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Money supply and monetary policy in Russia: A post-Keynesian approach revisited

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Предложение денег и денежно-кредитная политика в России: пост-кейнсианский подход

На английском языке

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Abstract: In our paper, using Granger causality tests on data covering 1995-2011 we find that credit is an important source of money supply endogeneity in Russia, with the two distinct sources of money supply endogeneity present: the one in the sense of accommodationist approach (through state-controlled firms) and another in the sense of structuralist approach (through private sector firms), with external credit operations being an important part of it. Inflation is found to be consistently the cause, not the result of changes in the money supply. Our findings support some recommendations for the Bank of Russia and its monetary policy.

Keywords: post-Keynesian economics, endogenous money supply, inflation, Russia

JEL Classification: E51, E52, E61

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Money supply and monetary policy in Russia: a post-Keynesian approach revisited

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Introduction

In the last two decades in the sphere of monetary policy there appeared what might be called the "consensus view" on what the Central Bank should be doing and using which instruments (Acocella 1998; Woodford 2003). The general idea (at least before the crisis of 2007-2008) was that the Central Bank should pursue inflation target using its own interest rate as an instrument. The recent financial and economic crisis led to a debate on the goals of monetary policy resulting in financial stability added to the list of major goals (Fullwiler 2013; Bénassy-Quéré et al. 2010). Recognizing interest rates as the main monetary policy instrument (and already by late 1990s most Central Banks used interest rate management – see e.g. Borio 1997) means accepting the fact that monetary aggregate cannot be controlled fully by the Central Bank, and hence cannot be a meaningful instrument of monetary policy. This also breaks the usual advice for controlling inflation through control of money supply growth – if the quantity of money cannot be decided upon by the Central Bank, its growth rate cannot be controlled as well. This is not to say the link between excessive growth of money and inflation does not exist, but such a link might be beyond the reach of monetary authorities. These developments in discussions of monetary policy highlighted the fact that the quantity of money in the economy and inflationary processes are not governed by the Central Bank alone, but depend to a large extent on the behavior of the banking system

and non-banking economic agents (firms and households). That is, the fact that money is not a control variable that can be used by the Central Bank at its discretion but rather the result of interaction of many economic agents' decisions, and, in this sense, money supply is endogenous, not exogenous, in relation to the economic system, was more or less implicitly recognized within the economic profession.

However, the fact of money supply endogeneity was not accepted explicitly by most economists, and a lot of macroeconomic models continued to view money aggregates as related to a small number of variables and control parameters (such as monetary base, norms of reserve requirements, refinancing interest rate etc.). Such approach allowed viewing money as being under control of the Central Bank and in particular described credit as being subordinate to the amount of reserves made available to the banking system through monetary policy measures. This view of credit is erroneous as has been shown clearly by the recent crisis, and as has been demonstrated in a long tradition of endogenous money view supported, to different degrees, by various schools of economic thought. The importance of credit behavior for the monetary sector developments and its consequences for overall economic stance and policy advice are currently widely discussed, and theoretical justifications of monetary policy consistent with the goal of financial stability using interest rates as an instrument and accounting for the role of credit in the economic system started to appear (Fullwiler 2013).

In order to be more precise in the policy advice and to understand better the potential for monetary policy governance, it is important not only to recognize the role of credit in the economy, but also its various forms, specificities and sources. This calls for careful investigation of empirical regularities concerning behavior of credit

aggregates in relation to monetary aggregates, money base, and inflation in various economic settings. While we have already conducted an exercise of this sort for Russia (Vymyatnina 2006), it is of interest to see if the regularities found out on earlier set of data continue to the present, as well as to account for an extra source of endogeneity disregarded in the previous paper – the external sector of the economy. Therefore we analyze in this paper the extended period covering 1995-2011, which included two crisis periods relevant for Russia – 1998 'Russian' crisis and 2008 world financial and economic crisis. We investigate several hypotheses related to various approaches to and various sources of money endogeneity, and our general conclusion is that certain regularities in relations between credit aggregates and monetary and inflation indicators are continuous regardless of crises and changes in monetary policy stance.

The paper is structured as follows. The next section briefly presents discussion of endogenous money perspective and major approaches to it theoretically, outlines important sources of endogeneity of money supply in Russia and summarizes hypotheses related to endogenous money and their sources. After that we present a brief survey of empirical inquiries into money endogeneity in different countries. Next section provides overview of data and methodology used and discusses the main results. The last section concludes with summarizing our results and policy advice stemming from them as well as considering further potential research directions.

Theory of endogenous money: definitions and literature review

The textbook story of money presents it as something controlled by the government (or, more precisely, monetary

authorities) through issue of base money and additional instruments of monetary policy assisting to achieve the desired quantity of money in circulation. Such view places money in an exogenous position in relation to the economic system: economy is given some amount of money, and it has to live with it until the Central Bank decides for some reason to adjust the amount. Of course, this is oversimplification, but it illustrates accurately the underlying belief that the quantity of money is well controllable by the monetary authorities and subject to changes at their will.

Alternative views on the role of money in the economic system consider it to be endogenous, defined *within* the economic system by the needs of economic agents. The central role here is given to the development of credit aggregates. Unlike the exogenous monetary theory that assumes that credit is constrained by the supply of reserves, the endogenous view either dismisses any constraints on credit or broadens them. Most important contributions to the theory of endogenous money comes from post-Keynesian tradition, but a number of insights also come from new-Keynesian school of thought. We briefly describe below their views on money supply endogeneity.

While there are many schools of thought regarding money as endogenous within post-Keynesian tradition (including endogenous money approach *per se*, Italian and French versions of circuit theory, contributions of Minsky and Kalecki, chartalism, to name just some), the most relevant for endogenous money debate in our context are two approaches to endogenous money supply: accommodationst (horizontalist) and structuralist ones. Proponents of the first include, for example, Kaldor, Moore, Lavoie, Arestis, advocates of the second include Minsky, Pollin, Palley, Howells, Rochon.

Both approaches start from the common ground in that both recognize importance of time in the production process: entrepreneur has to pay factors of production and suppliers of raw materials *before* the product is produced and sold and the gain is realized[1] (Fontana 2002). This means that unless the producer has previous savings (retained earnings), he will have to resort to credit to pay his workers and suppliers. Therefore, credit extension is largely driven in this view by the firms' decisions to produce, to develop new products, to increase scope of production, to invest in new technologies etc. The differences between the two approaches appear at the next stage when banking system comes into play.

Accommodationist approach

Banks in this view are considered *price-makers*, setting the price of credit (credit interest rate), and *quantity-takers*, extending credit to the amount of demand from creditworthy borrowers (Moore 1989). Operation of credit necessarily implies not only increasing asset side of the bank balance sheet, but an equal increase in its liabilities side, since credits are issued in the form of opened deposits[2]. New deposits opened by a bank lead to the necessity to adjust reserves (both obligatory and optional) held with the Central Bank. The latter in this case sets its interest rate (refinancing, discount or a similar one depending on a country) and then accommodates demand for additional reserves at the said interest rate in full. This means that changes in the net volume of outstanding credit of the banking system lead to changes in the net volume of

[1] Importance of time for the production process has been mentioned in many works, most notably by Keynes (e.g. 1936), Kaldor (e.g. 1957), Robinson (e.g. 1956).

[2] This is a part of the usual textbook story that credit extension creates more money, but viewed from a more realistic angle.

money base and monetary aggregates[3]. The causality link is expected to be one-way strictly, running from credit to deposits, money base and money aggregates.

Furthermore, changes in the expected nominal income lead to changes in the demand for bank credit, and, through it, to changes in the volume of deposits and monetary aggregate. At the same time changes in net volume of credit lead to changes in economic growth, thus affecting nominal income and aggregate demand of the next period. Hence the bidirectional causality between nominal income and broad definition of monetary aggregate is expected.

The accommodative behavior of the Central Bank might be questioned, but, as the proponents of this approach stress, if the Central Bank cares for stability of the banking system, it will support banks' requests for additional reserves to keep the system going performing its role of the creditor of last resort. In accommodationist approach the creditworthy demand for credit leads the way with supply of credit, reserves and money adjusting. Banks do not need prior excess of reserves to issue credit (Fullwiler 2013), they create it on demand provided the analysis of corresponding risks and benefits is in their favor[4]. Since the banks have to earn profit, and extension

[3] As Howells and Bain stress, we cannot be specific as to which monetary aggregate changes to which extent in response to the changes in net credit volume, since both credits and deposits have different duration and types, and the widest possible definition of monetary aggregate serves best to describe the relation between changes in credit volume and changes in monetary aggregates (Howells and Bain: 2003, 36).

[4] In this the approach directly contradicts the loanable funds theory (advanced, among others, by (Kohn 1981, McKinnon 1973, Bibow 2000) that assumes that supply of credit is characterised by the production function, meaning that in order to issue credit a bank will have to forego alternative usage of its liabilities. Such a view means regarding money as one other 'good' which is methodologically

of credit threatens them with necessity of borrowing reserves from the Central Bank at the refinancing rate, the credit interest rate will be a mark-up over refinancing rate. Thus, banks set the price – credit interest rate, and accommodate any demand that stems from it, and the same is true of the Central Bank behavior – it sets the price – refinancing rate – and accommodate any extra demand for reserves from the banking system. This means that under any refinancing rate set on the vertical axis the supply of credit (and hence, reserves and money) will be a horizontal line, thus the name of the approach. In this case recommendations for monetary policy are quite simple – change refinancing rate in the desired direction and wait while the changes in interest rate system go through the full cycle to influence credit demand and money supply.

Structuralist approach

The accommodative behavior of the Central Bank in regards to reserves extension and accommodating behavior of banking system in regards to credit demand is questioned to be realistic enough in the structuralist approach to money supply endogeneity. The central difference in the reasoning is that to some extent banking system can control credit extension and Central Bank – extension of reserves (Palley 1994, Pollin 1991). The main difference in the reasoning between the two approaches comes from the analysis of liquidity preferences. The latter influence decisions of households, firms, banks and the Central Bank, and, in the end, the process of money creation in the economy.

In case of households, the changes in liquidity preferences influence money supply in two ways. First, if the households have

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incorrect in post-Keynesian analysis, since money is an accepted means of payment, not possessing intrinsic value and thus explicitly distinct from 'good'.

low liquidity preferences, they will invest free money into assets of the real sector (producing firms), enhancing firms to grow and produce more, and thus increasing firms' demand for credit (Fontana 2000). Secondly, under low liquidity preferences households are more active in increasing their own credit exposure[5]. Low liquidity preferences of firms lead to increase in credit demand related to expansion of production, investment into new equipment and other expansionary activities. An increase in liquidity preferences might lead firms to decrease their credit exposure and even to decrease production operations (Bibow 1998).

Banking system also has its own liquidity preferences, and depending on it the mark-up over refinancing rate is set to define credit interest rate. In case of high liquidity preferences of the banking system (as was the case in the aftermath of the last financial crisis) banks increase their credit interest rates and might introduce additional prohibitive requirements to those seeking credit. Besides, banks have different liquidity preferences in relation to different categories of borrowers resulting in different credit interest rates. The Central Bank also has its liquidity preferences defined by its macroeconomic expectations and policy targets. And the Central Bank, like commercial banks, can differentiate commercial banks that apply for additional reserves setting the actual interest rate on reserves or required collateral according to its perception of their riskiness. 'Frown costs' can also include additional audit of the banks regarded as more risky, up to withdrawal of the banking license.

The liquidity preference view adds realism to the accommodationist approach view in that the banking system and the

[5] Arestis and Howells (1999) note that credit demand of households is more important than firms' credit demand in forming money supply.

Central Bank regain some control over credit development process by being able to place limits to the extension of credit through higher interest rates or some form of credit rationing. At the same time, the control over credit developments is not total. It is often mentioned in the literature (Palley 1994, Pollin 1991) that commercial banks in response to constraints of reserves by the Central Bank apply what is termed 'liabilities management' or 'structural changes' in the balance sheet. Commercial banks seek to avoid reserve requirements from the Central Bank and create products that are not covered by reserve requirements but essentially are the same or very similar to deposits, one example being 'certificate of deposit' creation. Such activity leads to structural changes in the balance sheets of commercial banks, hence the name of the approach[6].

Another, less mentioned implication of not total control over credit developments is that apart from practicing structural changes in the balance sheet, banks can also seek for foreign funds to make up the gap between reserves needed and reserves supplied by the Central Bank. Besides, households and firms in order to overcome credit restrictions imposed by the banking system can resort to borrowing abroad directly. Thus, external sector can be an important source of money supply endogeneity further reducing ability of the Central Bank and the banking system to exercise control over credit developments and supply of money in the end.

Since the Central Bank cannot totally control credit activity of commercial banks, but to some extent is able to do this, it means that changes in the net volume of credit lead to changes in money base and monetary aggregates as was the case of accommodationist

[6] Of course, not only liabilities side of the balance is managed, the banks manage their assets as well, including their credit portfolios through securitization and the like.

approach, but at the same time the reverse causal relationship is also true – changes in the amount of available reserves (money base) will lead to changes in the amount of credit. Central Bank to some extent can influence the liquidity preference of the banking system and thus the amount of credit extended. Structuralist approach agrees on the bilateral causal relation between nominal income and monetary aggregates of the accommodationist approach.

Comparison of the two approaches

One of the major differences between the two approaches relates to the elasticity of the Central Bank's reaction function. Moore (1991) suggested that Central Bank's reaction function can be described as short-term interest rate being a function of changes in reserves demand from commercial banks. Moore and his followers assume that this reaction function has infinite elasticity. Advocates of the structuralist approach state that this elasticity is finite. Among other things, Central Bank has usually several important goals of its policy, which makes impossible to satisfy indefinitely commercial banks demand for extra reserves. In their view the reaction function of the Central Bank is not a horizontal line (at a pre-defined refinancing rate), but an increasing step function. Another argument against infinite elasticity of the reaction function is related to behavior of commercial banks, and in the structuralist approach a general understanding is that credit extension can be sustained only under rising interest rates. The advocates of accommodationist approach criticize this idea on the grounds that this argument makes sense if we look at a separate bank, while if we consider banking system as a whole, the liquidity of assets in the system is not changed in relative terms, and liquidity preferences of the banking system cannot be an obstacle for credit development and money creation (Moore 2001).

An attempt to integrate the two approaches accounting for their varying opinions on the liquidity preferences was recently made by Fontana (2002). He noticed that liquidity preferences that commercial banks have influence interest rates on new credit applications, while existing customers usually use open credit line up to a certain amount at a predetermined interest rate. Thus, changes in the liquidity preferences of the banking system will not have immediate influence on the dynamics of credit aggregates unless some existing contracts are cancelled or changed. Besides, in the case of growing economy, all economic agents, including commercial banks, tend to underestimate risks, and thus banks tend to issue more credit at the same interest rate than they might do in conditions of economic recession. Such considerations support long horizontal pieces of the Central Bank (and commercial banks) reaction function, as in accommodationist view. However, extension of credit beyond certain amount even in the growing economy will be considered too risky, and starting from some credit volume the general interest rate on credit might be credibly expected to be higher. If the economy is in recession, banks take a more careful view of the risks of their borrowers, and tend to differentiate their customers more, thus creating a step-like reaction function of the banking system (similar reasoning can be applied to the Central Bank's reaction function).

Another important difference between the two approaches towards money supply endogeneity is the time dimension. Following Hicks (1982) Fontana (2002) suggests that accommodationist approach is related to one-period analysis with no uncertainty and with stable functional relations assuming implicitly that liquidity preferences of all economic agents are given. Such approach suits well a short-term analysis with no changes in the liquidity

preferences and no other behavioural changes. The structuralist approach then uses continuation analysis of money demand that allows for changes in liquidity preferences and forecasts of economic situation by the economic agents. Thus, the two approaches are not opposing each other, but rather complementary in their essence, each stressing different relevant points.

New-Keynesian creditist approach

Probably the first paper in the new-Keynesian creditist approach to money supply was Bernanke's (1983) work in which he demonstrated that spreading and worsening the consequences of the crisis of 1929 was largely due to increase in the liquidity preferences of commercial banks that constrained financing available to production firms. New Keynesians deny Modigliani-Miller theorem and assert that there is a difference between borrowed and own capital, which means that the structure of banking system assets plays an important role in forming money supply (Mazzoli 1998: 32-33). Further development of this approach included explicit modeling of banks assets structure (Greenwald and Stiglitz 1988, Delli Gatti and Gallegati 1997, Bernanke and Blinder 1982, Friedman and Kuttner 1993, Gertler and Gilchrist 1991).

In our opinion creditist approach of new-Keynesians is similar to the structuralist approach of post-Keynesians. The quantity of money in the economy in both approaches depends on liquidity preferences of both the banking system and non-banking public. New-Keynesian approach emphasizes that in case of financial instability or financial crisis the change in the scale and structure of banking system assets becomes the main transmission channel of financial problems into real sector of economy. The mechanism described in the new Keynesian creditist approach is especially

similar to Minsky's descriptions of his financial instability hypothesis (Minsky 1991, 1994).

Summarizing all three approaches to endogenous money supply, it should be stressed that in each instance the economy has as much money as it needs, and the logic behind this reasoning is not changed even in the presence of credit rationing phenomenon described by Stiglitz and Weiss (1981).

Inflation and the nature of money supply

An important difference between the orthodox and heterodox monetary theories is related to inflation perception and corresponding policy advice. The view of orthodox monetary theory on inflation is often summed up by a catchy Friedman's phrase 'Inflation is always and everywhere a monetary phenomenon' (Friedman 1987). The implied causality runs from excessive growth of money supply to increase in aggregate demand and to rising prices.

The heterodox monetary theory takes a different view. Inflation is seen in this tradition as a consequence of conflict of interests. It can be a conflict of interests between workers and capitalists when workers demand higher wages for themselves, and higher wages drive prices of final products up (Hewitson 1995, Dalziel 1990, Kalecki 1971). Another case of the conflict of interests can be presented as a conflict within working class, when a group of workers in one industry manages to get higher wages which results in higher prices for the final product of this industry, and demands of workers in other industries for higher wages (Rossi 2003: 133).

Another important explanation of inflation in the heterodox theory is related to the ideas from circuit theories of money

(advanced by Chick, Minsky, Davidson and also Schmitt, Cencini and, most recently by Rossi (2003))[7]. An important source of inflation is credit-financed substitution of worn-out capital. The costs of such substitution have been already accounted for in the price of products sold through depreciation calculations. However, these sums were not stored separately to be used for substitution of capital at a later stage, but rather used as part of profits. One more case of potentially inflationary credit issuance is the so called 'net lender' case when a consumer credit is extended. Since the main function of money in heterodox tradition is that of the means of final payments, the use of consumer credit creates extra money that is not supported by creation of new goods and services, and thus leads to 'empty' money (that is, money that is not supported by the production results), resulting in increasing price estimation of produced products. This last explanation of inflation might result in similar predictions to the orthodox theory: money supply growth due to consumer credit expansion will result in inflation, but the explanations of the same phenomenon are quite different.

Sources of endogenous money supply in Russia

As could be seen from the above reasoning, the main source of money supply endogeneity is credit demand of non-banking sector. However, in some cases this demand can have special features allowing for naming several sources of endogeneity. One very specific feature is related to countries with transition economies (or, as will be clear from the later explanation, for any economy in

[7] We do not discuss here important ideas from this line of monetary theory related to problems of using price indices to represent inflation, the definitions of the price level and purchasing power of money, troubles with empirical estimations of money circulation velocity etc. Interested readers should refer to Rossi (2003: chapter 2).

which government presence in the real sector is serious enough). In the socialist planned economy all money supply is endogenous – in the plan system any credit needed for producing according to plan is more or less automatically granted, and increase of wages or other production costs is a political decision also provided for in terms of credit or cash allowances to the firms.

In transition period the situation changes (Norcic et al. 1996). On the one hand a new sector of private firms emerges, and this sector operates according to market economy rules, credit is applied for and granted on the basis of creditworthiness of the firm. On the other hand an old sector remains in which firms often operate regardless of their profitability, since they are important socially (as providing employment for a whole region) or strategically. Since existence of such firms is desirable not on market terms, but on social or strategic grounds, the credits needed for continuation of production will be secured with the help of government bodies of various levels, and, in a sense, credit lines to such firms are more or less automatic. In our opinion, the new sector of economy is involved in money creation in the sense of structuralist approach of post-Keynesian tradition (and creditist approach of new-Keynesian tradition), while the old sector of economy is involved in money creation in the sense of accommodationist approach of post-Keynesian tradition. Thus, one source of endogeniety of money in Russia is credit demand of the new production sector, working according to market economy rules. Another source of money supply endogeneity stems from credit demand of old sector comprised of state-owned or socially important firms.

Besides, external sector remains a source of credit both to the banking system and non-banking economic agents (especially to large corporations), thus bringing in one more source of money

supply endogeneity and further limiting the level of control the Central Bank has over money supply (unless all cross-border financial operations require prior approval of the Central Bank).

Yet another source of money supply of endogeneity, the one that is especially difficult to control and study, is related to barter operations, when government money works as a unit of account, while the economic agents have to resort to a more or less direct exchange of one goods and services for other goods and services. In this sense money supply becomes even more endogenous and more uncontrollable then in case of normal credit developments, since mutual arrears and mutual accounts between various groups of economic agents create economic relations outside of government control reach. This was the case in Russia at the beginning of 1990s when the payments system was functioning extremely badly, banking system was crediting government rather than real sector, and a number of firms had to exchange their products between themselves as well as to pay their workers with the products they produced. Another diversion towards barter systems, this time more advanced, was noticed in Russia in the wake of 2008 crisis, when barter chains were created using specialized web-sites, thus allowing participating companies to overcome credit constraints[8].

[8] One such well-known project was run by German Sterligov and his barter web-sites system that was spread on to include Kazakhstan, Belarus and Ukraine.

Empirical studies of money supply endogeneity

One of the first empirical studies of the nature of money supply was Moore and Threadgold (1980) inquiry into money supply endogeneity in the UK. Later there appeared a number of papers, including works of Yang (1990) for Taiwan, Howells and Hussein (1998) for G7 countries, Nell (2001) for South Africa, Vera (2001) for Spain, Bala et al (2003) for Malaysia, Pinga and Nelson (2001) for a sample of 26 countries, Tas and Togay (2012) for the Gulf Cooperation Council countries, and many more. The most widely used methodology for such studies are causality tests of Granger and Sims and approaches based on them. The first wave of empirical studies of the nature of money supply was performed on data from G7 and separate developed economies with the general conclusion of endogenous money supply in the sense of the structuralist approach (Moore 1988, Palley 1994, Moore and Threadgold 1980, Howells and Hussein 1998). However by now the bulk of empirical studies on money supply endogeneity is devoted to developing and transition economies.

Vera (2001) studied endogeneity of money supply on the example of Spain in 1987-1998. In the period in question Spain has undergone serious changes in monetary policy related to preparation for participation in the euro system. The elimination of targeting money supply by the monetary authorities can be viewed as one of the first indicators of money supply endogeneity. Formal Granger causality tests involving credit to private non-banking sector, money multipliers and money base confirmed endogenous nature of money supply compatible with liabilities management practice on the part of commercial banks.

Nell (2001) studied money supply endogeneity in South Africa in 1966 to 1997. In this period the country experienced a serious shift in monetary policy from predominantly direct control of credit activity to management of refinancing rate and open market operations. The data on credits to private non-banking sector, money base and monetary aggregates were studied on two periods (separated by 1980) to check for possible changes in the nature of money supply with the change in monetary policy. However, no differences were found between the two periods, and money supply endogeneity in the sense of structuralist approach of post-Keynesians or creditist view of new-Keynesians was confirmed.

Yang (1990) confirmed money supply endogeneity on Taiwan in the period 1978 to 1988, however inflation processes seemed to be defined by some additional factors, as inflation-monetary aggregate causality was not in line with the endogenous money supply view. Bala et al. (2003) studied money supply in Malaysia in 1985-2000. They included in their study credits to non-financial private sector, monetary aggregates, money base and GDP, and found that causality tests implied money supply endogeneity in accordance with the structuralist approach.

Pigna and Nelson (2001) had a sample of 26 countries for 1980-1999. They found signs of endogenous money supply according to accommodationist approach in Chile and Sri-Lanka and according to structuralist approach in India, Argentine, Korea and Pakistan. Tas and Togay (2012) worked with data on 6 countries of the Gulf Cooperation Council in 2000s and confirmed money supply endogeneity in these countries, which, in their opinion, has important implications for the future monetary union of these countries. Our own previous study (Vymyatnina 2006) has confirmed money supply endogeneity for Russia for the period 1995-2004.

The authors of new-Keynesian tradition used causality tests to confirm existence and importance of the credit channel of monetary policy. The most notable of such works is Bernanke (1990) in which he confirmed the existence of credit channel of monetary policy in the US. Later Bernanke and Blinder (1992) confirmed, using Granger causality tests, that interest rates allowed better forecasting of macroeconomic variables (e.g. inflation) as compared with monetary aggregates. Besides, they demonstrated that volume of credit is also important in forecasting real variables. Similar conclusions have been reached by Alfaro (2003) for Chile, Gupta (2004) for India and Pakistan. These studies confirm importance of interest rates and credit aggregates in forecasting real sector variables, and thus confirm money supply endogeneity hypothesis in the formulation of creditist view of new-Keynesians.

Thus, a number of empirical studies, performed from different theoretical underpinnings, for countries with different monetary policy regimes and of varying development levels, and in very different time periods, confirmed presence of money supply endogeneity, and its importance for forecasting real sector variables. This stresses the fact that money supply endogeneity is a fact, and a fact requiring attention from the Central Bank to make its monetary policy and its tools more efficient.

Data and methodology

Theoretical discussion of endogenous money supply can be summarized in the table 1 below.

Table 1. Comparative table of approaches to exogenous and endogenous money supply

Orthodox monetary theory (neoclassical synthesis)	Accommodationist approach (post-Keynesian)	Structuralist approach (post-Keynesian)	Creditist view of new-Keynesians
M0 → Credit M3 → Credit M3 → Nominal income M3 → Inflation	Credit → M0 Credit → M3 M3 ⇔ Nominal income Inflation → M3	Credit ⇔M0 Credit ⇔ M3 M3 ⇔ Nominal income Inflation → M3	Credit ⇔M0 Credit ⇔ M3 M3 ⇔ Nominal income M3 → Inflation

The sign «→» denotes one-side causality direction, and the sign «⇔» denotes bi-directional causality.

Data

In order to test the nature of money supply in Russia and the sources of its endogeneity if that is found, we use the following monthly data (July 1995 – December 2011):

- Money base (wide definition by the Bank of Russia; www.cbr.ru) – *M0*[9];
- Credit to non-financial private firms and households (Bank of Russia; www.cbr.ru) – *CP*;
- Credit to non-financial state-owned firms (Bank of Russia; www.cbr.ru) – *CG*;
- Monetary aggregate *M2* (national definition, Bank of Russia; www.cbr.ru);
- Monetary aggregate *M3* (Bank of Russia; www.cbr.ru);
- Price level (data of RET e-journal issued previously by RECEP – author archive; then Rosstat data, www.gks.ru) - *P*;
- Nominal GDP (ministry of finance estimate) – *Y*;
- Real GDP in 2000 prices (Rosstat data, www.gks.ru) – Y_r;
- Refinancing rate (Bank of Russia; www.cbr.ru) - *i*;
- Average monthly exchange rate between USD and ruble (Bank of Russia; www.cbr.ru) – *ERD*;
- Average monthly exchange rate between euro and ruble (Bank of Russia; www.cbr.ru) – *ERE*;
- Data on external trade – total and with Eurozone countries (Bank of Russia; www.cbr.ru);
- Average monthly price of the barrel of oil both nominal and real in 2005 prices (IMF IFS data) – *OILP*;
- Core inflation (i.e. inflation excluding administratively set prices and tariffs and prices of seasonal goods; Bank of Russia; www.cbr.ru) – $b\pi$;

[9] Lowercase letters further denote logs of corresponding variables (except for the refinancing rate); the sign Δ denotes first difference of the corresponding time series.

- Share of credits from foreign lenders in the total amount of banking system liabilities (Bank of Russia; www.cbr.ru) – *SHARE*.

Three indicators of credit were considered throughout the study:

- Credit to non-financial private firms and households (potential source of money supply endogeneity in the sense of structuralist approach – credit to the 'new' sector of economy);
- Credit to state-owned firms (potential source of money supply endogeneity in the sense of accommodationist approach – credit to the 'old' sector of economy);
- Total credit to non-banking sector, the sum of the two above-mentioned types of credit – *CT* (potential source of money supply endogeneity in the sense of structuralist approach – credit to the economy as a whole).

Data on the price level allowed calculation of inflation indicator π as the first difference of log-price level series. Data on money base and monetary aggregates were used to calculate money multipliers *mm2* and *mm3*. Data on *ERD* and *ERE* were used to calculate *ERA* – nominal effective exchange rate. The weights were based on trade, assuming that euros are used in the trade with Eurozone countries, while USD is used in all other trade transactions. This assumption does not contradict, in our opinion, the high level of dollarization of the world economy (similar assumptions are made in e.g. Charemza et al. 2009).

The choice of the start date for the study is explained by the availability of data, the end period is explained by the latest available data on all indicators at the time the research was made. In the period

of 1995-2011 Russian economy had two crises: the first in August 1998 ('Russian' crisis) and the second in 2008 (world financial and economic crisis). Therefore we introduce 4 different sub-samples: a full sample, a pre-crisis sample (July 1995 – July 1998), between-crisis sample (January 1999 – December 2007), post-crisis sample (January 2009 – December 2011). The pre-crisis sample also corresponds to a different monetary policy regime when the Bank of Russia was in fact monetizing government debt rather than following any discernible monetary policy. Since the year 2000 Bank of Russia switched into preparation for inflation targeting regime and responsible monetary policy; government debt financing was stopped[10].

Econometric methodology

Following example of other empirical researchers in the field we also employ Granger causality tests to test alternative monetary theories summarized in table 1. A difficulty with interpreting results from Granger causality tests as causal links is related to the fact that these tests tell us if one variable can help in forecasting better the future values of another variable, not whether "variable one" causes changes in "variable two". However, we assume that with an appropriate economic theory behind the relations found with the help of causality tests one can assert causality directions as well[11].

[10] For more details on Russia's monetary policy in the period in question one can refer, e.g. to Dabrowski et al (2001), Ulyukaev (2007; in Russian), Vymyatnina 2006.

[11] It should be also stressed that the results of Granger tests can be interpreted as related to exogenous or endogenous money supply theories, but should not be mixed with presence or absence of exogeneity in econometric sense.

The sequence of work with the data was as follows. First data were checked for the order of integration[12]. Next series with the same order of integration were checked for cointegration[13] with the view to establish not only short-run (usual Granger test), but also potential long-run causality links[14]. Then Granger tests were run on the appropriate transformations of the series (stationary). Further we report only summarized results of all tests. Detailed results and the full dataset used for analysis are available from the author upon request.

Results and discussion

The following table presents results of cointegration relations between series of the same order of integration (only theoretically reasonable pairs were considered).

Table 2. Cointegration tests results

Pair of variables	*Full sample*	*Pre-crisis*	*Between-crises*	*Post-crisis*
cg_t и $m0_t$	no	--	yes	no
cg_t и $m2_t$	no	--	no	yes
cg_t и $m3_t$	no	--	--	no
cg_t и $mm2_t$	no	yes	no	no
cg_t и $mm3_t$	no	yes	yes	no
cp_t и $m0_t$	no	--	yes	yes
cp_t и $m2_t$	no	--	no	yes

[12] Most series were found to be integrated of order 1, often with a constant and a time trend. Details of stationarity tests are available from the author upon request.

[13] Engle-Granger procedure was used; for details see Appendix 1.

[14] See appendix 1 for more details on Granger causality tests and distinction between short-run and long-run causality.

Table 2 continued				
Pair of variables	*Full sample*	*Pre-crisis*	*Between-crises*	*Post-crisis*
cp_t и $m3_t$	no	--	--	yes
cp_t и $mm2_t$	no	yes	yes	no
cp_t и $mm3_t$	yes	yes	yes	no
ct_t и $m0_t$	no	--	yes	yes
ct_t и $m2_t$	no	--	yes	yes
ct_t и $m3_t$	no	--	--	yes
ct_t и $mm2_t$	no	yes	yes	no
ct_t и $mm3_t$	yes	yes	yes	no
y_t и $m2_t$	yes	--	yes	--
y_t и $m3_t$	yes	--	--	--
π_t и $mm2_t$	--	yes	--	no
π_t и $mm3_t$	--	yes	--	yes
erd_t и $mm2_t$	--	yes	yes	--
erd_t и $mm3_t$	--	yes	yes	--
ere_t и $mm2_t$	--	--	no	--
ere_t и $mm3_t$	--	--	yes	--
era_t и $mm2_t$	--	--	yes	--
era_t и $mm3_t$	--	--	yes	--
The sign «--» means the test was not run.				

As we can see from the results above, in many cases there is no cointegration. And in many cases where cointegration is present, the results are not very convincing due to small sample size. Most reliable results in our opinion are those for the between-crises sample, since (a) macroeconomic conditions are more stable, and (b) sample size is larger compared to other subsamples. Taking into account high economic volatility of the pre-crisis and post-crisis subsamples, and the potential change of long-run functional

relations, in our further analysis we use only those cointegration relations that were found on the full sample or the between-crises sample. It is worth mentioning that cointegration is found on more than one subsample for the pairs “inflation – money multiplier”, “total credit to non-banking public – money base”, “credit to state-owned firms – money base”, “credit to state-owned firms – monetary aggregate M2”, “GDP – money aggregate”, and “exchange rate – money multiplier”. This indicates formation of stable long-run relationships between these pairs of variables. It is interesting that for pairs “credit – money multiplier” cointegration has almost never been detected, which means that money multiplier is defined by a range of factors different from those for credit demand. In view of this we consider methodologically sound to perform Granger causality tests for pairs “credit – monetary aggregate”, but not “credit – money multiplier” (as has been done in e.g. Vera (2001)).

Further for each pair of variables to be tested for Granger causality VAR-models with maximum lags of 6, 9 and 12 were estimated on the full and between-crises samples (for the pre-crisis and post-crisis samples only 6-lags VARs were estimated). Residuals of these VARs were checked for heteroscedasticity, autocorrelation, stationarity and normality. The latter has been the only problem with the estimated VARs, but this assumption is rarely found true in practice, and most properties of test statistics hold without normal distribution of residuals.

Table 3 below presents results of Granger causality tests for the full sample. The following results should be mentioned: total credit to non-banking sector of economy Granger-causes M0 and M3; credit to state-owned firms Granger-causes M0, M2 and M3; credit to private non-financial sector Granger-causes M2. In all these cases causality runs one way, from credit aggregates to money base

and monetary aggregates. M2 and M3 Granger-cause nominal GDP, inflation Granger-causes M0 and M3 (but not the other way round!). It is interesting also that USD-related exchange rate Granger-causes M0 and M3, while for euro-related exchange rate and nominal effective exchange rate Granger causality runs in the other direction. These results can be interpreted as confirming priority of USD-ruble exchange rate for Bank of Russia's monetary policy, while euro exchange rate was adjusted more or less in line with USD exchange rate depending on dynamics of monetary aggregates. It should be also noted that most of external trade revenue inflows are in USD, making its exchange rate more important for monetary policy.

For those pairs that had cointegration confirmed (see Table 2), VECM instead of VAR-model was estimated. Coefficients responsible for long-run Granger causality are reported under 'ECM' lines. Estimated ECM coefficients for pairs of "nominal GDP – M2 (M3)" are insignificant, suggesting no true long-run relation in existence between these pairs of variables. The results generally are in line with those we received in an earlier study (Vymyatnina 2006), though there are less cases of bidirectional Granger causality, which might be explained by a longer observation period.

Summing up results for the full sample, Granger causality test results for credit to state-owned firms and total credit to non-financial sector support endogenous money supply hypothesis as stated in accommodationist approach. In part of credit to state-owned firms the results support our hypothesis of 'old' sector credit as a source of money endogeneity. It should be stressed that 10 years since Russia has been recognized as a country with market economy[15], state-owned firms in Russia are still run according to soft

[15] USA recognized Russia as a country with market economy in April 2002.

budget constraints model, and this influences monetary aggregates unilaterally and should be accounted for in monetary policy conduct. It is also of interest that inflation Granger-causes M0 and M3, but there is no Granger causality between inflation and M2[16]. These results reinforce the point that inflation had mostly non-monetary causes during this period, and the Bank of Russia could not fight it with tight monetary policy[17]. It is also important to note the absence of Granger causality in pairs 'core inflation – monetary aggregate' in any direction, which additionally supports the absence of monetary influence in inflation processes in this period.

Table 3. Granger causality tests for the full sample

Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta cg_t \rightarrow \Delta m0_t$	5.913293 (0.4330)	**18.89570**** (0.0261)	**22.90261**** (0.0286)
$\Delta m0_t \rightarrow \Delta cg_t$	1.823047 (0.9352)	5.577439 (0.7814)	6.768720 (0.8725)
$\Delta cg_t \rightarrow \Delta m2_t$	**12.55697*** (0,0506)	**22.94158**** (0,0063)	**23.31854**** (0,0251)
$\Delta m2_t \rightarrow \Delta cg_t$	3.440742 (0,7518)	3.938522 (0,9154)	7.789717 (0,8013)
$\Delta cg_t \rightarrow \Delta m3_t$	7.366899 (0.2882)	**92.64945***** (0.0000)	**104.9910***** (0.0000)
$\Delta m3_t \rightarrow \Delta cg_t$	4.785992 (0.5715)	6.974198 (0.6398)	11.58995 (0.4791)
$\Delta cp_t \rightarrow \Delta m0_t$	6.930597 (0.3273)	10.75795 (0.2927)	13.78809 (0.3144)
$\Delta m0_t \rightarrow \Delta cp_t$	4.528102 (0.6056)	8.351707 (0.4991)	13.46865 (0.3359)
$\Delta cp_t \rightarrow \Delta m2_t$	**10.67113***	7.153056	9.192892

[16] This supports the tendency mentioned by the Bank of Russia in its yearly reports on the weakening of relationship between M2 and inflation.

[17] This is not to deny the importance of the Bank of Russia efforts in sterilizing of excessive money supply resulting from high oil prices.

	(0,0991)	(0,6212)	(0,68640
Table 3 continued			
Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta m2_t \rightarrow \Delta cp_t$	2.902870 (0,8209)	9.851887 (0,3626)	17.62289 (0,1276)
$\Delta cp_t \rightarrow \Delta m3_t$	5.010741 (0,5424)	12.27549 (0,1982)	13.48722 (0,3346)
$\Delta m3_t \rightarrow \Delta cp_t$	5.791526 (0,4469)	6.598306 (0,6789)	13.84339 (0,3108)
$\Delta ct_t \rightarrow \Delta m0_t$	5.769624 (0,4495)	**15.46389*** (0,0790)	**18.83380*** (0,0926)
$\Delta m0_t \rightarrow \Delta ct_t$	4.635350 (0,5914)	5.163926 (0,8198)	10.12672 (0,6048)
$\Delta ct_t \rightarrow \Delta m2_t$	4.977183 (0,5467)	12.60663 (0,1812)	16.74968 (0,1593)
$\Delta m2_t \rightarrow \Delta ct_t$	7.941524 (0,2424)	7.391969 (0,5964)	11.52553 (0,4845)
$\Delta ct_t \rightarrow \Delta m3_t$	5.769581 (0,4495)	**20.19403**** (0,0168)	**27.18477***** (0,0073)
$\Delta m3_t \rightarrow \Delta ct_t$	4.199901 (0,6496)	6.239833 (0,7157)	17.74438 (0,1237)
$\Delta y_t \rightarrow \Delta m2_t$ *ECM*	5.111973 (0,5295)	8.139469 (0,5202)	8.352395 (0,7570) 1.301766 [1.46416]
$\Delta m2_t \rightarrow \Delta y_t$ *ECM*	**22.62021***** (0,0009)	**22.69546***** (0,0069)	**21.68853**** (0,0412) -8.438313 [-5.07325]
$\Delta y_t \rightarrow \Delta m3_t$ *ECM*	7.156822 (0,3066)	11.33110 (0,2537)	10.35829 (0,5846) 1.302888 [1.65407]
$\Delta m3_t \rightarrow \Delta y_t$ *ECM*	**14.02666**** (0,0293)	**20.11932**** (0,0172)	**18.59561*** (0,0988) -8.908409 [-5.44656]
$\pi_t \rightarrow \Delta m0_t$	**20.09607***** (0,0991)	**22.05313***** (0,6212)	**27.30050***** (0,68640

	(0,0027)	(0,0087)	(0,0070)
Table 3 continued			
Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta m0_t \rightarrow \pi_t$	3.236590 (0,7786)	5.247352 (0,8122)	5.440478 (0,9416)
$\pi_t \rightarrow \Delta m2_t$	6.338794 (0,3863)	8.472029 (0,4874)	6.963590 (0,8600)
$\Delta m2_t \rightarrow \pi_t$	9.844034 (0,1314)	12.92102 (0,1662)	14.75541 (0,2551)
$\pi_t \rightarrow \Delta m3_t$	**215.7829***** (0,0000)	**220.9593***** (0,0000)	**221.5169***** (0,0000)
$\Delta m3_t \rightarrow \pi_t$	8.076239 (0,23260	12.64228 (0,1795)	16.27126 (0,1791)
$\Delta erd_t \rightarrow \Delta m0_t$	**13.52191*** (0,0951)	**18.01992*** (0,0546)	**29.67732***** (0,0085)
$\Delta m0_t \rightarrow \Delta erd_t$	2.964462 (0,93660	4.089293 (0,94320	5.720790 (0,9730)
$\Delta erd_t \rightarrow \Delta m2_t$	2.374452 (0,8822)	5.623032 (0,7770)	4.583910 (0,9705)
$\Delta m2_t \rightarrow \Delta erd_t$	10.27571 (0,1135)	13.39842 (0,1454)	16.47611 (0,1704)
$\Delta erd_t \rightarrow \Delta m3_t$	**155.6031***** (0,0000)	**158.0266***** (0,0000)	**153.2682***** (0,0000)
$\Delta m3_t \rightarrow \Delta erd_t$	8.492554 (0,2042)	13.84601 (0,1279)	**18.67536*** (0,0967)
$\Delta ere_t \rightarrow \Delta m0_t$	2.920617 (0,8187)	6.757816 (0,6623)	8.790883 (0,7207)
$\Delta m0_t \rightarrow \Delta ere_t$	**12.54274*** (0,0509)	13.15071 (0,1559)	**19.13566*** (0,0853)
$\Delta ere_t \rightarrow \Delta m2_t$	5.718030 (0,4555)	9.918968 (0,3571)	9.609454 (0,6502)
$\Delta m2_t \rightarrow \Delta ere_t$	**21.11483***** (0,0017)	**25.78859***** (0,0022)	**29.11564***** (0,0038)
$\Delta ere_t \rightarrow \Delta m3_t$	8.821811 (0,1839)	11.91064 (0,2184)	14.63567 (0,2620)
$\Delta m3_t \rightarrow \Delta ere_t$	**13.39657**** (0,0372)	**20.69566**** (0,0141)	**31.49007***** (0,0017)
$\Delta era_t \rightarrow \Delta m0_t$	4.436559	11.98271	12.76202

	(0,6178)	(0,2143)	(0,3866)
Table 3 continued			
Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta m0_t \rightarrow \Delta era_t$	7.140756 (0,3080)	5.940979 (0,7458)	5.896376 (0,9212)
$\Delta era_t \rightarrow \Delta m2_t$	4.561122 (0,6012)	7.918751 (0,5424)	14.45167 (0,2728)
$\Delta m2_t \rightarrow \Delta era_t$	**17.99547***** (0,0062)	**17.41897**** (0,0425)	**23.32267**** (0,0251)
$\Delta era_t \rightarrow \Delta m3_t$	2.358310 (0,8840)	6.084797 (0,7314)	10.08998 (0,6081)
$\Delta m3_t \rightarrow \Delta era_t$	**14.42211**** (0,0253)	**15.36998*** (0,0813)	**25.54633**** (0,0124)
P-value of test-statistics is in parentheses. * denotes H0 being rejected at p-value of 99% ** denotes H0 being rejected at p-value of 95% *** denotes H0 being rejected at p-value of 90% In square parentheses value of t-statistics for ECM coefficient is presented.			

Results for pre-crisis and post-crisis subsamples are provided in Table 4. There are interesting differences for pre-crisis period compared with the full sample. Credit to state-owned firms is not Granger-cause of M0, M2 or M3, but is Granger-caused by M2 (at 90% p-value). At the same time credit to private non-financial sector Granger-causes M0 and M3, while total credit to non-financial sector and M3 Granger-cause each other. Inflation changes in the pre-crisis period is preceded by M0, and for the pairs ‘inflation-M2’ and ‘inflation-M3’ Granger causality is bidirectional. Another important distinction is that USD exchange rate Granger causes M0, which is explained by ruble being officially pegged to USD in this period (variant of currency board policy). Oil prices do not exhibit any sort of Granger causality, which is natural taking into account low oil prices of the period.

These differences have at least two explanations. First of all, pre-crisis sample is short, has high volatility of major macroeconomic indicators and is characterized by loose economic policy (both fiscal and monetary). Secondly, in the pre-crisis period barter schemes of all sorts are actively used, and this means that a large number of transactions (including also implicit credit relations) are not covered by official statistics. Money base could have only a very limited influence on credit activity of the banking system in that period, since refinancing mechanisms are largely undeveloped, creditworthy customers are almost non-existent, government bonds market provides for commercial banks a secure and risk-free (as it seemed) way to earn profit. Inflation was defined by monetary aggregates since relative prices were still in the adjustment process after prices liberalization of 1992, and increases in prices in response to official announcements of wage or pensions increases was a common phenomenon.

Thus analysis of results for the pre-crisis period does not allow us to make any conclusions on the validity of one or another approach to money supply for the case of credit to state-owned firms. However results for credit to private non-financial sector support accommodationist approach that contradicts our hypothesis that it is credit to state-owned firms that should have such effect on the monetary aggregates. Again, one of the explanations here is underdevelopment of financial system, when credit to any company required guarantees from another company or government authorities. The results for total credit to non-financial sector support structuralist approach to money supply endogeneity, while results for inflation do not allow supporting any of the theories considered.

Table 4. Granger causality tests for the pre-crisis and post-crisis sub-samples

Pair of variables	Pre-crisis (max. lag 6)	Post-crisis (max. lag 6)
$\Delta cg_t \rightarrow \Delta m0_t$	7.003386 (0,3205)	**17.41756**** **(0,0426)**
$\Delta m0_t \rightarrow \Delta cg_t$	1.366269 (0,9679)	6.052603 (0,7346)
$\Delta cg_t \rightarrow \Delta m2_t$	6.457205 (0,3740)	8.577827 (0,2844)
$\Delta m2_t \rightarrow \Delta cg_t$	**12.02148*** **(0,0615)**	8.526026 (0,2885)
$\Delta cg_t \rightarrow \Delta m3_t$	5.947517 (0,4291)	6.121606 (0,4097)
$\Delta m3_t \rightarrow \Delta cg_t$	8.136136 (0,2283)	2.080299 (0,9122)
$\Delta cp_t \rightarrow \Delta m0_t$	**14.23599**** **(0,0471)**	**22.52281***** **(0,0074)**
$\Delta m0_t \rightarrow \Delta cp_t$	6.095853 (0,5286)	**15.86325*** **(0,0698)**
$\Delta cp_t \rightarrow \Delta m2_t$	7.684256 (0,2622)	**16.50430**** **(0,0209)**
$\Delta m2_t \rightarrow \Delta cp_t$	2.603659 (0,8567)	**28.54799***** **(0,00020**
$\Delta cp_t \rightarrow \Delta m3_t$	**14.00642*** **(0,0816)**	3.360209 (0,7625)
$\Delta m3_t \rightarrow \Delta cp_t$	6.379501 (0,6048)	**21.22935***** **(0,0017)**
$\Delta ct_t \rightarrow \Delta m0_t$	7.444164 (0,2817)	**16.16899**** **(0,0236)**
$\Delta m0_t \rightarrow \Delta ct_t$	5.392273 (0,4946)	10.55274 (0,1594)
$\Delta ct_t \rightarrow \Delta m2_t$	3.664297 (0,7220)	**17.01751**** **(0,0173)**
$\Delta m2_t \rightarrow \Delta ct_t$	7.542895 (0,2735)	**28.12300***** **(0,0002)**
$\Delta ct_t \rightarrow \Delta m3_t$	**7.937279**** **(0,0473)**	3.407126 (0,7563)

Table 4 continued		
Pair of variables	Pre-crisis (max. lag 6)	Post-crisis (max. lag 6)
$\Delta m3_t \rightarrow \Delta ct_t$	**7.265029*** **(0,0639)**	**21.00632***** **(0,0018)**
$\Delta y_t \rightarrow \Delta m2_t$	4.330781 (0,6320)	7.724660 (0,2590)
$\Delta m2_t \rightarrow \Delta y_t$	1.106767 (0,9812)	**24.43009***** **(0,0004)**
$\Delta y_t \rightarrow \Delta m3_t$	5.675686 (0,4605)	4.209850 (0,6483)
$\Delta m3_t \rightarrow \Delta y_t$	3.258649 (0,7758)	**16.15914**** **(0,0129)**
$\pi_t \rightarrow \Delta m0_t$	9.017861 (0,3408)	5.680099 (0,4600)
$\Delta m0_t \rightarrow \pi_t$	**13.49582*** **(0,0959)**	**12.49274*** **(0,0518)**
$\pi_t \rightarrow \Delta m2_t$	**11.32821*** **(0,0787)**	4.655117 (0,5887)
$\Delta m2_t \rightarrow \pi_t$	**10.70418*** **(0,0980)**	3.613166 (0,7289)
$\pi_t \rightarrow \Delta m3_t$	**19.37176***** **(0,0036)**	2.654433 (0,8508)
$\Delta m3_t \rightarrow \pi_t$	**15.04255**** **(0,0199)**	5.656345 (0,4628)
$\Delta erd_t \rightarrow \Delta m0_t$	**14.36441**** **(0,0258)**	2.908368 (0,8203)
$\Delta m0_t \rightarrow \Delta erd_t$	8.449534 (0,2070)	1.919588 (0,9269)
$\Delta erd_t \rightarrow \Delta m2_t$	8.008775 (0,2375)	4.482265 (0,4823)
$\Delta m2_t \rightarrow \Delta erd_t$	3.641761 (0,7250)	**10.91640*** **(0,0531)**
$\Delta erd_t \rightarrow \Delta m3_t$	4.127389 (0,6594)	1.907797 (0,9280)
$\Delta m3_t \rightarrow \Delta erd_t$	6.425284 (0,3773)	**22.34512***** **(0,0010)**
$\Delta era_t \rightarrow \Delta m2_t$	--	3.541755 (0,7384)

Table 4 continued		
Pair of variables	Pre-crisis (max. lag 6)	Post-crisis (max. lag 6)
$\Delta m2_t \rightarrow \Delta era_t$	--	**13.45219**** **(0,0364)**
$\Delta era_t \rightarrow \Delta m3_t$	--	4.666303 (0,5873)
$\Delta m3_t \rightarrow \Delta era_t$	--	**17.53856***** **(0,0075)**
$\Delta oilp_t \rightarrow \Delta erd_t$	3.501096 (0,7438)	**26.58621***** **(0,0002)**
$\Delta erd_t \rightarrow \Delta oilp_t$	5.261977 (0,5107)	9.365803 (0,1540)
$\Delta oilp_t \rightarrow \Delta ere_t$	--	**12.65581**** **(0,0488)**
$\Delta ere_t \rightarrow \Delta oilp_t$	--	**10.89978*** **(0,0915)**
$\Delta oilp_t \rightarrow \Delta era_t$	--	**19.95727***** **(0,0028)**
$\Delta era_t \rightarrow \Delta oilp_t$	--	**11.66419*** **(0,0699)**
P-value of test-statistics is in parentheses. * denotes H0 being rejected at p-value of 99% ** denotes H0 being rejected at p-value of 95% *** denotes H0 being rejected at p-value of 90%		

Results for the post-crisis subsample are also different in some cases from the results for the full sample. First, for no pair of variables charactarised by cointegration a significant ECM model could be found. Hence, no long-run Granger causality was found for this period. Credit to state-owned firms continues to Granger-cause M0, and the same is true for credit to private non-financial sector and total credit to non-financial sector. This stresses importance of credit for M0 dynamics, and also reflects specifics of the post-crisis period when Bank of Russia continued to support high liquidity in the banking sector, while the latter expressed the need in additional liquidity in part due to continuation and restructuring of credits

issued earlier. As M0 Granger-causes credit to private non-financial sector, this is in line with the abovementioned note on the Bank of Russia policy, suggesting also that banking system was more constrained in reserves than prior to the crisis (mostly due to the loss of some external financing after crisis).

It should be also mentioned that bidirectional Granger causality for aggregates of total credit and credit to private non-financial sector with M2 supports structuralist approach to money supply endogeneity. The one-way Granger causality from M3 to total credit to non-financial sector reflects, in our opinion, the necessity felt acutely by the banking sector after the crisis to close the gap between the share of its assets and liabilities denominated in foreign currency (Fig. 1). Differences are also in that monetary aggregates Granger-cause nominal GDP, and M0 influences inflation, the latter being consequence of (a) liquidity provision by the Bank of Russia after the crisis and (b) devaluation of ruble. One-way Granger causality from monetary aggregates to USD exchange rate and nominal effective exchange rate is explained by the actions of the Bank of Russia on the foreign exchange market balancing its official exchange rate and situation on the money market. Most interesting results, in our opinion, are related to bidirectional Granger causality between oil prices and euro and nominal effective exchange rates that can be explained by the 'third factors' influence, most notably, by oil exporters' sales of their foreign currency denominated revenues[18].

[18] This assumption is supported by the Bank of Russia in its yearly reports of 2010 and 2011.

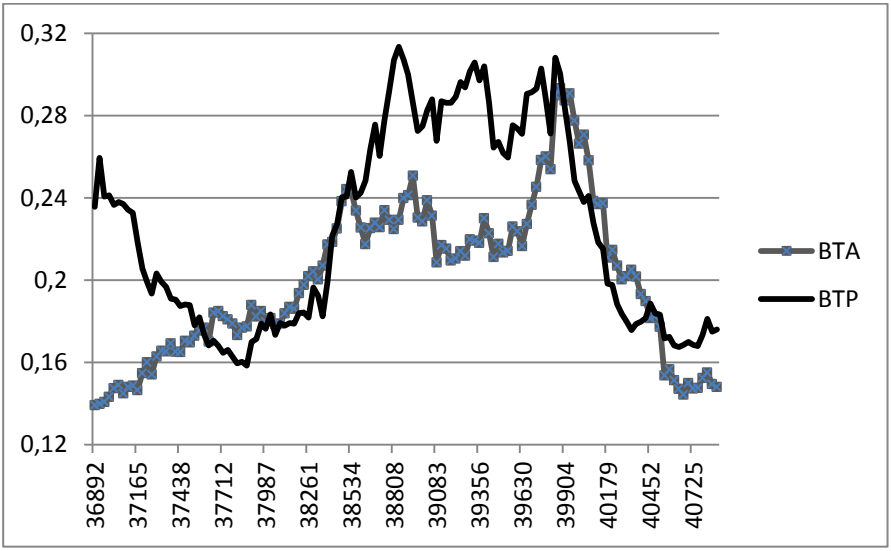

Fig. 1 Share of credits in foreign currency in the total assets of the banking system (BTA) and share of borrowings in the foreign currency in the total liabilities of the banking system (BTP) in 2001-2011. Author's calculations on the basis of Bank of Russia's data (www.cbr.ru).

Results of Granger causality tests on the between-crises sample are summarized in Table 5. They are similar to the results for the full sample; however it contains less confirmations of Granger causality than the full sample. We can confirm that credit to state-owned firms is a long-run Granger-cause of M0, and M0 is a long-run Granger-cause of credit to private non-financial sector. Total credit to non-financial sector is a long-run Granger-cause of M2. Taking into account bidirectional Granger causality for the pairs of 'credit to private non-financial sector – M0', 'total credit to non-financial sector – M0', and 'total credit to non-financial sector – M3' we conclude that credit market is an important factor in M0 and M3 dynamics. M2 Granger-causes nominal GDP. It should be also stressed that inflation Granger-causes M3 with the exception of 12 lags when the causality is bidirectional. USD exchange rate

influences monetary aggregates, but the causality is bidirectional now in most cases. However euro exchange rate and nominal effective exchange rate are Granger-caused by monetary aggregates, and the causality links are not stable (they are found only for some indicators and some lag lengths). We interpret these results as supporting the view that during between-crises period Bank of Russia cared in its operations mostly about the USD exchange rate, partly as a consequence of oil exporters' revenues being USD-denominated.

Table 5. Granger causality tests for the between-crises subsample

Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta cg_t \rightarrow \Delta m0_t$ *ECM*	4.955806 (0,6654) **-0.142419** **[-2.90598]**	6.252024 (0,7145) **-0.142508** **[-2.44422]**	14.40050 (0,2759) **-0.132668** **[-2.20874]**
$\Delta m0_t \rightarrow \Delta cg_t$ *ECM*	10.37076 (0,1685) -0.054945 [-0.85330]	13.40672 (0,1450) 0.019819 [0.25414]	15.03942 (0,2393) -0.042957 [-0.53976]
$\Delta cg_t \rightarrow \Delta m2_t$	2.747082 (0,8399)	9.961783 (0,3536)	13.93427 (0,2367)
$\Delta m2_t \rightarrow \Delta cg_t$	10.02354 (0,1237)	13.87362 (0,1269)	14.28925 (0,2174)
$\Delta cg_t \rightarrow \Delta m3_t$	2.281599 (0,8921)	8.564171 (0,4784)	**20.87114*** **(0,0523)**
$\Delta m3_t \rightarrow \Delta cg_t$	10.16944 (0,1177)	13.08266 (0,1589)	15.99490 (0,1915)
$\Delta cp_t \rightarrow \Delta m0_t$ *ECM*	3.953528 (0.6830) -0.017944 [-1.55575	6.802269 (0.6577) -0.024156 [-1.81813]	7.931346 (0.6355) -0.024729 [-1.76213]

Table 5 continued			
Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta m0_t \rightarrow \Delta cp_t$ *ECM*	9.426670 (0.1510) **0.106372** **[3.32902]**	8.437579 (0.4907) **0.102837** **[2.81545]**	7.391257 (0.6881) **0.117099** **[3.07811]**
$\Delta cp_t \rightarrow \Delta m2_t$	9.488292 (0.3028)	11.55580 (0.2395)	12.79425 (0.3070)
$\Delta m2_t \rightarrow \Delta cp_t$	12.55724 (0.1280)	12.23412 (0.2004)	12.99056 (0.2939)
$\Delta cp_t \rightarrow \Delta m3_t$	**11.00796*** **(0.0881**	**15.03439*** **(0.0900)**	**20.98739*** **(0.0506)**
$\Delta m3_t \rightarrow \Delta cp_t$	**25.73651***** **(0.0002)**	**26.37926***** **(0.0018)**	**32.51917***** **(0.0012)**
$\Delta ct_t \rightarrow \Delta m0_t$ *ECM*	8.175959 (0.2255) **-0.010114** **[-4.11694]**	14.21282 (0.1150) **-0.009422** **[-3.39265]**	**17.24539*** **(0.1000)** **-0.023088** **[-2.50247]**
$\Delta m0_t \rightarrow \Delta ct_t$ *ECM*	8.157135 (0.2268) -0.000739 [-0.09829]	7.728220 (0.5618) 0.005865 [0.71425]	**17.31789*** **(0.0988)** **0.066915** **[2.41462]**
$\Delta ct_t \rightarrow \Delta m2_t$ *ECM*	3.067234 (0.8004) **-0.140457** **[-3.49851**	9.095740 (0.4285) **-0.152417** **[-3.06544]**	13.95199 (0.3038) **-0.123504** **[-2.03272]**
$\Delta m2_t \rightarrow \Delta ct_t$ *ECM*	3.903563 (0.6897) **0.102299** **[1.80160]**	4.857405 (0.8466) **0.141401** **[2.10578]**	7.390162 (0.8308) **0.207326** **[2.56987]**
$\Delta ct_t \rightarrow \Delta m3_t$	**11.47714*** **(0.0747)**	**15.47492*** **(0.0787)**	**19.07019*** **(0.868)**
$\Delta m3_t \rightarrow \Delta ct_t$	**22.06953***** **(0.0012)**	**24.91734***** **(0.0031)**	**25.38745**** **(0.131)**
$\Delta y_t \rightarrow \Delta m2_t$ *ECM*	2.457853 (0.8732) 0.188416 [1.06661]	5.200824 (0.8165) 0.239608 [1.05282]	9.289478 (0.6780) 0.330010 [1.23089]

Table 5 continued			
Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta m2_t \rightarrow \Delta y_t$ *ECM*	**13.31376**** **(0.0383)** **-1.486882** **[-3.97507]**	**15.83382*** **(0.0704)** **-1.625022** **[-3.43042]**	**18.57867*** **(0.0992)** **-1.695898** **[-3.02014]**
$\Delta y_t \rightarrow \Delta m3_t$	0.664849 (0.9952)	3.960509 (0.9140)	4.916966 (0.9607)
$\Delta m3_t \rightarrow \Delta y_t$	2.538609 (0.8641)	6.090439 (0.7308)	9.192799 (0.6864)
$\pi_t \rightarrow \Delta m0_t$	8.030463 (0.2359)	13.87140 (0.1270)	12.24332 (0.4263)
$\Delta m0_t \rightarrow \pi_t$	4.705383 (0.5821)	9.826767 (0.3647)	13.00009 (0.3690)
$\pi_t \rightarrow \Delta m2_t$	3.272213 (0.7740)	8.518714 (0.4828)	12.24056 (0.4266)
$\Delta m2_t \rightarrow \pi_t$	3.790384 (0.7050)	9.053435 (0.4324)	10.43218 (0.5781)
$\pi_t \rightarrow \Delta m3_t$	**12.50250*** **(0,0517)**	**16.43277*** **(0,0584)**	**20.21506*** **(0.0631)**
$\Delta m3_t \rightarrow \pi_t$	3.691838 (0,7183)	13.09213 (0,1585)	**21.33864**** **(0.0456)**
$\Delta erd_t \rightarrow \Delta m0_t$	**14.91753**** **(0,0209)**	**20.71704**** **(0,0140)**	**21.37306**** **(0,0452)**
$\Delta m0_t \rightarrow \Delta erd_t$	8.173267 (0,2257)	9.878598 (03604)	**25.26639**** **(0,0136)**
$\Delta erd_t \rightarrow \Delta m2_t$	5.312817 (0,5044)	**15.90510*** **(0,0689)**	16.70265 (0,1611)
$\Delta m2_t \rightarrow \Delta erd_t$	**10.69557*** **(0,0983)**	8.987601 (0,4384)	14.01977 (0,2994)
$\Delta erd_t \rightarrow \Delta m3_t$	9.257216 (0,1596)	11.51862 (0,2418)	**16.75864*** **(0,0799)**
$\Delta m3_t \rightarrow \Delta erd_t$	**22.31877***** **(0,0011)**	**16.50067*** **(0,0571)**	15.62421 (0,1109)
$\Delta ere_t \rightarrow \Delta m0_t$	7.248999 (0,2984)	11.54977 (0,2399)	12.63380 (0,3962)
$\Delta m0_t \rightarrow \Delta ere_t$	9.425016 (0,1510)	9.548629 (0,3882)	17.67359 (0,1260)

Table 5 continued			
Pair of variables	Max. lag 6	Max. lag 9	Max. lag 12
$\Delta ere_t \rightarrow \Delta m2_t$	1.915861 (0,9273)	7.572456 (0,5777)	7.091744 (0,8515)
$\Delta m2_t \rightarrow \Delta ere_t$	10.03767 (0,1231)	12.35030 (0,1943)	16.70558 (0,1610)
$\Delta ere_t \rightarrow \Delta m3_t$	4.387614 (0.6244)	8.134860 (0.5206)	8.503162 (0.7447)
$\Delta m3_t \rightarrow \Delta ere_t$	7.079120 (0.3136)	11.07940 (0.2703)	**18.68949*** **(0.0963)**
$\Delta era_t \rightarrow \Delta m0_t$	4.327048 (0.6325)	13.30649 (0.1492)	15.30981 (0.2249)
$\Delta m0_t \rightarrow \Delta era_t$	**11.47663*** **(0.0747)**	10.58343 (0.3053)	17.63928 (0.1271)
$\Delta era_t \rightarrow \Delta m2_t$	0.992169 (0.9859)	7.457295 (0.5896)	7.000182 (0.8576)
$\Delta m2_t \rightarrow \Delta era_t$	8.769340 (0.1870)	9.390419 (0.4020)	17.15155 (01440)
$\Delta era_t \rightarrow \Delta m3_t$	4.862724 (0.5615)	8.751294 (0.4605)	8.332162 (0.7587)
$\Delta m3_t \rightarrow \Delta era_t$	6.332549 (0.3870)	7.547597 (0.5803)	14.62256 (0.2627)
P-value of test-statistics is in parentheses. * denotes H0 being rejected at p-value of 99% ** denotes H0 being rejected at p-value of 95% *** denotes H0 being rejected at p-value of 90% In square parentheses value of t-statistics for ECM coefficient is presented.			

Conclusions and policy recommendations

Summary of results from the four different sub-samples analyzed is presented in Table 6. Granger causality tests involving total credit to non-financial sector support endogenous money supply in the understanding of structuralist approach, exception being full sample, for which accommodationist view is supported by the data. Our explanation of such contradiction in results is that full sample

includes two crisis periods. Interestingly, for credit to state-owned firms the data support accommodationist approach also for the case of between-crises sample. This reinforces our hypothesis that credits to state-owned firms are largely guaranteed by the authorities of some level. Summarizing overall results we can claim that empirical data support money supply endogeneity in Russia in 1995-2011.

Table 6. Summary of Granger causality tests results on all sub-samples

	Accepted monetary theory			
Credit aggregate	*Full sample*	*Pre-crisis sample*	*Between-crises sample*	*Post-crisis sample*
Credit to state-owned firms	accommoda-tionist approach	inconclusive	accommoda-tonist approach	inconclusive
Credit to private non-financial sector	inconclusive weak indications in favor of accommoda-tionist approach	accommoda-tionist approach	structuralist approach /creditist view	structuralist approach /creditist view
Total credit to non-financial sector	accommoda-tonist approach	structuralist approach /creditist view	structuralist approach /creditist view	structuralist approach /creditis view

The results received justify some recommendations concerning monetary policy in Russia. First of all, credit does play an

important role in defining monetary aggregates throughout the whole studied period. And it should be stressed that credit to state-owned firms unilaterally causes money base and monetary aggregates. This suggests that Bank of Russia should carefully control credit activities of the banking system, paying a special attention to state-owned firms' credit dynamics. This is topical also in light of high growth rates of credit both to state-owned firms and to private non-financial sector. It might be useful for the Bank of Russia to consider introduction of specific reserve requirements related to composition of a bank's assets as is suggested by some post-Keynesians (Palley 2004). Such additional reserve requirements, linked to types of credit will allow Bank of Russia flexibility in transmission of monetary policy on to the real sector of economy. Importance of credit aggregates for monetary aggregates dynamics can be also regarded as an implicit indication of credit channel of monetary policy transmission, existence of which was confirmed by other studies (e.g. Sokolov 2009).

Secondly, our results confirm that base interest rate (refinancing rate) is a more effective instrument of monetary policy than targeting money base or monetary aggregates. In addition to acknowledged by the Bank of Russia weakening relation between monetary aggregates and inflation, our results suggest that the Bank of Russia should continue and develop further short-term interest rate management practice. Interest rate management will be more effective in influencing credit extended in the economy, and through it – in influencing monetary aggregates, aggregate demand and inflation. This recommendation is reinforced by the one-way Granger causality from inflation to M3. Similar results can be found in other studies on Russia (Esanov et al. 2004).

If we turn our attention to the ‘conflict of interests’ mechanism described in post-Keynesian monetary theory, we should mention that its functioning reminds very much the situation in Russia in most of 1990s after price liberalization. The first wave of price increases was based on psychological considerations of people from the deficit economy, e.g. ‘buy while there is something to buy’ and ‘increase prices while you have what to sell’. Next waves of price increases were related in the 1990s to government announcements of increases of wages or social transfers. The results when inflation influences money base and monetary aggregates rather than otherwise can be fitted into the reasoning described above.

Comparing our results with those of other empirical studies of money supply endogeneity in other countries and other periods it should be noted that post-Keynesian hypothesis of endogenous money supply is confirmed in many countries, under various monetary policy regimes and at different periods of time, making post-Keynesian monetary theory an obvious candidate for improving our understanding of money sphere in our economies.

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Appendix 1. Granger causality tests

The present explanation of Granger causality tests follows exposition in Charemza and Deadman (1997, pp. 166-167, 190).

Let U_t denote information set that includes all past and current information existing by the moment t; X_t denote information set that includes all past and current information in existence on a variable x by the moment t. That means $X_t = \{x_1, x_2, \ldots, x_t\}$; $X_t \subset U_t$. Let y_t be the current value of variable y ($y_t \in U_t$), and $\tilde{y}_t$ to denote an unbiased forecast of the value of y_t.

Then Granger causality definition can be formulated as follows. If $MSE(\tilde{y}_t | U_{t-1}) < MSE(\tilde{y}_t | U_{t-1} \setminus X_{t-1})$ then $x \rightarrow y$ (x Granger-causes y). Instant causality definition can be expressed as follows. If $MSE(\tilde{y}_t | U_{t-1} \setminus y_t) < MSE(\tilde{y}_t | U_{t-1} \setminus X_{t-1}, y_t)$ then $x \Rightarrow y$. MSE stands here for mean square error of the forecast. Granger causality test is based on the straight econometrics testing if Granger causality definition is true for a pair of variables. Assume that y can be decscribed by the following unconstrained VAR-model:

$$y_t = A_0 D_t + \sum_{j=1}^{k} \alpha_j y_{t-j} + \sum_{j=1}^{k} \beta_j x_{t-j} + \varepsilon_t$$

where D_t includes deterministic components (constant, deterministic trend, seasonal dummies etc.) and ε_t stands for error term.

Then we can say that x is not Granger-cause of y if $\beta_1 = \beta_2 = \ldots = \beta_k = 0$. The latter statement can be varified using the Wald test.

If the two variables x and y, Granger causality between which is in question, are known to be cointegrated, then VAR-model of Granger causality test is modified to include residuals from cointegrating

euqation, and the definition of Granger causality is also modified. A following VAR-model is estimated:

$$\begin{bmatrix} \Delta x_t \\ \Delta y_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} \times [\hat{u}_{t-1}] + \begin{bmatrix} r_1 & r_2 \\ r_3 & r_4 \end{bmatrix} \times \begin{bmatrix} \Delta x_{t-1} \\ \Delta y_{t-1} \end{bmatrix} + \begin{bmatrix} \xi_{1t} \\ \xi_{2t} \end{bmatrix}$$

where u_t stands for residuals of cointegrating euqation. In this case we can define long-run Granger causality: x is long-run Granger-cause of y if (1) x_t and y_t are cointegrated and (2) $\alpha_2 \neq 0$. And x is short-run Granger-cause of y if $\gamma_3 \neq 0$.

It has been shown in econometric literature that results of causality tests can be different depending on the lag lengths (Feige and Pearce 1979; Batten and Thornton 1985). At the same time lag length is difficult to choose a-priori, on the basis of theoretical considerations (Bishop: 1979). Hence it is considered best to estimate several models with different lag lengths to confirm Granger causality (Pinga and Nelson 2011). We used 6, 9 and 12 lags where data allowed for such lag lengths, or just 6 lags for short sub-samples.

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