price variables have been estimated for Malaysia (Baharumshah, 2004), South Africa (Hall et al., 2007b), Mexico (Hsing, 2007), China (Baharumshah et al.,2009a, b). With the exception of Baharumshah (2004), where a negative impact is obtained, all of these studies find a positive effect of wealth on money demand. For the largest emerging economy, China, market capitalization of listed companies was somewhat lower than in Russia as a share of GDP in 2008 (65% and 79%, respectively).

We estimate money demand functions including a measure of wealth for Russia after the 1998 crisis in a cointegrated vector autoregressive (VAR) framework. In the first part of the empirical study, we use an aggregate wealth variable where weights on housing and equity prices are chosen on the basis of previous empirical studies for other economies. In the second part, we let the data determine weights and examine the importance of housing and equities separately. The exchange-rate variable in our study is the rate of a dual-currency basket comprised of the dollar and euro using time-varying weights to capture the increasing importance of the euro as a reserve currency in Russia.

The analysis finds our measures of wealth to be important in that they significantly enter the long-run money demand equation and there is feedback from money to asset prices. Even so, their inclusion in the estimated system does not lower the estimated income elasticity to the theoretically suggested value of one. This suggests that there are other important factors at play, such as the remonetization of the Russian economy and a gradual return of confidence in the ruble. Finally, the estimated system displays instability as external shocks hit the Russian economy, especially after the collapse of Lehman Brothers in September 2008. This is most likely due to devaluation pressures on the ruble that led to re-dollarization, reversing the stabilizing de-dollarization trend that prevailed throughout most of the previous nine years.

This paper is structured as follows. Section 2 discusses the increased importance of wealth effects in the Russian economy and the importance of the money stock in the conduct of policy. Section 3 presents the formal model and discusses some relevant data issues. Empirical evidence is presented in Section 4, and Section 5 concludes with policy implications.

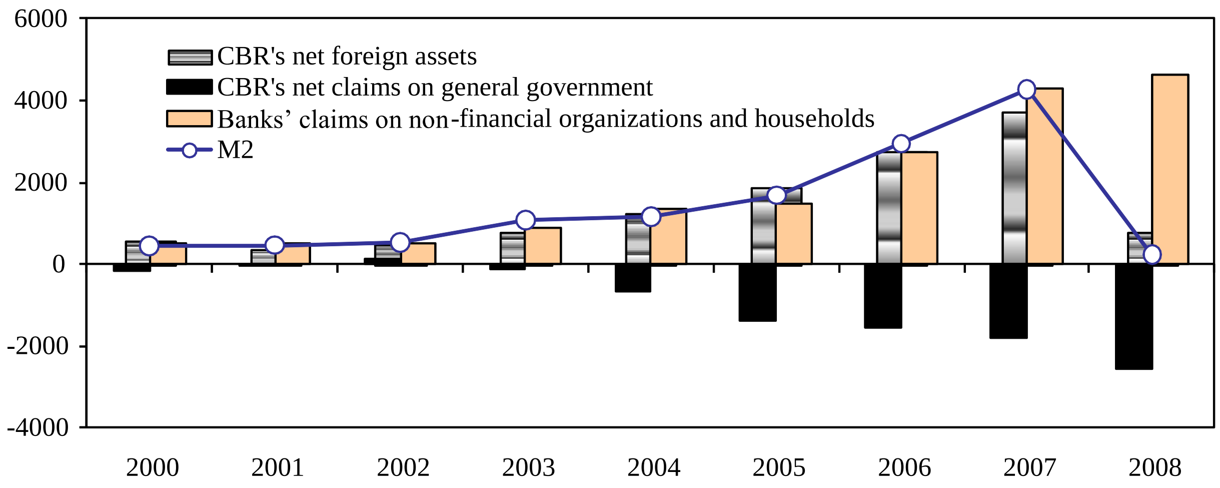
2 The role of money in policy and the increasing importance of wealth

Russian monetary policy moved from monetary programming in 1993-1995 (where there was an implied need to finance the budget deficit) to exchange rate-based stabilization in 1996-1998 (which saw defense of the exchange rate peg ultimately fail). Following the 1998 crisis, monetary policy focused on preserving price stability, limited by the managed floating exchange rate regime that required increasingly large amounts of foreign exchange interventions. Fiscal policy has similarly undergone a transition from running large budgetary deficits to creating sovereign funds for accumulation of excess revenues.

Traditionally, the Central Bank of Russia (CBR) has paid considerable attention to monetary developments in assessing its overall monetary policy stance. The forecast of the broad money stock (M2) and the monetary program that provides projections of CBR balance sheet components is published in the *Guidelines for the Single State Monetary Policy*. The numbers should be taken as aspirational in light of the CBR's hands-on management of the exchange rate regime and active intervention on foreign exchange markets. What is important is that they provide points of reference compatible with the government macroeconomic forecast (and specifically with the inflation target).

Another application of money indicators is the assessment of the current monetary policy stance. The level of interest rates may not always be considered representative for this issue due to Russia's relatively under-developed financial system and possible influences from foreign interest rates under the managed exchanged rate, perceived by many market participants as *de facto* pegging. Another benefit of examining the dynamics of monetary aggregates is the nature of the factors that drive them. As noted by King (2007), a crucial task of monetary analysis is to distinguish money supply shocks from endogenous money demand shocks that can largely be ignored. The Russian economy is evidently prone to money supply shocks, given that CBR interventions represent an important source of money stock growth (see Figure 1). Accordingly, it is important for the policymaker to be able to identify these shocks and their macroeconomic effects.

Figure 1 Main sources of money supply growth (annual growth, bln. rubles)



Source: Central Bank of Russia

Among the measures of money stock, the M2 aggregate, which includes currency in circulation and bank deposits in national currency, is the most widely used. The drawback of this indicator is that a significant part of money holdings in Russia is in foreign currency. On the other hand, analysis of broader money aggregates is even more complicated as a significant share of foreign currency holdings is in the form of cash and cannot be measured accurately. Given this situation, the M2 aggregate, which is not fully representative but well-measured, becomes the preferred choice of money indicator for our modeling purposes. Our job becomes trying to account for presumable shifts in currency preferences.

In addition to currency substitution, wealth is a second factor that may significantly influence money demand. Starting in 2005, asset price growth rates in Russia soared, far exceeding the growth rates in most European countries. Figure 2 shows annual growth rates in housing and equity prices in selected economies during the period 2002-2006. The scope of these developments and the significant increase in the volume of transactions in asset markets are likely to influence demand for money through transactions demand.

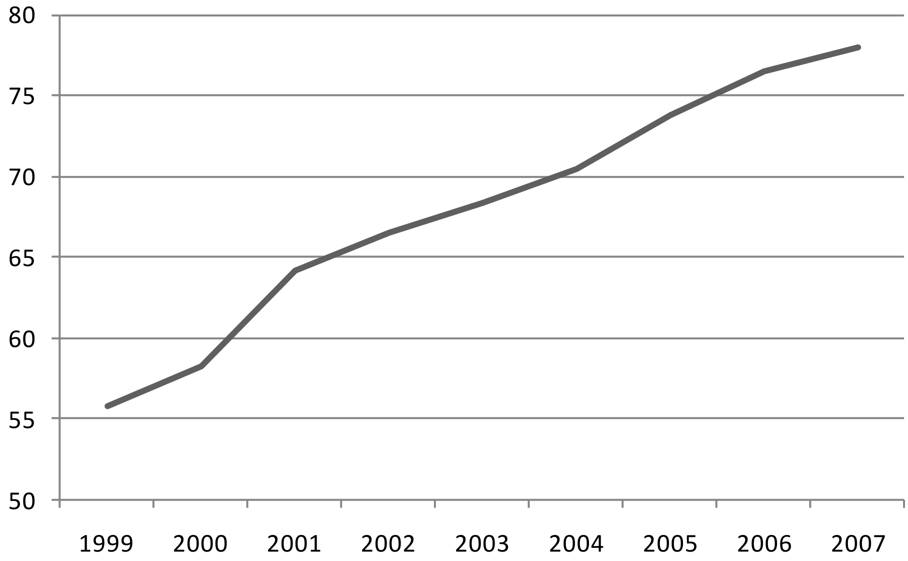
Figure 2 Asset price annual growth rates in 2002-2006 (period averages, %)

Sources: Egert and Mihaljek (2007); various stock exchange websites; authors' calculations.

The volume channel, however, is not the only way the wealth effect may influence money demand. Housing wealth may be viewed as constituting a significant part of households' wealth. Traditionally, renting has never been widespread in Russia. The 2002 national census found only about 3%

of households were renting a house or an apartment and that about 20% of households owned a secondary dwelling (mainly for seasonal use). The ownership of houses and apartments is mainly private. The share of total housing stock (measured as available area) owned by households increased from 56 % in 1999 to 78% in 2007, as shown in Figure 3. Equities are not a significant component of household financial wealth, but their price can be viewed as a proxy for corporate wealth. The boom in equity prices (see Figure 2) suggests that share price growth may have influenced money demand as well.

Figure 3 Share of housing stock (as area) owned by households (%)



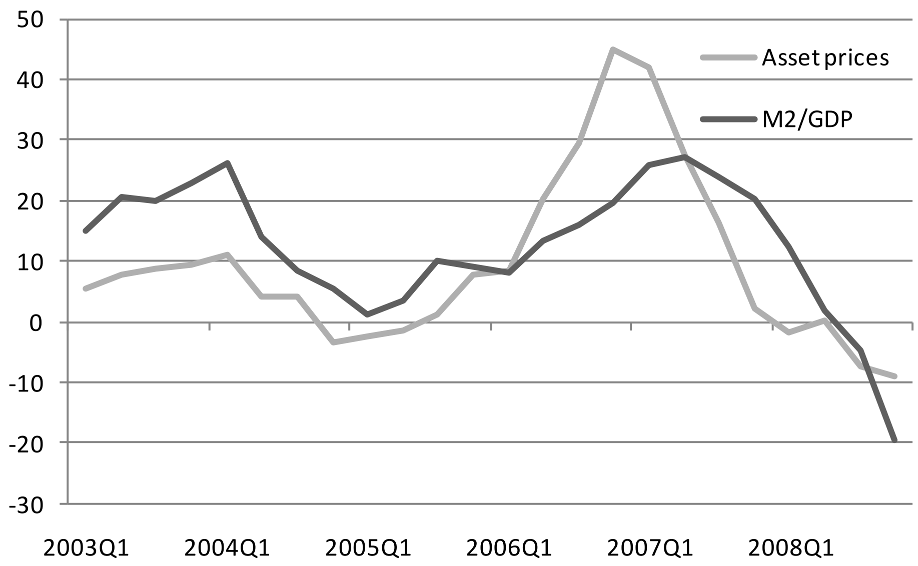
Source: Rosstat[6]

As pointed out by Friedman (1988), the increase in wealth due to the growth of asset prices may be associated with increased demand for other liquid assets (including money) that are part of the wealth portfolio. If this is the case and asset prices can be used as an adequate proxy for wealth, the inclusion of this variable into a money demand function could be crucial for the Russian economy (as well as for other emerging markets) as it reflects the process of initial wealth formation. The negative substitution effect caused by the decrease of attractiveness of money holdings in the presence of higher yields on non-money assets does not seem probable, since these forms of savings are still rare for Russia. Thus, the wealth variable may potentially be an important explanatory factor of the rapid monetization of the Russian economy in 2005-2007. Figure 4 shows the clear co-

[6] Russian Federal Service for State Statistics.

movements in real asset prices (which we define below as a weighted average of housing and equity prices) and monetization (M2 divided by GDP).

Figure 4 Real asset prices and M2/GDP ratio (y-o-y growth, %)



Sources: Central Bank of Russia, Rosstat, authors' calculations

3 Model specification and data issues

As has become conventional in the literature for money demand, we use a vector error correction (VEC) model to allow for explicit modeling of short and long-run (cointegration) relationships. Our vector correction model can be written as:

$$\Delta x_t = \Pi x_{t-1} + \Gamma_1 \, \Delta x_{t-1} + \ldots + \Gamma_p \, \Delta x_{t-p} + CD_t + \varepsilon_t \, . \qquad (1)$$

In (1), x_t is a (K x 1) vector of endogenous variables and the Γ_p are fixed (K x K) coefficient matrices. We further assume that ε_t follows a white noise process with $E(\varepsilon_t)=0$. When some or all of the K endogenous variables are cointegrated, the matrix Π has reduced rank r. This can be written as $\alpha\beta'$, where α and β denote the loading coefficients and the cointegrating vectors, respectively. D_t contains the deterministic terms outside the cointegrating vector, and C is the coefficient matrix associated with the deterministic terms.

Our main specification for long-run real money demand in the Russian economy is of the form:

$$(m - p)_t = \beta_1 y_t + \beta_2 w_t + \beta_3 e_t + ec_t \,, \qquad (2)$$

where *m* is the M2 money stock, *y* denotes GDP, *p* is GDP deflator, *w* denotes real wealth, *e* is the rate of ruble exchange rate appreciation, *ec* denotes the error correction term, and β's are coefficients to be estimated. Except for exchange rate appreciation all variables are expressed in logarithms and are seasonally adjusted with TRAMO/SEATS.

For the income variable and the deflator, we use monthly GDP and GDP deflator series. These are interpolated routinely for CBR internal needs on the basis of the set of proxy variables (the most important being Rosstat's index of output of the five core sectors of the economy).

The wealth variable is proxied by the asset price index. Generally the composite asset price index should be estimated as a weighted average of residential and commercial property and stock prices. The soundest approach would be to compute the weights based on indicators of national wealth. This approach is not possible here, however, due to the limited data available. Therefore, our weights are chosen based on the respective numbers for other countries (see Borio et al., 1994) and on our perception of the representativeness of each component. The aggregate wealth indicator is accordingly estimated as a weighted average of house prices (weight 0.9) and stock prices (weight 0.1). We also perform estimates at a disaggregated level, including house and stock price indicators separately. We use Rosstat data on house prices (quarterly data are available from 2002 onwards, while annual data are available for earlier periods). These were interpolated proportionally based on monthly data for house prices in Moscow produced by the IRN real estate agency (since these data are not available for 1999 the interpolation is spread evenly throughout the year). The house price index is then computed as a weighted average of prices on the primary (weight 1/3) and secondary (weight 2/3) markets.[7] We use the RTS index of shares trades on the Moscow Stock Exchange as the indicator of stock prices in rubles. The GDP deflator is then applied to compute the variables in real terms.

We use exchange rate appreciation as the opportunity cost of holding rubles − a routine choice in a dollarized economy such as Russia's (see Oomes and Ohnsorge, 2005; Korhonen and Mehrotra, 2010). Importantly, the relative underdevelopment of the money market precludes the use

[7] The primary market refers only to newly constructed housing, and the secondary market to the remaining share of the market.

of interest rates for this purpose. Throughout the reviewed period, the euro gains popularity as a reserve currency in Russia. We therefore use the weighted average of the ruble's appreciation against the USD and the euro, with weights similar to those of the bi-currency basket introduced as an operational target by the CBR in 2005. While the structure of foreign currency deposits in Russia is unavailable, by other subsidiary indicators for weights of the bi-currency basket, shown in Table 1, suggest our estimates are reasonable. During the estimation period, the composition of the basket changes from being almost entirely USD, to nearly equal weights for the USD and the euro. To capture the adaptive nature of expectations regarding the exchange rate dynamics, we use the appreciation rate in the form of a backward-looking six-month moving average.

Table 1 Weights used for the computation of ruble appreciation rate

Weights assigned to each currency during the respective period	1999M1-2005M2	2005M3-2005M5	2005M6-2005M7	2005M8-2005M11	2005M12-2006M1	2006M2 to present
USD	0.9	0.8	0.7	0.65	0.6	0.55
Euro	0.1	0.2	0.3	0.35	0.4	0.45

Regarding sample length, finding sufficiently long, yet economically meaningful, time-series is often a serious obstacle for econometric studies of the Russian economy. Considering the effect of the 1998 crisis and the ensuing changes in the conduct of monetary and fiscal policy, it would seem reasonable to concentrate solely on the post-crisis period. That leaves us with a time-series of ten years, which may seem insufficient, especially when data of quarterly frequency are used. Therefore, it has become a common practice among researchers to use variables that may be somewhat less representative, but for which monthly data are available. In the present study, we use monthly data from July 1999 to August 2008.[8] We have decided not to include the period 2008M9-2008M12 into the sample, since the analyzed variables were affected by substantial external shocks during that time, possibly biasing the estimates. Instead, we test to determine if the money demand relationship remained stable over that period by conducting out-of-sample forecasts after estimating the main model.

Unit root and cointegration tests are performed for all series. The KPSS test for unit roots with two lags suggests that the endogenous series in levels terms are non-stationary, while in first differences the null of stationarity can never be rejected at conventional levels of significance. Giv-

[8] We also made estimates using quarterly data and obtained similar results. Here, however, we only report the more statistically credible monthly estimates.

en these findings, it is possible that there is cointegration between the system variables. Cointegration tests were performed using the Johansen trace test procedure. As deterministic terms, we include a constant and a trend. We set the exchange rate restricted in the long run, as it only appears in the model's long-run cointegrating relationship. The results from the test depend on the lag length. With a lag length of 5, we reject a rank of zero at the 95% level (*p*-value of 0.05), whereas a rank of one cannot be rejected (*p*-value 0.12). A lag length of 4 suggested by the Akaike information criterion leads to a rejection of even a cointegrating rank of one (*p*-value of 0.04). If we extend the testing sample until 2008M12 to include the financial crisis, and allow for a structural break in 2008M9, the Akaike criterion suggests that there is one cointegration relationship. We continue with the assumption of a cointegrating rank of one. The VEC estimation results, in particular the loading coefficients, show that a model with one cointegrating vector produces reasonable results.

4 Empirical evidence

We commence the estimation with the model with the aggregate wealth variable. The lag length is determined by the Akaike information criterion, which suggests three lags in first differences, corresponding to four lags in levels terms. A constant is included as a deterministic term, and it is left unrestricted in the short-run part of the model. As in Korhonen and Mehrotra (2010), the exchange rate is modeled as a deterministic variable due to the policy nature of this variable in the Russian economy. The cointegration relation is estimated by the simple two-step estimator (S2S). As Brüggemann and Lütkepohl (2005) show, this estimator produces relatively robust estimates in short samples. The cointegration equation is estimated as follows, with standard errors in parentheses:

$$\underset{}{(m\text{-}p)_t}=\underset{(0.206)}{2.043\, y_t} + \underset{(0.148)}{0.579 w_t} + \underset{(2.204)}{7.625\, e_t} + ec_t \quad (3)$$

All coefficients have the signs suggested by theory. An increase in income is associated with a higher real money stock. The relatively high income elasticity is in line with the re-monetization process that took place in the Russian economy after the 1998 crisis. The positive sign on the wealth variable suggests that income effect dominates the substitution effect of wealth (Friedman, 1988). Finally, higher exchange rate appreciation increases demand for rubles. While the lag length of three may appear short, the S2S estimator produces highly comparable results for other lag lengths, as reported in Table 2.

Table 2 Estimated cointegration relations with alternative lag lengths

Lag length	*y*	*w*	*e*
2	2.210 (0.197)	0.459 (0.144)	6.548 (2.061)
3	2.043 (0.206)	0.579 (0.148)	7.625 (2.204)
4	2.044 (0.244)	0.531 (0.177)	8.343 (2.615)
5	1.910 (0.239)	0.616 (0.176)	9.274 (2.617)
6	2.047 (0.229)	0.489 (0.173)	9.189 (2.541)

Note: standard errors in parentheses.

High income elasticity, a distinctive feature of the estimated cointegration equation, suggests re-monetization affects money demand beyond the impact *via* wealth.[9] This seems plausible for Russia, given the intensive financial system development and disappearance of barter operations during the reviewed period. Moreover, there is a gradual return of confidence in the national currency after the high inflation and depreciation periods in the 1990s.[10] While one would expect this coefficient to prove unstable and decrease over time, there is evidence that an income elasticity higher than unity is a common feature of many emerging market economies during certain stages of development. Table A1 in the Appendix shows estimates of the income elasticity from money demand studies for various emerging economies.

The estimated long-run equation may be used to construct the money gap to measure excess liquidity. The money gap is estimated as the deviation of actual money stock from the equilibrium level, determined by the trend values of the explanatory variables, as follows:[11]

[9] It may difficult to distinguish between income and wealth effects given their intrinsic relationship. One solution could be to restrict income elasticity in accordance with theoretical assumptions. If we restrict the coefficient on income to one, i.e. modeling the determinants of monetization rather than the demand for money, the estimated cointegrating vector becomes $(m\text{-}p\text{-}y)_t = 1.287w_t + 8.9e_t + ec_t$. However, such a restriction is not supported by the data.

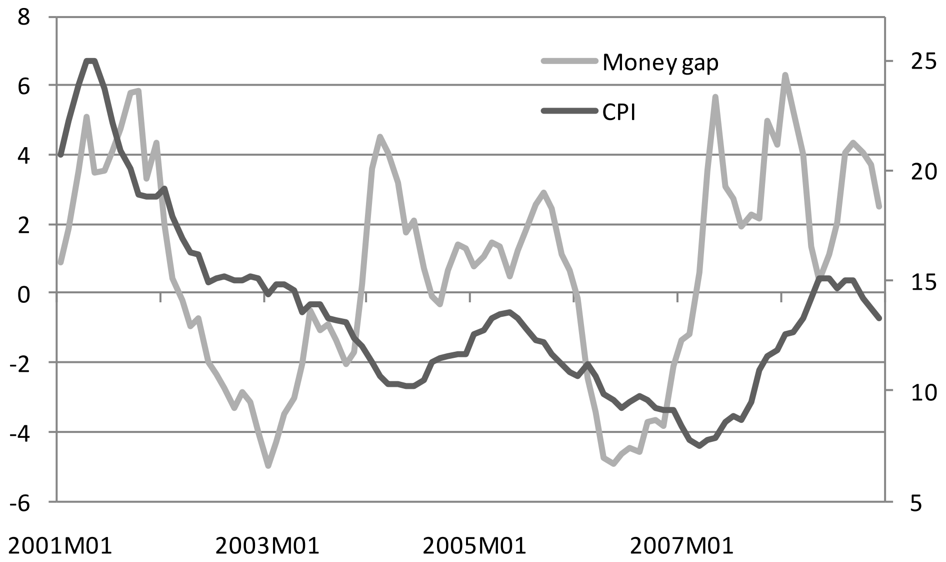
[10] In principle, it could be possible to model the remonetization process by a simple linear trend in the cointegration relationship, instead of letting the process be reflected in the other estimated coefficients. More generally, it is difficult to theoretically justify the inclusion of a trend in a money demand relationship.

[11] The trend values were estimated with an HP filter with the smoothing parameter of lambda chosen as 100,000 for the scale variable and 50 for the other variables.

$$\text{Money gap} = (m_t\text{-}p_t)^*\text{-}2.043\ y_t^* - 0.579 w_t^* - 7.625\ e_t^* . \quad (4)$$

The estimated indicator may be used to measure the monetary stance for various purposes, including assessment of inflationary pressures stemming from money stock growth. The money gap indicates that the high growth rates of M2 in 2006-2007 resulted in the formation of significant excess liquidity in the economy. This may have contributed to the acceleration of inflation in 2007-2008, although obviously other factors must be considered.

Figure 5 Money gap (%) and CPI (y-o-y growth, %)



Sources: Authors' calculations, Rosstat

The short-run part of the model is initially estimated by ordinary least squares. Next, we sequentially eliminate the statistically insignificant coefficients with a *t*-value threshold level of 1.67, corresponding to a 10% significance level. The final three system equations are estimated by feasible generalized least squares as follows:[12]

$$\underset{}{\Delta(m\text{-}p)_t} = -\underset{(0.029)}{0.108 ec_{t-1}} + \underset{(0.081)}{0.420\ \Delta(m\text{-}p)_{t-1}} + \underset{(0.060)}{0.123\ \Delta w_{t-1}} - \underset{(0.216)}{0.805} + u_{1t} \quad (5)$$

$$\Delta y_t = \underset{(0.017)}{0.027 ec_{t-1}} + \underset{(0.046)}{0.096\ \Delta(m\text{-}p)_{t-1}} - \underset{(0.092)}{0.402\ \Delta y_{t-1}} - \underset{(0.088)}{0.241\ \Delta y_{t-2}} - \underset{(0.035)}{0.058\ \Delta w_{t-3}} + \underset{(0.125)}{0.208} + u_{2t} \quad (6)$$

[12] As the exchange rate enters the system as a deterministic variable, there is no system equation for the exchange rate. The imposed restrictions in the subset model are not rejected by a likelihood ratio test (*p*-value of 0.93).

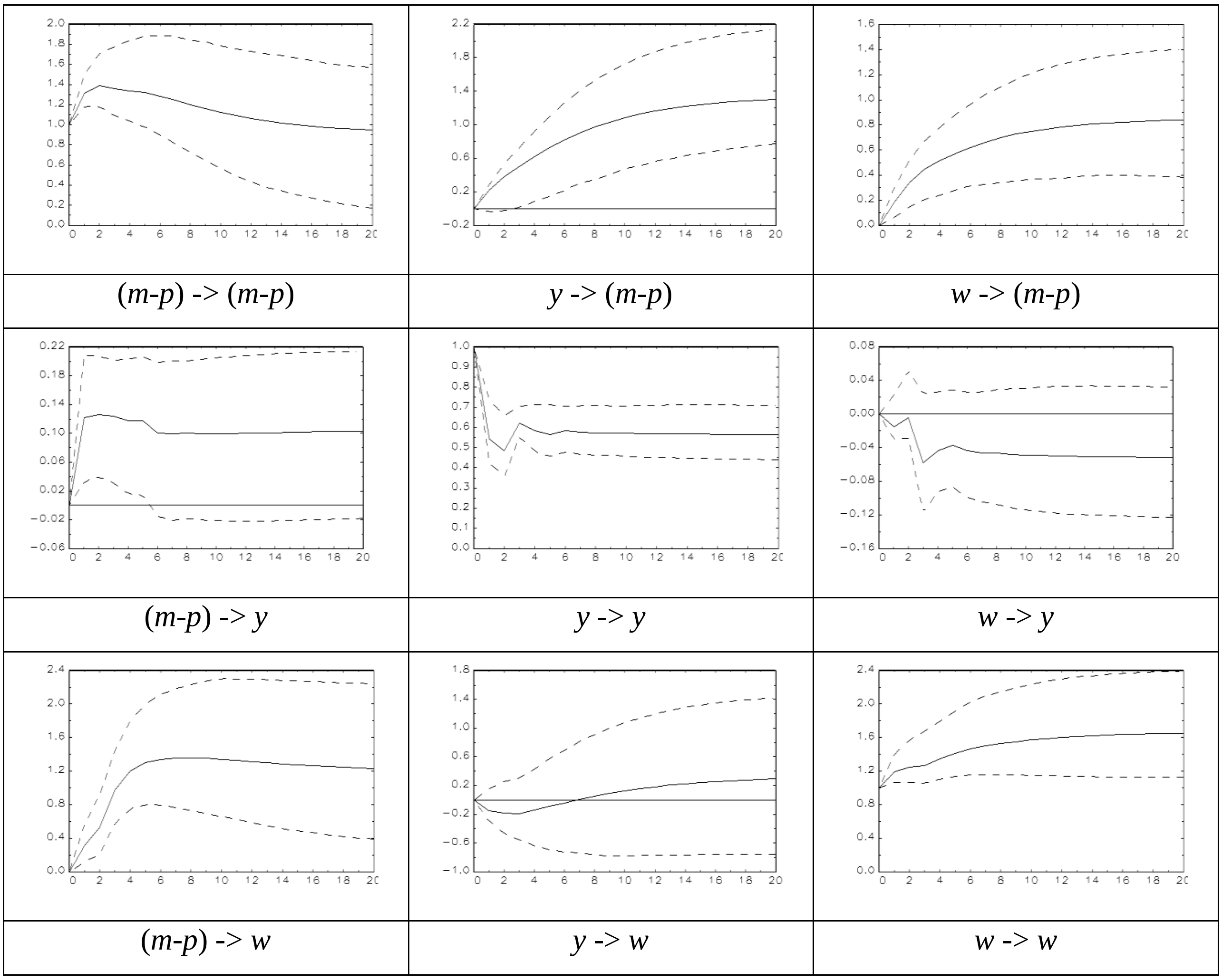
$$\Delta w_t = \underset{(0.041)}{0.073} ec_{t-1} + \underset{(0.121)}{0.244}\, \Delta(m-p)_{t-1} - \underset{(0.088)}{0.230}\, \Delta w_{t-1} - \underset{(0.124)}{0.313}\, \Delta (m-p)_{t-3} + \underset{(0.311)}{0.543} + u_{3t} \qquad (7)$$

This model performs satisfactorily in the major misspecification tests for autocorrelation and ARCH-effects in the residuals.[13] The loading coefficients suggest that excess liquidity is corrected within the system, as the loading coefficient in the equation for money (5) is statistically significant and negative. Moreover, excess liquidity in the Russian economy feeds both higher real GDP and wealth. The estimated system equations point to statistically significant short-run feedback dynamics between real money and wealth.

As reduced form equations only provide limited information as regards model dynamics, we look at impulse responses in the following. To avoid imposing (sometimes rather arbitrary) structures on the impulse responses, e.g. in the form of a Cholesky decomposition of the variance-covariance matrix, we use forecast error impulse responses (see Breitung et al. 2004). This choice of estimating the impulse responses is justified by the examination of the correlation matrix, which suggests only statistically insignificant correlation between the equation residuals. The estimated impulse responses, with bootstrapped Hall 90% percentile confidence intervals, are depicted in Figure 6.

[13] The *p*-values from an adjusted Portmanteau test amount to 0.80 (16 lags) and 0.67 (12 lags). Similarly, the *p*-values from an LM-test for autocorrelation are 0.77 (4 lags) and 0.99 (1 lag). There is evidence of ARCH-effects in the residuals of the first equation (*p*-value 0.00, 16 lags), but not in the second and third equations (*p*-values 0.39 and 0.17, respectively).

Figure 6 Impulse responses.



In Figure 6, a positive shock to the real money stock leads to an increase both in income and wealth. Similarly, a positive shock to wealth leads to an increase in the real money stock, which is in line with the estimated cointegrating relationship. These results seem particularly important as they suggest that the acceleration of money growth in Russia was at least partly demand driven *via* the wealth effect, and thus did not present much of an inflationary threat. Moreover, the excessive money stock growth itself may have contributed to the asset price boom in Russia. A positive shock to income (captured by a shock to real GDP) leads to an increase in the real money stock, possibly due to increased transactions demand for money. The impulse responses between income and wealth are statistically insignificant, which is in line with the limited feedback relationships detected for these variables in the estimated short-run part of the system (Eqs. 5-7). It is also likely that wealth creation in Russia has been too recent a phenomenon to contribute significantly to output formation during our sample period.

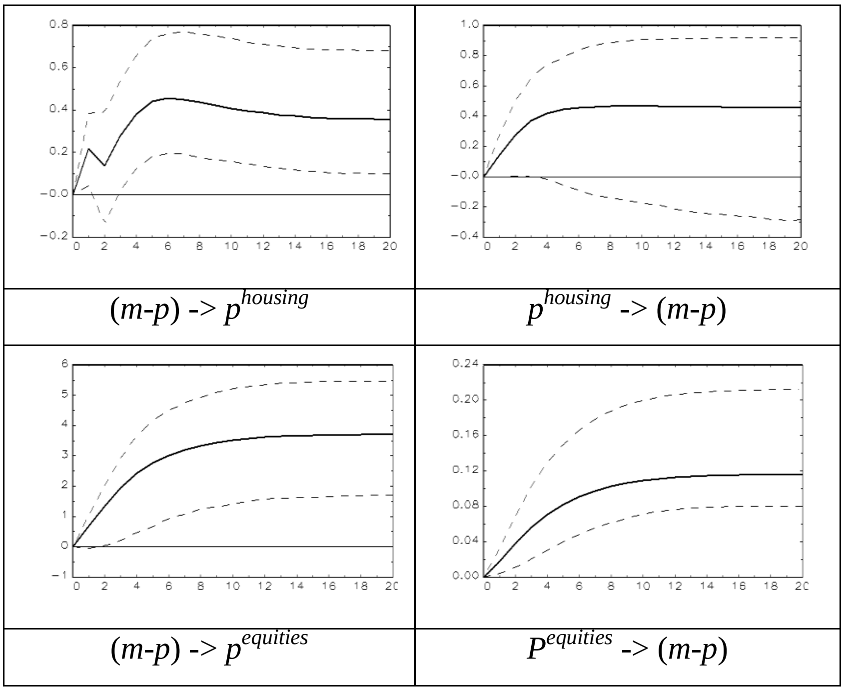
While the previous estimation revealed the importance of wealth at an aggregate level for Russian money demand, it may be of interest to look at the impacts of the two components of the aggregate wealth variable − housing and equities. For this purpose, we re-estimate the VEC model by including housing and equity prices separately, otherwise maintaining an identical model. The estimated cointegration relationship in this case is:

$$(m\text{-}p)_t = \underset{(0.188)}{1.910}\, y_t + \underset{(0.138)}{0.343} p^{housing}_t + \underset{(0.054)}{0.199}\, p^{equities}_t + \underset{(2.138)}{8.641}\, e_t + ec_t \qquad (8)$$

The long-run coefficients for income and the exchange rate are remarkably close to those obtained for the benchmark model. The cointegrating equation further suggests that the demand for money reacts with a higher coefficient to changes in housing than in equity prices.[14] In this larger model, a subset model only maintains two of the four possible loading coefficients. The first belongs to the real money stock (and again suggests adjustment to equilibrium) with a coefficient of -0.088 (standard error 0.021). The second significant loading belongs to real equity prices, implying that excess liquidity leads to an increase in equity prices in Russia (coefficient 0.703 with a standard error of 0.183). This relatively high loading coefficient is in line with the generally rapid movements in equity prices. It is likely that the higher number of coefficient estimates leads to lower statistical significance in general, and the model reduction procedure thus eliminates the coefficient for real GDP equation from the final larger model. Regarding the impulse response dynamics, we display the dynamics between real money stock and housing and equity prices. Again, as the correlation of the residuals is relatively low, we use forecast error impulse responses.

[14] We obtain a relatively high coefficient on equity prices despite the fact that the share of financial wealth held in the form of equities in Russia is still small. It is likely that equity prices reflect partly the impact of oil prices as oil is an important asset of Russian companies. We have not included oil as a separate variable in the reported benchmark model due to the already high number of estimated coefficients in our short sample.

Figure 7 Impulse response dynamics from model with equity and housing prices



The impulse response dynamics in Figure 7 suggest that a positive shock to the real national money stock leads to an increase in both equity and housing prices. Similarly, there are wealth effects from housing and equity prices to the real money stock, although the statistical significance is much clearer for equity prices.[15]

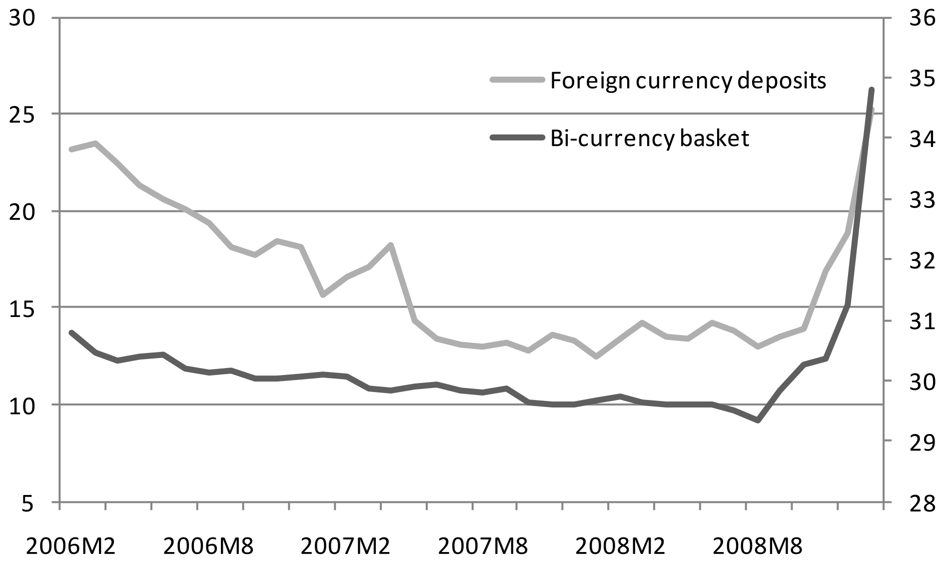
Finally, we are interested in the impacts of the global financial crisis on the demand for Russian national money stock, especially in terms of the stability of the money demand system. Presumably, all of the analyzed variables were subject to substantial external shocks during the period of 2008M9-2008M12. Following the fall in both foreign and domestic demand, as well as the deterioration of credit availability, Russian GDP started to shrink in the last quarter of 2008. Stock prices collapsed by more than 50% in ruble terms during the final four months of 2008 after the sudden halt and reversal of capital flows. Housing prices were slower to react, decreasing only by about 1% in 2008Q4, representing the first episode of house price deflation recorded by official statistics.

The dynamics of monetary aggregates in the end of 2008 were mainly driven by foreign exchange market developments. After the reversal of capital flows and a deterioration of the trade

[15] The high statistical association of money stock and equity price growth should be interpreted with caution. These two variables may be driven by a common factor, i.e. foreign capital inflows that contributed to the boom on the stock market and forced the CBR to intervene in the foreign currency markets and increase the money supply. On the other hand, one should not rule out the possibility of excess domestic liquidity as the source of the acceleration of stock price growth.

balance, the ruble faced strong devaluation pressure. The CBR implemented a “controlled devaluation” in steady increments (about 1% per step) against the bi-currency basket. That strategy was aimed at preventing a sharp deterioration of balances due to the devaluation effect, but it also reinforced expectations of further depreciation and induced additional demand (including for speculative purposes) for foreign currency. The loss of confidence in the banking system created the perception among many Russian households that foreign cash was the only risk-free asset that produced some yield. As a result, the depreciation effect on the demand for national currency, which would normally be captured by the exchange rate variable in the model, was amplified substantially. Figure 8 shows the share of foreign currency deposits and the value of the bi-currency basket.

Figure 8 Foreign currency deposits (as share of total deposits, %; left axis) and the ruble value of the bi-currency basket (right axis)

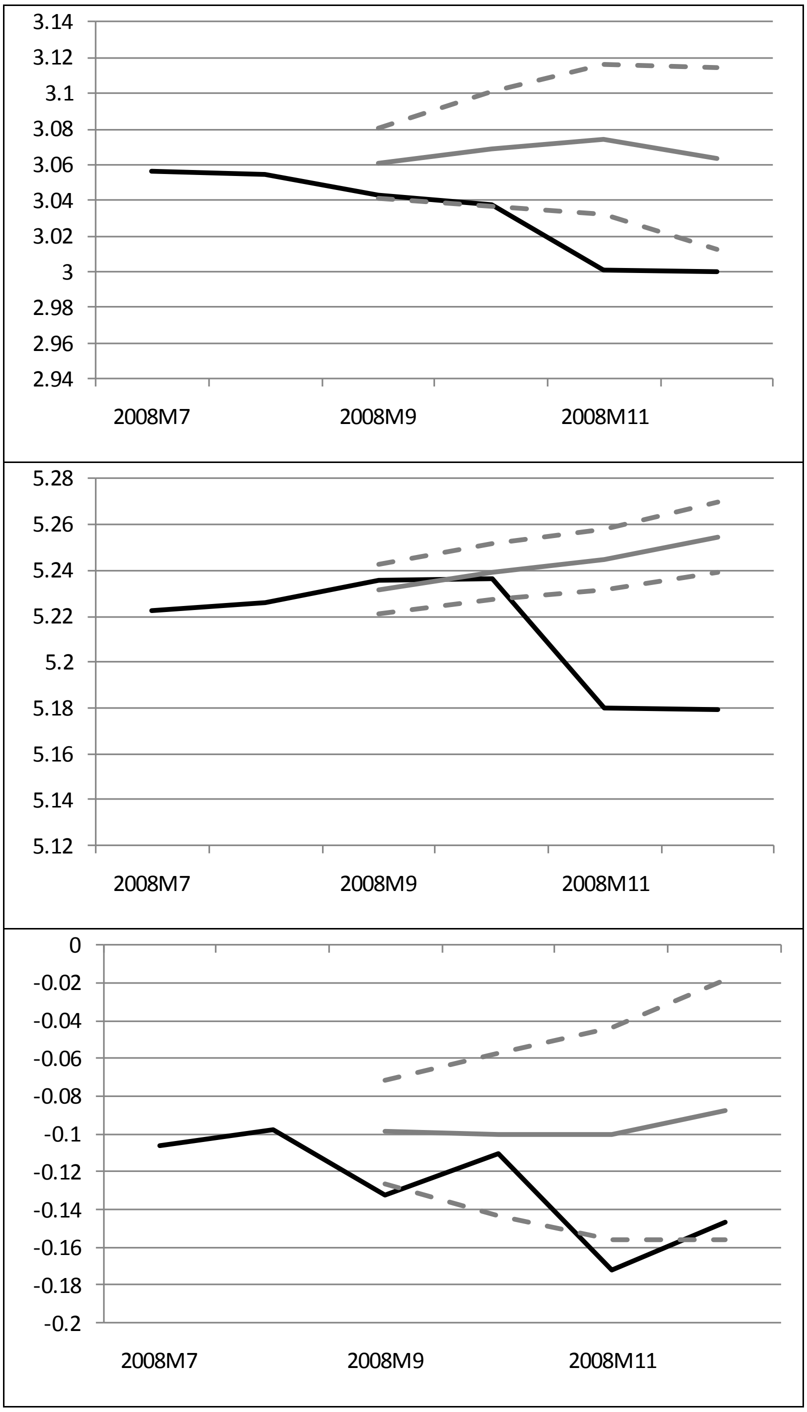


Source: Central Bank of Russia

The circumstances forced the CBR to buy up rubles. This, together with the slowdown of credit growth, resulted in a 9% decrease in seasonally-adjusted M2 during the period from 2008M9 to 2008M12.

To test the extent to which these developments can be considered as exogenous to the estimated system, we perform out-of-sample forecasts with the benchmark model including the aggregate wealth variable from 2008M9-2008M12. If the crisis did not bring about instability in the money demand system, we would expect the actual outcomes for real money, GDP, and wealth to fall inside the confidence intervals for the out-of-sample forecasts. The results from the forecasting exercise are depicted in Figure 9, together with the 90% confidence intervals.

Figure 9 Forecasts for model during financial crisis of end-2008 (grey solid line). Real money (top), GDP (middle), and wealth (bottom)



While the observations for real money and GDP (black solid line) fall within the confidence intervals for the forecasts (dashed lines), wealth is already outside the confidence bands in the first forecast observation (2008M9). The model fails to capture the slowdown in money growth and GDP brought about by the financial crisis. This is especially prominent for the last two observations of 2008. This is not surprising as such, since the global financial crisis is exogenous to the estimated system. Evidence of a structural break is also obtained by estimating the benchmark model up to 2008M12 and performing a Chow forecast test for model stability in 2008M9. The test statistic is 7.843, with a bootstrapped p-value (obtained with 1,000 replications) amounting to 0.002. Therefore, we clearly reject the null hypothesis of stability.

5 Conclusions

We examined the importance of the wealth effect for Russian money demand during the 2000s. During the reviewed period, Russia experiences substantial wealth formation, especially in the housing sphere. While the ownership of equities has never been equally important, the strong share price growth during a part of the estimation period suggests that a wealth impact from share price developments cannot be ruled out *a priori*.

We find that both our aggregate wealth variable, and its components housing and equity prices included separately, significantly enter the long-run money demand function. The finding about the importance of wealth for emerging market money demand is similar to that noted by Adam (2000) for Chile, Baharumshah (2009b) for China, Hall et al. (2007b) for South Africa, and Hsing (2007) for Mexico. However, estimated income elasticity remains high even with the inclusion of wealth in the estimated system. This is likely due to re-monetization taking place in the Russian economy. As the financial crisis hit the Russian economy in late 2008, our system becomes unstable. This is hardly surprising as the crisis was entirely exogenous, and induced significant re-dollarization in the economy, partly driven by expectations of further ruble depreciation.

These results suggest monetary authorities need to pay attention to the developments in wealth and asset prices when attempting to infer the inflationary impacts of money dynamics. Specifically, excess money growth was found to significantly impact asset prices in the Russian economy and thus influence wealth formation. However, given the instability brought about by the financial crisis, the information value of money is weakened, making the evaluation of inflationary pressures more difficult.

Our study leaves several interesting research questions open. When national wealth data become available, it would be interesting to look at other, perhaps more disaggregated, measures of wealth than used here. Also, it is worthwhile to evaluate whether money demand returns to historical relationships that prevailed before the global financial crisis to derive information about inflationary (consumer and asset price) pressures.

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Appendix

Table A1 The results of long-run money demand estimates in the emerging market economies (*r*- interest rate, *e* – exchange rate, *w* – wealth, *π - inflation*)

	Money variable	*Scale variable (elasticity) / Price level*	*Other variables*
Aguirre et al. 2006 (Argentina)	M1, M2	GDP(1.7;1.9)/CPI	*r*
Pelipas 2006 (Belarus)	M1	Industrial production (1.11) / CPI	*r*, *e*
Baharumshah et al. 2009a (China)	M2	GDP (0.6-2)/GDP deflator	*r*, *w*
Babic 2000 (Croatia)	M0, M1	GDP (2.1;1.8) / CPI	*r*
Dabušinskas 2005 (Estonia)	M2	GDP (1.7-2) / GDP deflator	*r*
James 2005 (Indonesia)	M2	GDP (1.53 + trend) / CPI	*r*
Tillers 2004 (Latvia)	M2X	GDP (2.3) /CPI	*r*
Budina *et al* 2006 (Romania)	M2	Industrial production (2.23) / CPI	*π, e*
Hall et al. 2007a (South Africa)	M3	GDP (1.2-1.5)/GDP deflator	*r*, *w*
Goujon 2006 (Vietnam)	M2	Industrial production (1.15) / CPI	*π*, *e*
Oomes, Ohnsorge 2005 (Russia)	M0, M2	Industrial production (2.1;3.16) / CPI	*r*, *e*
Korhonen, Mehrotra 2010 (Russia)	M2	Key sectors output (1.73 + trend) / CPI	*π, e*

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