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Monetary Regimes and the Real Economy

(Empirical Tests before and after the Introduction of the Currency Board in Bulgaria)

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Abbreviations

ADF	*Augmented Dickey − Fuller test*
AIC	*Akaike information criterion*
BK filter	*Baxter − King filter*
BN decomposition	*Beveridge − Nelson decomposition*
CB	*Currency board*
DS	*Difference stationary*
HP filter	*Hodrick − Prescott filter*
ISI	*Industrial sales index*
PP	*Phillips − Perron test*
RBC	*Real business cycle*
RSI	*Retail sales index*
TS	*Trend stationary*
VAR	*Vector autoregression*

MONETARY REGIMES AND THE REAL ECONOMY

Empirical Tests before and after the Introduction of the Currency Board in Bulgaria

SUMMARY. THIS PAPER PROVIDES ELEMENTS OF A RESPONSE TO A LONG-DEBATED ISSUE IN ECONOMICS ON THE SOURCES OF SHOCKS AND THE DIRECTION OF THE RELATIONSHIP BETWEEN REAL ECONOMY AND MONETARY VARIABLES. IN MODERN LITERATURE THIS DISCUSSION BOILS DOWN TO THE FOLLOWING EXTREME VIEWS: "THE DIRECTION OF IMPULSES MOVES FROM MONEY TO REAL VARIABLES" AND "THE DIRECTION OF IMPULSES MOVES FROM REAL VARIABLES TO MONEY." DURING THE PERIOD UNDER REVIEW BULGARIA EXPERIENCED A SHIFT IN THE MONETARY REGIME: FROM DISCRETIONARY CENTRAL BANK TO A STATIC CURRENCY BOARD (CB). EMPIRICAL DATA MAKES IT POSSIBLE TO ANALYZE THE EFFECT OF THIS INSTITUTIONAL CHANGE ON REAL SECTOR DYNAMICS. THE PRESENT STUDY WILL HELP CLARIFY A QUESTION OF PRESENT INTEREST FOR BULGARIA: DOES THE CB INHIBIT REAL SECTOR DEVELOPMENT OR NOT? THE STUDY IS A SKETCH OF THE DISCUSSION OF WHAT THE CB CAN AND CANNOT DO. THERE ARE FOUR THEORETICAL VIEWS ON THE REAL – MONETARY RELATIONSHIP: THE MONETARIST THEORY (FRIEDMAN – SCHWARTZ), THE THEORY OF RATIONAL EXPECTATIONS (LUCAS – BARRO), THE REAL BUSINESS CYCLE THEORY (RBC) AND THE AUSTRIAN ANALYSIS (MISES, HAYEK). THE HYPOTHESIS THAT THE CB HAS A LIMITED INFLUENCE ON THE REAL ECONOMY IS CONFIRMED. MONTHLY DATA FOR THE PERIOD JANUARY 1995 – MARCH 1999 IS USED.

JEL classification: E32, E42, E51

Keywords: monetary regimes, currency boards, money – income causality, reverse causation

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It is indeed evident that money is nothing but the representation of labor and commodities, and serves only as a method of rating or estimating them. Where coin is in greater plenty, as a greater quantity of it is required to represent the same quantity of goods, it can have no effect, either good or bad – any more than it would make an alteration on a merchant's books, if, instead of the Arabian method of notation, which requires few characters, he should make use of the Roman, which requires a great many.

D. Hume, Of Money, 1752, p. 32

I. Objects of the Study

The traditional and most commonly used argument against the currency board relates to the following: as the CB restricts money supply and a growing economy needs more money, real sector development is therefore inhibited (implicitly assuming that impulses come from money to the real economy). This critique builds on the quantity theory of money: **MV = PY**, where **M** is the money supply, **V** is the velocity of money, **P** is the general price level and **Y** is the volume of domestic output[1]). Dynamization of the above equation by inclusion of rates highlights the critique against the CB: $\dot{m}/m + \dot{v}/v = \dot{p}/p + \dot{y}/y$. The opponents of CB argue that with constant velocity of money (i.e. stable money demand – for unknown reason) a possible constraint on money supply may lead to a slower growth and/or deflation[2].

The assertion that the CB is restrictive contradicts logic because in practice the CB may restrict as well as increase money supply. Therefore it acts symmetrically.

A more appropriate point of attack on the CB may be seen in money supply *volatility* rather than the direction of money supply movement because with any failed attempt at sterilization (replacement of external sources of reserve money with domestic in order to preserve reserve money) a change in net foreign assets may cause shocks in the money supply.

It should be noted that the CB requires full liberalization of all markets and variables except for the exchange rate. The purity of this mechanism ensures automatic balance of money demand and supply mainly through interest rate and price movements.

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[1] *Without going into detail we state that the equation on exchange as well as the more sophisticated versions of the quantity theory give a wrong idea of the mechanisms by which money affects the behavior of economic agents. For more detail, see* ***Mises*** *(1912).*

[2] *Under this monetary regime, deflation is an indication of the smooth operation of the CB rather than a signal of severe restriction. It indicates that prices are flexible and the economy adjusts through the real, not through the nominal variables (****Tsang, S.****, 1999).*

Also, it is often argued that CB positive effects are limited to the achievement of a temporary financial stabilization.

In practice, attacks against the CB have never been substantiated, the specific channels of the CB effect on economic activity have never been identified and criticism has never been tested empirically.

From the beginning we would like to note that the present analysis is not aimed at studying the business cycle in Bulgaria after the economic changes evolving since the early 1990s, i.e. this study *does not adhere completely to the real business cycle theory*. The objective of this study is different and relates to the following two assumptions.

First, the theoretical interpretation and empirical testing of the direction and magnitude of the relationship between monetary and real macroeconomic variables under different monetary regimes over the period 1991 – 1999 (prior to the introduction of the CB and thereafter).[3] Determining the direction of impulses from real to monetary economy and/or vice versa makes it possible to draw certain conclusions on the efficiency of different economic policies. *In this paper we are not concerned with the channels of monetary and real sector interaction and assume them as existent.*

Second, defining a possible scope of action by monetary authorities and selecting the optimum[4] monetary regime. We derive from the assumption that the optimum monetary regime should be based on clear evidence of the relationship and the direction of the relationship between money and real economy. If impulses move from the real sector to money, then the problems of the Bulgarian economy are entirely structural (microeconomic) and cannot be solved through monetary measures. The optimum monetary regime may be that regime which leads to price stability and provides stimuli for individual agents at a

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[3] *During the review period two monetary regimes are identified. The first, within the period 1991 − June 1997, is a regime of discretionary monetary policy which comes closest to the pragmatic approach to monetary policy described in literature. The second period, from July 1997 until now, is a period of currency board rules. In monetary rules literature this regime is considered as a private case of exchange rate targeting. For detailed presentation of monetary regimes, see* ***Mishkin, F.*** *(1999). The two periods − prior to the introduction of the CB and after that − may be also viewed as regimes of floating (controlled) and fixed exchange rate respectively. This gives the opportunity of comparing the direction of the monetary − real causality under the two regimes. A similar study on the efficiency of monetary policy under a floating and fixed exchange rate for the USA, Germany and France is made by* ***Bruno, C.*** *(1997).*

[4] *We use the word 'optimum' because it is widely and commonly used, being fully aware that it is impossible to measure the optimum in an economy. At an individual level, it is subjective and at macro level it results from unintentional relationships between economic agents. See* ***Salin*** *(1990, 1991).*

micro level in order to overcome structural disequilibria[5].

We would like to note that *the results obtained and conclusions drawn refer to the operation of the Bulgarian monetary regimes during the review period.* These results should not be automatically transferred to other countries or other periods in the development of the Bulgarian economy.

There is also the question of whether the argument of CB creating hard budget constraints on economic agents (government, financial institutions, households) contradicts the argument that it follows real economy movement. Such contradiction is irrelevant because the idea of the CB is to leave economic agents 'alone' in the market, i.e. to reduce additional shocks on the real sector that may be triggered by the central bank and its discretionary monetary policy.

II. Theoretical and Methodological Fundamentals of the Study

Four Theoretical Interpretations of Money – Income Causality

One of the earliest discussions in economic theory relates to money and real economy causality. In modern literature this debate boils down to the following two extreme views: "impulses come from money to real variables" and "impulses come from real variables to money", as well as to many intermediate assertions. Although this issue may seem minor at first sight, its answer is of crucial importance for economic policy, particularly monetary policy[6]. Depending on the answers to this question four trends may be distinguished in economics literature: the monetarists, the theory of rational expectations, the real business cycle and the Austrian analysis. We intentionally do not concern the

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[5] *In support of our thesis we will cite the architect of the Argentine currency board* ***D. Cavallo****: "... Macroeconomic stabilization was just the starting point. The real core of the program was its insistence on* ***microeconomic reform****. By that, we mean a series of structural changes geared at reducing or eliminating distortions in goods and factor markets. The extent and depth of* ***microeconomic reform*** *in Argentina between 1991 and 1996 was unprecedented, maybe greater than in any other country during the similar time span."*

[6] *On the importance of this discussion, see the general studies on this issue:* ***Ahmed, S.*** *(1993);* ***Backus, D., P. Kehoe*** *(1992);* ***Bergman, B., M. Bordo, L. Jonung*** *(1998);* ***Blanchard, O.*** *(1990);* ***Christiano, L., M. Eichenbaum, Ch. Evans*** *(1998);* ***Fuhrer, J., S. Schuh*** *(1998);* ***Leeper, E., Ch. Sims, T. Zha*** *(1996);* ***Boschen, J. F, L. O. Mills*** *(1995);* ***Beandry, P, M. Saito*** *(1998);* ***Mc Candless, G., W. Weber*** *(1995);* ***Bernanke, B., I. Mihov*** *(1995, 1998);* ***Thoma, M.*** *(1994).*

Keynesian approach pleading for discretionary monetary policy because in our opinion the inconsistency of this approach has been proved both from a theoretical and practical point of view[7].

According to the ***monetarist*** view, money supply dynamics is the major source of real income volatility[8]. The well-known analysis of the monetary history of the United States by *Friedman* and *Schwartz* (1963) was a pioneering work in this respect. By studying carefully the behavior of time series of money supply and income, they found that money supply changes precede income changes. Hence they drew the theoretical conclusion that money causes real sector movement. Subsequently their methodology was applied to almost all developed countries. For this theory to be capable of sending messages to monetary policy, some auxiliary theoretical hypotheses had to be adopted. The first states that money demand is a function of permanent income (*Friedman – permanent income hypothesis*). The second identifies monetary policy neutrality in the long run as well as growing influence of income volatility under discretionary monetary policy (*Friedman, 1969*). The message to monetary policy is clear: it should be governed by a definite rule which in Friedman's theory boils down to permanent money supply growth.

The second step in the attack against discretionary monetary policy is the *Lucas* approach and the theory of rational expectations. Monetary policy is *super neutral*, i.e. it is neutral even in the short run. Here impulses also come from money to the real economy but the shocks in money supply are divided into anticipated and unanticipated. The ***Lucas*** critique *(1976)* may be used as an auxiliary theorem. It states that economic agents are rational (take into account the whole set of information, not only the dynamics of the observed variable) and therefore monetary policy is inefficient because the parameters of the model incorporate economic expectations and are not permanent. Shocks come only from the unanticipated component of money supply which

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[7] *Of course, the search for nominal and real rigidities by the new Keynesians continues (**Blanchard, O.**, 1990). Over the recent years efforts have been made to synthesize the different 'neo' trends (**Goodfriend, M., R. King,** 1997). These efforts explained by the desire to build a theory which all economists would expound are not only irrelevant but also methodologically wrong. They do build on the logic of social science development and reveal utter ignorance of economics methodology. The specificity of social sciences is that the impulse for their development comes from diversity and inner competition.*

[8] *For detailed presentation of the monetarist theory on money supply and real income causality, see: **Friedman, M., A. Schwartz** (1963); **Friedman, M.** (1969); **Tobin, J.** (1970); **Lucas, R.** (1994); **Romer, Ch., D. Romer** (1994); **Hoover, K., S. Perez** (1994); **Smith, B.** (1994); **Miron, J.** (1994).*

surprises agents and they cannot distinguish general price level movement from relative prices movement[9]. The *Sargent – Wallace* model is based on the *Lucas* approach, stating that monetary policy does not have a systematic effect on the real economy (1975).

The third wave of attacks is related to the ***real business cycle*** theory[10] which makes monetary policy entirely senseless. In this case impulses come from the real economy to money, the latter following closely real sector dynamics. Money enters the production function. It follows real sector development (*reverse causation*) and adapts to different kinds of shocks, triggered mainly from supply. In these models money supply is endogenous and monetary policy tools are inefficient and have no systematic effect on economic agents.

Within the real business cycle theory the major transmission channels of real shock influence on money are two: through transaction services of banks and financial intermediaries and through the expectations of economic agents. In the first case the dynamics of deposits (called *secondary money*) reflects real sector development and the optimum behavior of economic agents. Deposits and financial services enter the production function. Impulses from the real economy pass through secondary money and reach the monetary base (*primary money*). In the second case economic agents' expectations about income and production dynamics cause changes in demand for money and credit and hence in the money supply.

The fourth, and probably the most severe criticism of monetary policy and monetary variables manipulation was that launched by the ***Austrian analysis*** (*Menger, K., Mises, L., Hayek, F, Selgin, G., Salin, P.*)[11]. Although chronologically this approach originated first, at the beginning of the century, it took almost a century to rediscover it. In practice, the first three analysis schemes may be viewed as consistent denunciation of the traditional Keynesian scheme of money management and as restoration of early century monetary analysis. The Austrian analysis is an orderly constructed system which relates money to individual choice, consumption, savings and investment. Any manipulation

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[9] *For detailed presentation, see:* ***Barro, R.*** *(1977, 1978, 1981);* ***Lucas, R. E.*** *(1972, 1975, 1976, 1996);* ***Lucas, R., T. Sargent*** *(1979);* ***Sargent, T., N. Wallace*** *(1975).*

[10] *For detailed presentation of the models on the real business cycle, see:* ***Kydland, F, Ed. Prescott*** *(1982, 1990);* ***Long, J., Ch. Plosser*** *(1983);* ***King, R., Ch. Plosser*** *(1984, 1994);* ***Prescott, Ed.*** *(1986, 1998, 1999);* ***Plosser, Ch.*** *(1989);* ***McCallum, B.*** *(1990);* ***King, R., S. Rebelo*** *(1998);* ***Farmer, R.*** *(1997).*

[11] ***Menger, K.*** *(1892),* ***Mises, L.*** *(1912, 1928),* ***Hayek, F.*** *(1931, 1933),* ***White, L.*** *(1984, 1995),* ***Selgin, G.*** *(1988),* ***Salin, P.*** *(1990).*

of money supply destroys the fundamental principles of economic choice. Money is not neutral and its dynamics is decisive for real sector trajectory. It influences real economy through the output structure and relative prices, being the chief information signal.

Money *nonneutrality* exists both in the short and in the long run. Hayek, for example, considers that the quantity theory is not only wrong but it does not state anything about money influence. First, according to him (Mises's interpretation is similar), a double increase in money supply does not result in a double increase in the general level of prices even in the long run because money growth changes the structure of relative prices and all behavioral variables of individuals, i.e. the very structure of cash stock is changed. And second, the quantity theory has no practical value as it does not show how the new money supply distorts the structure of relative prices. Hayek singles out two key proportions: the ratio between prices of capital goods and consumer goods and the ratio between the nominal and the natural interest rate. The central bank and monetary policy not only cause inflation or deflation (both are equally harmful); the point is they destroy the system of relative prices by injecting or withdrawing liquidity. The Austrian analysis states that the most appropriate system leading to optimization of the quantity of money is the system of private, competitive money. Only in this case money supply fluctuations arising from money demand and supply have a disruptive effect on the real economy.

Under ***currency board*** the central bank has no monetary policy tools at its disposal and therefore it is unable to 'shock' money supply[12]. The latter is a result of developments in the balance of payments (change in the monetary base) and real economy behavior (change in the multiplier). Thus passive money supply additionally enhances the importance of studying the direction of monetary – real impulses because it is crucial to know whether money adjusts rapidly to changes in the real economy. If it does, then *any criticism of the static character of the currency board is irrelevant*.

Empirical and Statistical Methodology

On the Variables Used as Approximators of Real Income

In examining the relationship between real and monetary variables as approximators of real economy development we use monthly sales

[12] *We will not consider here the possibilities of government deposit affecting reserve money. This is comprehensively examined in:* ***Nenovsky, N., K. Hristov, 1998***.

income in industry and net sales income in trade.[13] This is prompted by the lack of monthly data on gross domestic product and industrial output index which may serve as approximators of GDP. The analyzed period is short and we cannot use quarterly data on GDP dynamics which is available since 1994.[14] Availability of data on the above-mentioned variables which we use as approximators of real activity in the economy determines the period of our study (January 1995 – March 1999).

On the Definition of Money

In terms of money supply indicators, in this paper we use the conventional division of monetary aggregates (reserve money, quasi-money, broad money) well-known in monetary statistics, as well as the division of *money into primary and secondary*, introduced by *Rolnick and Weber*. Such division of money is logically consistent and the change in the monetary regime in Bulgaria with the introduction of the currency board does not make it impossible to examine relationships between real and nominal variables because of data inconsistency. Dividing money depending on whether it is determined by the real economy's behavior or the government's policy eliminate the shortcomings of traditional monetary aggregates.

For the purposes of the analysis we introduce the following division of the components of money supply over the review period: *determined by monetary authorities and determined by real economy development (by the behavior of households and firms*[15]). Following the *Rolnick, We-*

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[13] *We are aware of the statistical incompleteness of these indicators. This implies to statistics characteristics in general. Monetary statistics also has its shortcomings. The real sector dynamics can be measured by survey indicators such as business climate, assessment of production activity, instability of the economic environment, plans for investment,* et al. *Such series of data exist and will be used in a forthcoming sequel of this article.*

[14] ***Chow*** *and* ***Lin*** *(1971) derive a procedure through which quarterly data may be distributed over the months of the respective quarter so as to generate monthly data on the analyzed variable. Data available in Bulgaria does not allow us to apply this paradigm to generate monthly GDP data on the basis of available official data on a quarterly basis. For a short description of this paradigm, see also* ***Robertson, J., E. Tallman*** *(1999).*

[15] *The importance of dividing money into primary and secondary may be seen in the theories describing fiduciary and commodity money.* ***Tobin, J.*** *(1963) proved the importance of fiduciary money considering commercial banks as financial intermediaries creating circulation funds (bank deposits − secondary money), which are fundamentally different from those created by the government (primary money).* ***Wallace, N.*** *(1977) formalizes J. Tobin's approach using the so-called overlapping generation models. Other conditions being equal, changes in growth rates of primary money lead directly to changes in inflation rates. This is not true for the commercial banks (secondary money). Banks change their liabilities when there is a change in technology and propensity to saving and investment in the economy. As a result, changes in bank li-*

ber approach (1995, 1997) we define the first as *primary money* and the second as *secondary money*.[16]

The ***first type*** includes reserve money over the period of discretionary monetary policy (1991 – July 1997) and minimum required reserves of commercial banks after the introduction of the currency board (without excess reserves). The government deposit in the balance sheet of the Issue Department, as shown in *Nenovsky, N., K. Hristov* (1998), affects indirectly primary money and may be viewed as a real shock affecting it. For the real economy the behavior of primary money is exogenously set and is determined by the preferences of those implementing economic policy.

The ***second type*** arises spontaneously from the needs of households, companies and financial intermediaries. In terms of volume this component encompasses the better half of money supply: banknotes (when unconditionally exchanged for reserve currency or a good in commodity money), all types of deposits, and part of commercial banks' reserves (excess reserves). In this study we have included in secondary money all types of deposits over the period preceding the introduction of the currency board. After June 1997 secondary money consists of banking system deposits and banknotes and coins in circulation (as these are unconditionally exchanged for the reserve currency).[17]

At a constant level of minimum required reserves primary money is a function of the indirect influence of the government deposit in the balance sheet of the Issue Department and secondary money. Then the only channels for discretion in money supply management are the central bank's policy in respect of minimum reserves and the government's policy in respect of revenue and expenditure (management of the government's deposit with the BNB).

On the Statistical Techniques

In the analysis of the relationship between real and monetary variables we use a wide range of statistical and econometric techniques following the chronology of development of the theories expounding the

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abilities may not be related to changes in inflation. When these are related, the nature of the relationship (positive or negative) will be determined by the nature of changes in fundamentals. In other words, impulses are triggered from the real economy to secondary money.

[16] *For detailed presentation of the division into primary and secondary money, see:* ***Rolnick, A., W. Weber*** *(1995).* ***Rolnick, A., W. Weber*** *(1997). Such a division is a kind of accommodation of inside and outside money made initially by* ***Gurley, Shaw*** *(1960).*

[17] *Banknotes and coins under a currency board arrangement are exchangeable for other fiduciary money (the reserve currency) which in practice is primary money for the country whose currency has been chosen as reserve.*

relationship between monetary and real variables. First we examine the dynamics of the two types of variables over the periods of the two monetary regimes. Examination of their variances provides us with the answer of their relative stability over the two periods. Meanwhile we analyze the correlation of monetary series (at levels and growth rates) with the variables approximating real economic activity (monthly sales incomes in industry and net sales income in trade).

After reviewing the volatility and correlation between real and monetary variables in the spirit of the monetarist approach, we seek to answer the question of whether changes in monetary aggregates precede changes in real variables. In this study we analyze the relationship between cyclical components of the series describing the monetary and the real sectors of the economy. To this end, we separate the series into cyclical and trend components using *Hodrick – Prescott* filter (*Hodrick – Prescott, 1996*)[18]. We examine the cyclical components derived to establish whether changes in the cyclical part of money supply precede changes in the cyclical part of the variables describing the real sector, i.e. we seek to answer the question whether money supply is pro-cyclical or anti-cyclical.

In checking the theories of rational expectations and the real business cycle we apply the widely used in recent years econometric approach of *vector autoregression (VAR)*. This approach, introduced in econometric analysis by *Sims* (1972, 1980, 1992), does not divide variables into endogenous and exogenous as in structural econometrics[19].

In applying the theory of rational expectations following *Barro's* approach (1976, 1977, 1978) we divide changes in money supply into anticipated and unanticipated and check through the *impulse response function* how these components would affect the variables used by us as

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[18] *We leave aside the imperfections of this filter. In the analysis we take into account that series also contain a seasonal component and that is why we clear them from its influence. Decomposition of variables is detailed in the third section of this paper.*

[19] *With VAR models every variable is presented as a linear function of its past values, the past values of the other variables and components with nonrandom behavior as constant and time trend. As results obtained from VAR models are very sensitive in terms of model specification (levels or first differences; presence or absence of constant and trend), the characteristics of series should be examined carefully. Therefore series should be examined to determine whether they are* ***trend stationary*** *or* ***difference stationary****. We use ADF (or PP)* ***unit root test****. Before constructing the VAR models we test variables for cointegration (****Johansen Cointegration Test****). For detail description of VAR models, see:* ***Sims, Ch.*** *(1980, 1986, 1992, 1998);* ***Todd, T.*** *(1990);* ***Rudenbusch, G.*** *(1998);* ***Hamilton, J.*** *(1994);* ***Cochrane, J.*** *(1998);* ***Robertson, J., E. Tallman*** *(1999);* ***Evans, Ch., K. Kuttner*** *(1998);* ***Abadir, K., K. Hadri, E. Tzavalis*** *(1999);* ***Bagliano, F., C. Favero*** *(1997);* ***Favero, C.*** *(1998);* ***Bernanke, B., I. Mihov*** *(1995);* ***Faust, J.*** *(1998) It is also important to trace the variables in the vector in terms of exogenous order.*

real sector approximators. In contrast to *Barro*, we do not use a structural model for estimation of the anticipated component of money supply[20]. The assumption on which we build upon in using the *time series* method for the estimation of the anticipated component of monetary aggregates is that the estimate is a function only of the realized values of that variable in previous periods. At the same time we reckon that the already realized levels of money supply contain in themselves the *full information* on macroeconomic variables. Building on this logic, through the ARIMA model [21] we generate the anticipated component of individual monetary aggregates once we derive the unanticipated component (by subtraction) from real data. The next step involves, through the *impulse response function*, assessment of the influence of the anticipated and unanticipated components of monetary aggregates on variables, used as approximators of real economic activity.

While the above theories assumed that impulses come from monetary variables to real ones, the real business theory postulates *reverse causation*. Here we apply the *Granger causality test* within the VAR model and variance decomposition to determine to what extent the cyclical component of real variables causes cyclical recurrence in monetary aggregates and vice versa. After we define the direction of impulses through the *Granger causality* and *variance decomposition* we use the *impulse response function* to estimate the size of the effect on monetary variables caused by changes in real variables and vice versa.

III. The Models

Variables and Statistical Data

The present study uses monthly data for the period January 1995 – March 1999. Data is provided from the BNB monetary statistics on reserve money, quasi-money and broad money. The variables which we use as approximators of the real economy development are: the retail sales index at constant prices (1995 = 100) and the industrial sales index against average monthly sales in 1997 as basis. Calculations of primary and secondary money are made by the authors based on monthly data of BNB monetary survey (for description of the components of primary and secondary money and data on these series, see Appendix 2).

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[20] *See* ***Barro*** *(1976, 1977, 1978).*

[21] *Detailed description of the unit root tests is presented in the other section of this paper where models and results obtained are described.*

The analysis of this period points to the fact that two different monetary regimes existed in Bulgaria during the period under review: discretionary monetary policy and currency board rule-bound policy. From the point of view of *Lucas* critique (1976) the change in monetary regimes requires analysis of data and relationships in different subperiods as a result of the so-called *regime shifts* which makes the assumption of constant coefficients impossible.[22] Following this logic we examine the relationships between real and monetary variables in the two subperiods: January 1995 – June 1997 under discretionary monetary policy and July 1997 – March 1999 under the currency board.[23] The following variables are used:

PM – primary money
SM – secondary money
M0 – reserve money
M1 – narrow monetary aggregate
M3 – broad money (money supply)
QM – quasi-money
E – monthly average BGL/USD exchange rate
P – price level (December 1994 = 100)
IR – base interest rate
IIR – interbank interest rate
IS – industrial sales index (ISI) based on average monthly sales in 1997
RS – retail sales index (RSI) at constant prices (1995 = 100).

In constructing the models the above variables (without interest rates) are presented in logarithm (the small capitals of the above variables in the text mean the logarithm of that series).

Series Decomposition and Unit Root Test

We assume the analyzed series as having cyclical component, seasonal component and trend. Before decomposing the series into trend and cyclical component we adjust the seasonally variable series. Sea-

[22] *For more detail, see* ***Lucas, R. E.*** *(1976).*

[23] *On the other hand, the insufficient number of observations may lead to somewhat biased results. In theoretical literature there are studies which prove that models which do not incorporate changes in parameters, despite the regime shift, produce better results than models which incorporate changes in parameters due to regime shifts. For further detail, see:* ***Sims, Ch.*** *(1998).*

sonal adjustment removes the seasonal factor and makes it possible to decompose series into cyclical component and trend. After the seasonal adjustment the series look like this:

$$y_t = y_t^g + y_t^c \qquad t = 1, \ldots, T,$$

where

$\mathbf{y}_t$ is the series;
$\mathbf{y}^{\mathbf{g}}_{\mathbf{t}}$ is the series trend;
$\mathbf{y}^{\mathbf{c}}_{\mathbf{t}}$ is the cyclical component of the series.

The purpose of series decomposition is to separate the cyclical component of reviewed series and to examine the relationships and directions of influence between the cyclical components of monetary and real variables.[24] In this study we use the *Hodrick – Prescott filter*[25] to derive the cyclical component of the analyzed variables (see Appendix 2 for the graphical presentation of decomposed series). We subtract the trend generated through the HP filter from initial values to obtain the cyclical component of the respective series. The series obtained are stationary provided that initial series are trend stationary.

Being aware of the importance of whether initial series are trend stationary or difference stationary we check the variables for stationarity (unit root test) before detrending them.[26] If *trend stationary,* shocks have a temporary effect and a return to the trend occurs, while under *difference stationary* series shocks have a permanent effect. When initial series comprise a unit root, cyclical components are also non-stationary. Therefore, the latter are examined for stationary at first differences *(difference stationary* (DS). If initial series do not contain a unit root, cyclical components obtained after the elimination of the trend are stationary and we use these variable levels.

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[24] *In practice various techniques for isolation of a stationary cyclical component are used. These approaches are:* ***two-sided moving average****; first differences; clearing from linear or square time trend;* ***Kalman filter****;* ***BN decomposition****,* ***HP filter****;* ***BK filter****,* ***Beveridge, S., Ch. Nelson*** *(1981). Comparison of the advantages and disadvantages of the above-mentioned approaches and development of a new method for decomposition of nonstationary series into trend and cyclical component are presented in* ***Baxter, M., M. King*** *(1995).*

[25] *See* ***Hodrick, R., Ed. Prescott*** *(1977). For assessment of approaches to detrending economic series and analysis of HP filter see* ***King, R., S. Rebelo*** *(1993);* ***Hamilton*** *(1994);* ***Cogley, Nason*** *(1995);* ***Guay, A. P. St-Amant*** *(1996);* ***Ehlgen, J.*** *(1998).*

[26] *See* ***Nelson, Ch., C. Plosser*** *(1982);* ***Caporale, G., C. Hassapis, N. Pittis*** *(1998);* ***Hamilton, J.*** *(1994);* ***McCallum, B.*** *(1993);* ***Murrey, Ch., Ch. Nelson*** *(1998);* ***Phillips, P., Z. Xiao*** *(1998);* ***Rudebusch, G.*** *(1992);* ***Gil-Alana, L., P. Robinson*** *(1997).*

Critical values (McKinnon Critical Value – PP) *without constant and trend are as follows: for 1% (-2.66), 5% (-1.95) and 10% (-1.62).*[27]

Table 1

Variables	*PP* test			Integration and lags	
monthly data	levels	*1Δ*	*2Δ*	*I*	lags
PM	*0.68*	*-7.15*		*1*	*3*
SM	*1.48*	*-3.68*		*1*	*3*
M0	*1.17*	*-2.37*		*1*	*3*
M1	*3.14*			*0*	*3*
MQ	*-1.51*	*-5.43*		*1*	*3*
M3	*-0.85*	*-4.35*		*1*	*3*
E	*-0.98*	*-4.63*		*1*	*3*
P	*-1.11*	*-4.29*		*1*	*3*
IS	*0.11*	*-5.19*		*1*	*3*
RS	*-0.64*	*-6.02*		*1*	*3*

Results of the tests suggest that all reviewed series are **I(1)** by the first series without constant and trend with the exception of the monetary aggregate **M1** which is **I(0)** in all test combinations.

Variability of Real and Monetary Variables and Correlation between Them

Table 2

Variability of Real and Monetary Variables

	Standard Deviation		
	Whole Period	**Before CB**	**After CB**
RS	0.19	0.17	0.12
IS	-	-	0.10
Nominal money stock			
Primary money	*0.63*	*0.68*	*0.18*
Secondary money	*1.15*	*0.70*	*0.09*
Reserve money			
Nominal	1.34	0.73	0.14
Real	0.39	0.50	0.10
M1			
Nominal	1.45	0.74	0.21
Real	0.39	0.49	0.17

[27] *The optimum number of lags is determined through the minimization of the AIC criterion. Unit root tests with trend and constant display similar results.*

Quasi-money			
Nominal	0.97	0.69	0.07
Real	0.61	0.51	0.02
Broad money (M3)			
Nominal	1.10	0.71	0.10
Real	0.49	0.48	0.05
Interest rate			
Base interest rate	1.64	1.02	0.08
Interbank interest rate	2.10	0.98	0.24
Price level			
Consumer price index	1.57	1.18	0.11
Exchange rate	1.48	1.22	0.10

The review of the dynamics of major monetary variables in real and nominal terms in the periods prior to and after the introduction of a currency board indicates absolutely divergent behavior, reflecting the different philosophy of these two monetary systems. Variability comparison between the two periods of monetary variables rejects the traditional criticism of the currency board, associated with high variability of monetary aggregates and the interest rate under this monetary system (*Roubini, N., 1998*). This criticism is based on the logic that capital inflows and outflows reflect directly on the dynamics of reserve money, money supply and interest rates under the currency board arrangement and existing capital market globalization. Therefore, economists criticizing the currency board on the basis of particular theoretical assumptions think that a discretionary monetary policy is able to neutralize these shocks and to stabilize money supply and the interest rate. Data from Table 2 reveals that these accusations against the currency board are unjustified, and the discretionary monetary policy pursued between 1995 and 1997 had a destabilizing rather than a stabilizing effect (resulting in high variability of monetary aggregates, inflation and interest rates). Undoubtedly, the low variability of monetary aggregates and the interest rate may be explained by the lack of complete liberalization of the capital account and significant capital inflows in Bulgaria. Low capital inflows atypical of the countries under a currency board pose another question which partly relates to the subject of this paper: is a currency board arrangement enough credible for Bulgaria? Do countries like Bulgaria need more radical arrangement (dollarization)?[28]

[28] *The countries under a currency board arrangement are traditionally characterized by significant capital inflows.* ***Kaminsky, G., L. Leiderman (1998)*** *consider high real interest rates in the countries under a currency board as a signal of insufficient confidence in these countries to maintain this monetary system. Real interest rates in Bulgaria do not indicate such dynamics*

In addition, the low variability of monetary aggregates during the period of currency board operation may be explained by the role of the government deposit in the Issue Department balance sheet. In our article of 1998 *(Nenovsky, N., K. Hristov, 1998)* we focused on the opportunity to pursue a quasi monetary policy through government deposit management. On the other hand, due to government deposit inclusion in the Issue Department balance sheet, shocks caused by foreign debt payments may be absorbed by this deposit which helps avoid their direct effect on reserve money and money supply. That is the government deposit has a stabilizing impact by smoothing fluctuations in reserve money, money supply and interest rates.

Variability of the retail sales indices by which the real economy is approximated are relatively similar in both periods, while the period after the introduction of a currency board indicates lower volatility than in the previous period. Stabilization of price levels and interest rates (evidenced by lower volatility of these variables following the introduction of a currency board) reflect the lower variability of the retail sales index after the introduction of a currency board.

Table 3

Correlation between Monetary Variables and Retail Sales Index

	Whole Period	Before CB	After CB
RS	1.00	1.00	1.00
IS	0.81	0.98	0.75
Nominal money stock			
Primary money	*-0.17*	*-0.85*	*-0.15*
Secondary money	*0.01*	*-0.99*	*0.42*
Reserve money			
Nominal	-0.04	-0.74	0.10
Real	0.50	0.89	0.30
M1			
Nominal	-0.23	-0.86	-0.07
Real	0.56	0.90	0.42
Quasi-money			
Nominal	-0.05	-0.99	0.47
Real	0.23	0.73	-0.15

but very low capital inflows in the country pose the question about the credibility of the currency board in Bulgaria.

Broad money (M3)			
Nominal	-0.03	-0.99	0.47
Real	0.39	0.75	0.34
Interest rate			
Base interest rate	-0.10	-0.27	0.07
Interbank interest rate	-0.13	-0.41	-0.03
Price level			
Consumer price index	-0.30	-0.90	0.03
Exchange rate	0.004	-0.97	0.48

Table 4

Correlation between Monetary Variables and Industrial Sales Index

	Whole Period	Before CB	After CB
RS	-	-	0.75
IS	-	-	1.00
Nominal money stock			
Primary money	-	-	*-0.30*
Secondary money	-	-	*0.34*
Reserve money			
Nominal	-	-	0.21
Real	-	-	0.49
M1			
Nominal	-	-	0.04
Real	-	-	0.57
Quasi money			
Nominal	-	-	0.19
Real	-	-	-0.10
Broad money (M3)			
Nominal	-	-	0.28
Real	-	-	0.46
Interest rate			
Base interest rate	-	-	-0.09
Interbank interest rate	-	-	-0.10
Price level			
Consumer price index	-	-	-0.17
Exchange rate	-	-	0.24

Data from Tables 3 and 4 indicating the correlation between monetary variables and indices approximating the real economy reject the view that the real economy may be influenced through money supply management. Prior to the introduction of the currency board both indi-

ces were negative, correlated with all monetary aggregates, the exchange rate and inflation. This rejects the broadly acknowledged view that monetary policy can stimulate real sector growth. The negative relationship between retail sales index and industrial producer price index, and inflation confirms the view that price stability achieved under a currency board arrangement is the major prerequisite for a sustainable real sector growth[29].

Tables 3 and 4 confirm the hypothesis of a stronger relationship between secondary money and the real economy. Following the introduction of a currency board the tie of primary money to the **RS** and **IS** significantly weakened. The correlation between changes in monetary aggregates and these in real variables is negative. This suggests that currency management has an adverse (as it limits) rather than stabilizing and stimulating effect on the real economy. Lower correlation of primary money after the introduction of a currency board may be considered as a positive sign: the 'adverse' effect on the dynamics of both indicators of the real economy diminishes. These correlation characteristics are similar in secondary money: the 'repressive' effect of primary money on the real economy cannot be completely overcome although it is minimized.

Similar tendency occurred in the price impact on the real economy. Price movements may have both a stimulating and repressive effect on the real sector. Following the introduction of a currency board the repressive effect weakened dramatically which is evidenced by the two tables. After the peg of the lev to the Deutschemark (euro) USD/BGL exchange rate movements indicate a positive correlation with the real economy.

Monetarist Interpretation of Impulse Direction in the Economy

As we have already mentioned in the second section of this article, the monetarist view on the relationship between real and monetary variables may be summarized in the following two statements: first, changes in the volume of money are the major factor determining the business cycle (they precede, cause and are positively related to changes in the real income). Second, changes in the volume of money

[29] *Actually, this thesis was recognized in the economic theory long ago and any suspicion in Bulgaria signals poor knowledge of the conception on the role of the central bank and monetary policy in modern economic theory. For more detail, see:* ***Taylor, J.*** *(1997),* ***Fischer, S.*** *(1997),* ***Christiano, L., M. Eichenbaum, Ch. Evans*** *(1998).*

precede and are the major reason behind the general price level growth.[30]

Only the first statement is subject to study in this paper. It describes the relationship *between money supply dynamics and 'real' activity*. The methodology of the following two tables is similar to that of *Kydland, F., E. Prescott (1990).* However, they study the correlation only between lags in cyclical components within the framework of the real business cycle theory.

The following three tables present the correlation between the retail sales index and major monetary variables before and after the introduction of a currency board, and the correlation between the industrial sales index and major monetary variables after the introduction of a currency board (no data is available prior to the introduction of a currency board). Correlation dynamics is analyzed by *6 leads* and *6 lags*. When the correlation is (0), the series are not correlated, when it is close to (+1) they are positively correlated, and when the correlation is close to (-1) they are negatively correlated. **X(t)** is the current correlation (synchronous correlation).

The first two tables show that the correlation between the retail sales index and monetary variables prior to the introduction of a currency board is significantly greater and negative (the increase in monetary variables leads to a sales decline), while after the introduction of a currency board it is lower and positive (the increase in monetary variables leads to a growth in the index). The assumption that the correlation of the retail sales index with secondary money is much stronger than with primary money under both monetary systems is confirmed. It should be highlighted that secondary money is endogenous and it follows the real economy dynamics. The current correlation **[X(t)]** of the retail sales index with primary money is (-0.85) prior to the introduction of a currency board and (+0.02) after its introduction, and the correlation with secondary money is (-0.99) and (+0.46), and the correlation with prices (-0.90) and (+0.36) respectively.

The current correlation with the industrial sales index after the introduction of a currency board is as follows: with primary money (-0.24) and secondary money (+0.36), that is the increase in primary money results in a decline in the sales index, while secondary money is synchronous with the industrial sales index.

[30] *James Tobin rejects that* post hoc ergo propter hoc.

Table 5

Correlation between Monetary Variables and Retail Sales Index (January 1995 – June 1997)

	Correlation												
Variable X	**X (t-6)**	**X (t-5)**	**X (t-4)**	**X (t-3)**	**X (t-2)**	**X (t-1)**	**X (t)**	**X (t+1)**	**X (t+2)**	**X (t+3)**	**X (t+4)**	**X (t+5)**	**X (t+6)**
Primary money	0.40	0.55	0.31	0.29	0.28	0.11	-0.85	-0.07	-0.08	-0.32	-0.49	0.95	-0.19
Secondary money	-0.04	0.20	0.33	0.21	0.39	-0.36	-0.99	0.37	0.25	0.40	0.26	-0.89	-0.31
Reserve money	0.01	0.24	0.41	0.23	0.83	-0.43	-0.74	-0.15	-0.35	0.54	-0.36	-0.90	-0.22
M1	-0.05	0.41	0.36	-0.03	0.48	0.54	-0.86	0.07	-0.38	0.18	0.18	-0.82	-0.79
Quasi-money	0.04	0.25	0.40	0.24	0.24	-0.32	-0.99	0.56	0.68	0.55	-0.49	-0.53	-0.04
Broad money (M3)	0.01	0.24	0.37	0.21	0.33	-0.32	-0.99	0.60	0.48	0.56	-0.11	-0.70	-0.29
Exchange rate	0.22	0.12	0.59	0.07	0.19	-0.47	-0.97	0.37	0.24	0.95	-0.57	-0.62	-0.04
Consumer price index	-0.04	0.05	-0.02	0.26	0.31	0.25	-0.90	-0.75	-0.11	-0.46	0.39	0.67	-0.48

Table 6

Correlation between Monetary Variables and Retail Sales Index (July 1997 – March 1999)

	Correlation												
Variable X	**X (t-6)**	**X (t-5)**	**X (t-4)**	**X (t-3)**	**X (t-2)**	**X (t-1)**	**X (t)**	**X (t+1)**	**X (t+2)**	**X (t+3)**	**X (t+4)**	**X (t+5)**	**X (t+6)**
Primary money	0.90	-0.03	-0.01	-0.12	-0.09	-0.24	0.02	0.21	0.19	0.15	0.41	-0.15	-0.60
Secondary money	-0.11	-0.06	-0.13	-0.09	0.009	0.18	0.46	0.48	-0.32	-0.01	-0.03	-0.16	0.28
Reserve money	-0.02	0.08	0.11	0.03	0.03	-0.02	0.26	0.24	-0.06	0.28	0.03	0.19	0.25
M1	-0.11	0.02	0.07	0.08	0.03	0.01	0.13	0.32	-0.09	0.21	0.23	0.03	0.46
Quasi-money	0.12	-0.06	-0.22	-0.26	0.008	0.24	0.53	0.64	-0.24	-0.09	-0.006	-0.17	0.04
Broad money (M3)	0.07	-0.08	-0.17	-0.18	-0.03	0.15	0.56	0.55	-0.29	-0.001	0.007	-0.21	0.12
Exchange rate	0.11	-0.08	-0.24	-0.21	0.004	0.18	0.57	0.46	-0.43	-0.04	0.09	-0.23	0.05
Consumer price index	0.28	0.008	-0.09	-0.25	-0.21	-0.04	0.36	0.87	-0.03	-0.13	-0.07	-0.15	-0.04

Table 7

Correlation between Monetary Variables and Industrial Sales Index (July 1997 – March 1999)

	Correlation												
Variable X	**X (t-6)**	**X (t-5)**	**X (t-4)**	**X (t-3)**	**X (t-2)**	**X (t-1)**	**X (t)**	**X (t+1)**	**X (t+2)**	**X (t+3)**	**X (t+4)**	**X (t+5)**	**X (t+6)**
Primary money	0.63	-0.36	0.27	-0.07	-0.27	0.11	-0.24	0.41	0.007	-0.03	0.34	-0.11	-0.41
Secondary money	-0.11	0.24	-0.28	0.14	0.26	-0.09	0.36	0.24	-0.40	0.32	-0.13	-0.09	0.54
Reserve money	0.17	0.19	-0.03	0.29	0.10	-0.03	0.35	0.09	-0.18	0.44	-0.27	0.40	0.15
M1	-0.14	0.31	-0.05	0.20	0.22	-0.04	0.24	0.26	-0.26	0.41	0.08	-0.13	0.63
Quasi-money	0.01	0.15	-0.24	0.05	0.20	0.06	0.13	0.48	-0.41	0.18	0.007	-0.19	0.40
Broad money (M3)	0.001	0.15	-0.24	0.11	0.20	-0.01	0.29	0.37	-0.41	0.30	-0.08	-0.15	0.48
Exchange rate	0.10	0.07	-0.34	0.20	0.12	-0.06	0.22	0.33	-0.45	0.22	-0.02	-0.21	0.41
Consumer price index	-0.008	0.19	-0.11	-0.15	0.14	0.12	-0.05	0.60	-0.39	0.17	0.03	-0.27	0.35

A more significant positive (leading) correlation with past periods of primary money (prior to the introduction of a currency board) suggests that shocks on the exogenous part of money supply contributed to the real sector drop (Table 5).

Secondary money caused less fluctuations in retail sales. After the introduction of a currency board (Table 6) the adverse effect of secondary money has been overcome but a strong correlation of retail sales index with the sixth lag of primary money occurred (+0.90). This could be interpreted as relatively greater significance of a shock on primary money after the introduction of a currency board due to relatively calm economic agents under this monetary regime. The first following lag of secondary money is positively correlated with the current value of the retail sales index (+0.48), that is impulses come from the real economy to secondary money.

It should be noted that above tests (based on the correlation study) do not indicate causation but only functional dependence which is the major disadvantage of these tests.

The Theory of Rational Expectations and the Relationship between Real and Monetary Variables

Testing the relationship between monetary and real variables within the theory of rational expectations, we use the Barro's approach (1978) by dividing money supply growth into anticipated and unanticipated. The relationship between obtained money supply components and real variables is studied, seeking to answer whether the anticipated money supply component is neutral in respect of the real economy. The anticipated money supply component which is not subject to direct study[31] is assessed through the ARIMA model. Projected values obtained are considered as anticipated money supply growth rates and the difference between realized rates and anticipated rates appears as the unanticipated component of money supply growth.

Tested major VAR models are summarized in the table below. All variables are in logarithms and first differences (see stationary tests).[32]

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[31] *The test of this hypothesis is impeded by the fact that economic agents' expectations could not be directly reviewed, i.e. no data on the anticipated money supply component could be obtained. The assessment approach applied to anticipated and unanticipated money supply components is presented in Appendix 3.*

[32] *VAR models and results from the tests are available and may be obtained at request (E-Views 3.1 format).*

Model	Variables	Lags[33]
VAR (1)	rs, pmf, smf	4
VAR (2)	is, pmf, smf	4
VAR (3)	rs, m0f, qmf, m3f	4
VAR (4)	is, m0f, qmf, m3f	4
VAR (5)	rs, upm, usm	4
VAR (6)	is, upm, usm	4
VAR (7)	rs, um0, uqm, um3	4
VAR (8)	is, um0, uqm, um3	4

Tables 8, 9 and 10 display the results of the relationship (studied through VAR models) between the anticipated component of monetary aggregates composed by us (primary and secondary money) and indices of retail sales and industrial sales in the periods prior to and after the introduction of a currency board. The neutrality of anticipated components of primary and secondary money on both indices approximating the real economy, postulated in the theory of rational expectations, is confirmed to a great extent by the impulse response and variance decomposition. Prior to the introduction of a currency board shocks caused by monetary variables had a significant and constant effect on retail sales index which rejects the hypothesis of neutrality of primary and secondary money. Since the introduction of a currency board the shocks on anticipated components of monetary variables have an insignificant and quickly subsiding effect, with the variance of indices of retail sales and industrial sales accounting for a small percentage (see variance decomposition). The only exception of this are impulses resulting from the anticipated component of primary money to the industrial sales index which has a cyclical behavior and gradually subsided. The neutrality of these shocks on the anticipated component of primary money is also rejected by the fact that they account for approximately 40% of the variance of industrial sales. Actually, this result is expected under a currency board arrangement since the dynamics of primary money is impacted to a great extent by the balance of payments dynamics.[34]

[33] *The optimum number of lags is determined by minimizing the AIC criterion. For discussion on the optimum structure of lags under VAR models see:* ***Kamas*** *(1995).*

[34] *Here, as proved by* ***Nenovsky, N., K. Hristov****, the role of government deposit management in the Issue Department balance sheet should be also taken into account. Given the government's policy of maintaining a relatively constant deposit level (to a great extent attributable to exter-*

On the other hand, the strong dependence of industry on external markets and correspondingly the impact of industrial sales on the balance of payments and primary money establishes the interdependence of both variables.

Table 8

Effect of Anticipated Components of Primary and Secondary Money on Retail Sales Index (January 1995 – June 1997)

	Impulse Response			Variance Decomposition		
Period	D(LRS)	D(LPMF)	D(LSMF)	D(LRS)	D(LPMF)	D(LSMF)
1	0.050976	0.000000	0.000000	100.0000	0.000000	0.000000
2	0.034429	0.008395	-0.014047	93.39067	1.739330	4.870004
3	-0.016002	0.000449	-0.026515	80.62151	1.410378	17.96811
4	-0.012030	0.006660	0.004777	80.12146	2.202444	17.67610
5	-0.007728	-0.011222	-0.001733	78.43193	4.452713	17.11536
6	-0.009567	-0.026858	0.004536	69.43028	15.40906	15.16066
7	0.024733	-0.007513	0.024008	66.06051	13.60223	20.33726
8	0.012085	0.011953	-0.007212	65.04946	14.83460	20.11594
9	-0.009964	0.001885	-0.021193	61.95041	13.90015	24.14944
10	0.008143	0.009817	-0.008176	61.06914	14.64883	24.28203
11	-0.009941	-0.004223	-0.008966	60.82500	14.52362	24.65138
12	-0.009806	-0.020968	0.010303	57.71078	18.18917	24.10004

Table 9

Effect of Anticipated Components of Primary and Secondary Money on Retail Sales Index (July 1997 – March 1999)

	Impulse Response			Variance Decomposition		
Period	D(LRS)	D(LPMF)	D(LSMF)	D(LRS)	D(LPMF)	D(LSMF)
1	0.099929	0.000000	0.000000	100.0000	0.000000	0.000000
2	-0.004132	-0.014232	0.012540	96.52777	1.954681	1.517552
3	-0.017114	-0.021498	-0.000522	92.60431	5.978787	1.416906
4	-0.056014	0.019878	0.005914	91.47213	7.216985	1.310888
5	-0.008587	0.001548	-0.006914	91.20449	7.172775	1.622733
6	0.031194	0.019739	0.002973	89.48744	8.972745	1.539811
7	0.030075	-0.011405	-0.008840	88.95980	9.147554	1.892644
8	0.015073	-0.012216	0.000797	88.34725	9.796896	1.855855
9	-0.032517	-0.005700	-0.000390	88.85024	9.400914	1.748844
10	-0.006795	0.004167	0.007574	88.52587	9.432695	2.041434
11	-0.021703	0.010589	0.002246	88.27070	9.723629	2.005668
12	0.025450	0.001017	-0.004481	88.55537	9.405848	2.038785

nal restrictions: so-called performance criteria established by the IMF) in the three-year stand-by agreement, we have disregarded this effect.

Table 10

Effect of Anticipated Components of Primary and Secondary Money on Industrial Sales Index (July 1997 – March 1999)

	Impulse Response			Variance Decomposition		
Period	D(LIS)	D(LPMF)	D(LSMF)	D(LIS)	D(LPMF)	D(LSMF)
1	0.061045	0.000000	0.000000	100.0000	0.000000	0.000000
2	-0.027259	0.024226	0.003303	88.20265	11.58207	0.215279
3	0.000655	-0.044042	0.013642	62.13870	35.12252	2.738781
4	0.015670	0.028109	0.000139	57.30234	40.30333	2.394332
5	-0.021504	-0.005607	-0.014239	58.01091	37.51015	4.478942
6	0.015581	-0.015680	0.000902	57.57369	38.17157	4.254740
7	-0.004327	0.015612	0.006315	55.97516	39.49205	4.532790
8	-0.000616	-0.011497	0.002133	55.20018	40.28393	4.515897
9	0.007029	0.009650	-0.001123	54.90053	40.63590	4.463576
10	-0.009485	-0.001169	-0.005154	55.14999	40.17583	4.674179
11	0.005804	-0.007950	0.001490	54.94471	40.40471	4.650577
12	-0.002268	0.007264	0.002797	54.64345	40.65959	4.696958

The results of the VAR model on the effect of assessed anticipated components of standard monetary aggregates in monetary statistics (reserve money, quasi-money and broad money) on the variables approximating the real economy indicate similar results to these obtained by dividing money into primary and secondary. The hypothesis of neutrality of quasi-money and broad money to the retail sales index proved true prior to the introduction of a currency board. Shock response indicates an insignificant and quickly subsiding effect of shocks caused by these monetary variables the retail sales index. Concurrently, the results suggest a significant effect of changes in the anticipated reserve money component on the retail sales index, which rejects the hypothesis of neutrality of these shocks on the real economy.

The function of shock response indicates that the shock caused by reserve money in the first three periods results in a sales decrease, and three periods are required for subsiding of the shock. The results after the introduction of a currency board show neutrality of anticipated reserve money component, quasi-money and broad money. Certain impact of the impulses coming from reserve money occurs, but their effect was weaker than that in the period of discretionary monetary policy (less than 20% accounting for the variance of the retail sales index).

The analysis of the relationship between monetary aggregates and the industrial sales index under a currency board arrangement indicates neutrality of anticipated broad money component and lack of neutrality in respect of reserve money and quasi-money. As was explained, this result is natural and entirely based on the logic of money supply under a currency board.

Table 11

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (January 1995 – June 1997)

	Impulse Response				Variance Decomposition			
Period	D(LRS)	D(LM0F)	D(LQMF)	D(LM3F)	D(LRS)	D(LM0F)	D(LQMF)	D(LM3F)
1	0.042964	0.000000	0.000000	0.000000	100.0000	0.000000	0.000000	0.000000
2	0.020701	-0.018854	0.006708	0.000258	85.02675	13.28868	1.682089	0.002484
3	-0.017041	-0.037736	0.003737	-0.002643	58.15507	40.34821	1.336782	0.159936
4	-0.014305	-0.002792	-0.002316	-0.009265	58.75026	37.91471	1.364499	1.970536
5	-0.024755	0.002527	-0.005113	-0.002135	63.05682	33.43988	1.686568	1.816734
6	-0.006194	0.002605	-0.018840	0.008493	58.61181	30.85027	7.632123	2.905796
7	0.058825	0.008396	-0.013875	0.007456	71.56490	19.45848	6.634694	2.341926
8	0.038514	-0.022559	0.009740	-0.002535	71.43748	20.32582	6.258644	1.978054
9	0.001268	-0.043745	0.010404	-0.003143	60.87911	31.24337	6.120261	1.757256
10	-0.013678	-0.007138	-0.001830	-0.008036	60.88496	30.92560	6.010812	2.178635
11	-0.057819	0.009239	-0.000879	-0.005531	67.94796	25.30180	4.827404	1.922841
12	-0.044829	0.017409	-0.016846	0.001382	69.16185	23.53928	5.615022	1.683844

Table 12

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (July 1997 – March 1999)

Period	Impulse Response				Variance Decomposition			
	D(LRS)	D(LM0F)	D(LQMF)	D(LM3F)	D(LRS)	D(LM0F)	D(LQMF)	D(LM3F)
1	0.076148	0.000000	0.000000	0.000000	100.0000	0.000000	0.000000	0.000000
2	-0.005791	-0.022615	0.001070	-0.019841	86.55063	7.590274	0.017005	5.842095
3	-0.018650	-0.013722	0.004090	-0.008465	83.93362	9.503910	0.242724	6.319748
4	0.002943	-0.005372	-0.005320	-0.003881	83.13791	9.788267	0.620356	6.453463
5	-0.011487	0.042775	-0.006366	0.016529	65.03144	26.32271	0.892117	7.753737
6	-0.053171	-0.015274	0.007238	0.004885	71.15581	21.71479	1.081928	6.047468
7	0.065949	0.005897	0.010203	0.015755	76.72108	16.06621	1.382440	5.830267
8	-0.026465	-0.006686	-0.023785	-0.032982	71.01920	14.36206	4.046430	10.57231
9	0.052212	0.011579	0.019474	0.022959	71.23443	12.64937	5.001263	11.11493
10	-0.061745	-0.046365	-0.001782	-0.023297	68.51328	17.03226	3.936313	10.51814
11	0.096198	0.048914	-0.005022	0.012724	71.23622	17.92788	2.889759	7.946133
12	-0.158368	-0.051214	-0.007550	-0.027556	77.98243	14.40184	1.803426	5.812306

Table 13

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Industrial Sales Index (July 1997 – March 1999)

	Impulse Response				Variance Decomposition			
Period	D(LIS)	D(LM0F)	D(LQMF)	D(LM3F)	D(LIS)	D(LM0F)	D(LQMF)	D(LM3F)
1	0.043463	0.000000	0.000000	0.000000	100.0000	0.000000	0.000000	0.000000
2	-0.034221	0.031079	-0.003874	-0.015536	71.45839	22.55484	0.350473	5.636299
3	0.009283	-0.015046	0.042512	0.005665	48.89890	18.53005	28.32094	4.250108
4	0.034413	0.029685	-0.038289	-0.006187	43.28795	20.72639	32.86944	3.116222
5	-0.068382	-0.031418	0.017204	0.003670	56.37356	19.15644	22.43443	2.035571
6	0.044313	0.009947	0.012188	0.022973	58.61577	16.88167	19.94500	4.557556
7	0.001212	0.000785	-0.008104	-0.036990	54.44607	15.68173	18.84961	11.02259
8	-0.009216	0.018933	-0.022359	0.022625	51.17220	16.28465	19.89392	12.64924
9	0.005262	-0.032286	0.065061	-0.002977	41.17735	16.94352	31.69302	10.18611
10	0.017545	0.058943	-0.071912	-0.010970	31.65169	22.32485	38.07096	7.952497
11	-0.046216	-0.068516	0.076430	-0.000859	27.79846	26.15782	40.16058	5.883141
12	0.065940	0.075457	-0.083944	0.022752	26.97431	27.80016	40.12423	5.101305

The results of the VAR model on the relationship between unanticipated components of primary and secondary money and the two indices approximating the real economy entirely reject the thesis of the theory of rational expectations about the effect of unanticipated changes in money supply on real variables. In both periods prior to and after the introduction of a currency board unanticipated components of primary and secondary money are neutral in respect of retail and industrial sales indices (with the exception of the impact of unanticipated component of primary money on the industrial sales index after the introduction of a currency board). These results confirm the thesis of super neutrality of money and contradict to some extent the results obtained from the test of the relationship between anticipated components of monetary aggregates and real variables (in some cases reserve money and primary money are not neutral).

The results are also impacted by the manner of generating anticipated and unanticipated components of monetary aggregates. The use of the ***time series*** approach (ARIMA) may result in improper assessment of anticipated components of monetary aggregates with unanticipated components being included in anticipated ones.[35]

Table 14

Effect of Unanticipated Components of Primary and Secondary Money on Retail Sales Index (January 1995 – June 1997)

	Impulse Response			Variance Decomposition		
Period	D(LRS)	D(UPM)	D(USM)	D(LRS)	D(UPM)	D(USM)
1	0.062126	0.000000	0.000000	100.0000	0.000000	0.000000
2	0.040105	-0.011396	0.002218	97.59427	2.317919	0.087816
3	-0.022683	-0.007292	0.012791	94.44961	2.889766	2.660626
4	-0.016867	0.003509	0.002439	94.42759	2.943487	2.628922
5	-0.017159	0.013494	0.017460	88.45038	5.088153	6.461464
6	-0.017164	0.005068	-0.008477	87.78133	5.161495	7.057174
7	0.016720	-0.009786	-0.018229	83.77090	5.857073	10.37202
8	0.013490	-0.007663	0.001941	83.51059	6.363752	10.12565
9	0.006331	0.010291	0.001270	82.57711	7.446864	9.976026
10	0.007341	-0.003327	0.001524	82.55850	7.514378	9.927126
11	-0.014037	-0.004854	0.008400	82.09087	7.532587	10.37654
12	-0.013093	0.003900	0.000285	82.28283	7.544683	10.17248

[35] *Studying these dependences* ***Barro, R.*** *(1978) used a structural model for assessment of the anticipated component of monetary aggregates. Money supply growth is estimated as a function of past growth rates of money supply and unemployment and current changes in the variable reflecting the fiscal sector state. In this study the R. Barro's approach is not applied due to diffi-*

Table 15

Effect of Unanticipated Components of Primary and Secondary Money on Retail Sales Index (July 1997 – March 1999)

	Impulse Response			Variance Decomposition		
Period	D(LRS)	D(UPM)	D(USM)	D(LRS)	D(UPM)	D(USM)
1	0.102522	0.000000	0.000000	100.0000	0.000000	0.000000
2	-0.015025	0.009915	0.030497	91.25900	0.835528	7.905475
3	-0.017712	-0.013925	-0.013327	88.75587	2.347097	8.897029
4	0.008381	-0.007983	-0.011719	87.41517	2.797940	9.786894
5	-0.032788	0.014722	0.011559	86.20665	4.048101	9.745249
6	0.019039	-0.003795	-0.008564	86.03092	4.021904	9.947174
7	0.004603	-0.000422	0.005539	85.86988	4.008830	10.12129
8	-0.017436	0.001319	-0.003695	86.06857	3.934910	9.996522
9	0.021536	-0.003382	-0.000359	86.42247	3.887863	9.689671
10	-0.001641	0.003204	0.007588	86.04688	3.936374	10.01674
11	-0.018606	0.000368	-0.005793	86.16838	3.843147	9.988474
12	0.016644	-0.004689	-0.003251	86.23174	3.905390	9.862868

Table 16

Effect of Unanticipated Components of Primary and Secondary Money on Industrial Sales Index (July 1997 – March 1999)

	Impulse Response			Variance Decomposition		
Period	D(LIS)	D(UPM)	D(USM)	D(LIS)	D(UPM)	D(USM)
1	0.067948	0.000000	0.000000	100.0000	0.000000	0.000000
2	-0.034563	0.013087	0.014708	93.74742	2.762798	3.489783
3	0.001536	-0.016208	-0.012259	87.89651	6.560920	5.542569
4	0.014932	-0.015989	0.006559	84.59594	9.663721	5.740339
5	-0.025919	0.024909	-0.005409	79.32084	15.48985	5.189306
6	0.011476	-0.014133	9.69E-05	77.82784	17.17845	4.993712
7	0.006953	0.005628	0.001588	77.64869	17.37563	4.975684
8	-0.011857	-0.001515	-0.002657	77.91647	17.11230	4.971231
9	0.012527	0.002862	0.005476	77.96970	16.83891	5.191386
10	-0.006441	-0.002571	-0.003049	77.93454	16.80599	5.259474
11	-0.006955	0.000320	0.000412	78.04677	16.71938	5.233849
12	0.014715	-0.001337	-0.002881	78.46215	16.34130	5.196548

culties in finding a sufficiently reliable variable to estimate Bulgaria's fiscal sector state on a monthly basis.

If conventional monetary aggregates (reserve money, quasi-money and broad money) are used, the results are different from these obtained by dividing money into primary and secondary (which is explained by different methodological approaches in constructing monetary aggregates). In the period of conducting a discretionary monetary policy unanticipated components of monetary aggregates are neutral in terms of the retail sales index. Shocks caused by monetary aggregates affect significantly the retail price index and their effect is of permanent and cyclical nature. In general these shocks explain to a great extent the variance of retail sales, increasing to about 60% twelve months after their emergence. In the period of currency board operation unanticipated components of quasi-money and broad money are neutral in respect of retail and industrial sales indices. In real terms these indices are impacted only by unanticipated changes in reserve money, and the effect of shocks caused by reserve money is permanent and displays a cyclical dynamics.

The Real Business Cycle Theory and the Reverse Causation Test

The real business cycle theory postulates a reverse causation: from real to monetary variables. Here a causation test within the VAR model *variance decomposition* is applied to estimate the degree of cyclical recurrence in monetary aggregates and vice versa caused by the cyclical component of real variables. After the impulse direction and variance decomposition have been determined, the size of the effect prompting changes of real variables in monetary ones and vice versa is to be estimated using the impulse response function.

For this purpose we use the *Wald test* (similar to Granger test but displaying also indirect causation in case of more than two variables[36]) testing the hypothesis of zero-coefficients before monetary variables. Rejecting this hypothesis we assume that cyclical components of monetary variables cause a cyclical recurrence in the real economy. Acceptation of the null hypothesis allows to assume that impulses are generated most probably by the real economy to monetary variables.

[36] *See the review article about various approaches applied for empirical test of causation by* ***Bruneau*** *(1996).*

Table 17

Effect of Unanticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (January 1995 – June 1997)

	Impulse Response				Variance Decomposition			
Period	D(LRS)	D(UM0)	D(UQM)	D(UM3)	D(LRS)	D(UM0)	D(UQM)	D(UM3)
1	0.035123	0.000000	0.000000	0.000000	100.0000	0.000000	0.000000	0.000000
2	0.035408	0.006792	-0.018001	-0.010627	83.73623	1.553043	10.90865	3.802086
3	-0.001185	-0.008599	-0.012101	-0.003310	77.69589	3.748599	14.68765	3.867865
4	-0.002193	-0.026984	-0.005168	0.007433	62.05850	21.10935	12.37367	4.458485
5	0.005379	0.000272	-0.003326	-0.002277	62.07938	20.87611	12.50812	4.536386
6	-0.016031	-0.000252	0.002456	0.000582	64.23939	19.60658	11.88602	4.268014
7	0.002852	0.011321	0.023054	-0.015460	53.26450	18.65823	19.98168	8.095583
8	-0.007028	0.018949	0.011106	0.009317	48.47823	22.82131	19.97717	8.723286
9	-0.000540	-0.004790	-0.005345	0.017072	45.79708	21.92724	19.33147	12.94421
10	0.014333	-0.002340	-0.016777	0.000779	45.49303	20.39286	22.11495	11.99916
11	-0.005473	0.003467	-0.021346	-0.011890	41.93460	18.77850	26.40467	12.88223
12	-0.018156	-0.014948	0.009497	-0.002610	42.64954	20.04905	25.38357	11.91784

Table 18

Effect of Unanticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (July 1997 – March 1999)

	Impulse Response				Variance Decomposition			
Period	D(LRS)	D(UM0)	D(UQM)	D(UM3)	D(LRS)	D(UM0)	D(UQM)	D(UM3)
1	0.069019	0.000000	0.000000	0.000000	100.0000	0.000000	0.000000	0.000000
2	0.025244	0.025837	0.015413	-0.002884	85.53429	10.57181	3.762181	0.131724
3	-0.021154	-0.019538	-0.006094	0.003569	81.30222	14.58636	3.818683	0.292740
4	-0.007969	-0.005776	-0.009703	0.004289	79.86018	14.62444	4.982429	0.532947
5	-0.036991	0.000675	-0.014403	-0.001555	81.05845	12.05904	6.416315	0.466198
6	0.009413	-0.006825	-0.007041	-0.000403	80.38982	12.32398	6.827637	0.458562
7	0.008102	0.030291	0.008345	-0.004953	72.57589	19.98486	6.789401	0.649851
8	0.022950	-0.030499	-0.001643	0.002809	67.97915	25.42337	5.961689	0.635798
9	0.002268	0.040504	0.019279	-0.002826	57.99328	33.61805	7.788470	0.600205
10	-0.055456	-0.037269	-0.021915	0.003345	59.07032	32.13579	8.292949	0.500938
11	0.019066	0.003018	0.000890	0.001845	59.80933	31.54855	8.133234	0.508887
12	-0.015880	0.022044	-0.001838	-0.005380	58.75772	32.77283	7.834427	0.635023

Table 19

Effect of Unanticipated Components of Reserve Money, Quasi-money and M3 on Industrial Sales Index (July 1997 – March 1999)

	Impulse Response				Variance Decomposition			
Period	D(LIS)	D(UM0)	D(UQM)	D(UM3)	D(LIS)	D(UM0)	D(UQM)	D(UM3)
1	0.062137	0.000000	0.000000	0.000000	100.0000	0.000000	0.000000	0.000000
2	-0.047138	-0.012610	0.030089	0.002972	85.00338	2.222092	12.65113	0.123405
3	0.020836	-0.000608	-0.013373	-0.003048	83.78046	2.048984	13.93761	0.232949
4	0.009533	-0.001031	0.007400	0.002374	83.31700	2.023029	14.36043	0.299544
5	-0.043815	0.021177	0.002585	-0.000772	82.74044	5.907784	11.11550	0.236283
6	0.044325	-0.025481	-0.019473	-0.000365	78.89108	9.459970	11.46485	0.184108
7	-0.036041	0.032960	0.008796	0.002208	74.78296	14.86952	10.16131	0.186204
8	0.026129	-0.029829	-0.002075	-0.001024	71.91628	18.64663	9.261786	0.175309
9	-0.002567	-0.001353	0.011482	0.000660	71.37537	18.50707	9.941170	0.176389
10	-0.042437	0.039353	-0.011306	-0.001770	68.11626	22.82111	8.900574	0.162053
11	0.073070	-0.068785	-0.002514	0.001514	63.19986	30.65197	6.031341	0.116825
12	-0.085300	0.081311	0.010511	1.59E-05	59.71302	35.80418	4.402280	0.080520

Table 20

Wald Causation Test

Equation	H0	F -Statistic	Probability
rsc m0c(-1to-4) qmc(-1to-4) rsc(-1to-4)	c(1)=0, c(2)=0, c(3)=0, c(4)=0, c(5)=0, c(6)=0, c(7)=0, c(8)=0		
January 1995 – June 1997		0.658844	0.718596
July 1997 – March 1999		0.528420	0.809242
isc m0c(-1to-4) qmc(-1to-4) isc(-1to-4)	c(1)=0, c(2)=0, c(3)=0, c(4)=0, c(5)=0, c(6)=0, c(7)=0, c(8)=0		
July 1997 – March 1999		0.838029	0.593065
rsc pmc(-1to-4) smc(-1to-4) rsc(-1to-4)	c(1)=0, c(2)=0, c(3)=0, c(4)=0, c(5)=0, c(6)=0, c(7)=0, c(8)=0		
January 1995 – June 1997		0.627992	0.742094
July 1997 – March 1999		0.219568	0.978006
isc pmc(-1to-4) smc(-1to-4) isc(-1to-4)	c(1)=0, c(2)=0, c(3)=0, c(4)=0, c(5)=0, c(6)=0, c(7)=0, c(8)=0		
July 1997 – March 1999		0.963443	0.515527

Table 20 shows causation tests between logarithms of cyclical components of monetary and real variables which have **c** extension (e. g. the cyclical component of reserve money **m0** is **m0c**). Symbols with the same extension of cyclical components are used in charts.

Statistical characteristics confirm the hypothesis that monetary impulses (generated both by primary and secondary money) do not have a permanent effect on real variables, and *money follows and 'services' real sector developments*. This applies to both monetary regimes. These results may be considered as yet another argument against a central bank implementing a discretionary monetary policy.

Tested major VAR models are summarized below. All variables are in logarithms and first differences (see stationary tests).

Model	Variables	Lags
VAR(1)	m0c, qmc, rsc	4
VAR(2)	m0c, qmc, isc	4
VAR(3)	pmc, smc, rsc	4
VAR(4)	pmc, smc, isc	4

The following six charts show the impulse response and variance decomposition between cyclical component logarithms of monetary and real variables within VAR models.

Chart 1

Relationship between Cyclical Components of Reserve Money, Quasi-money and Retail Sales Index (January 1995 – June 1997) VAR (m0c, qmc, rsc)

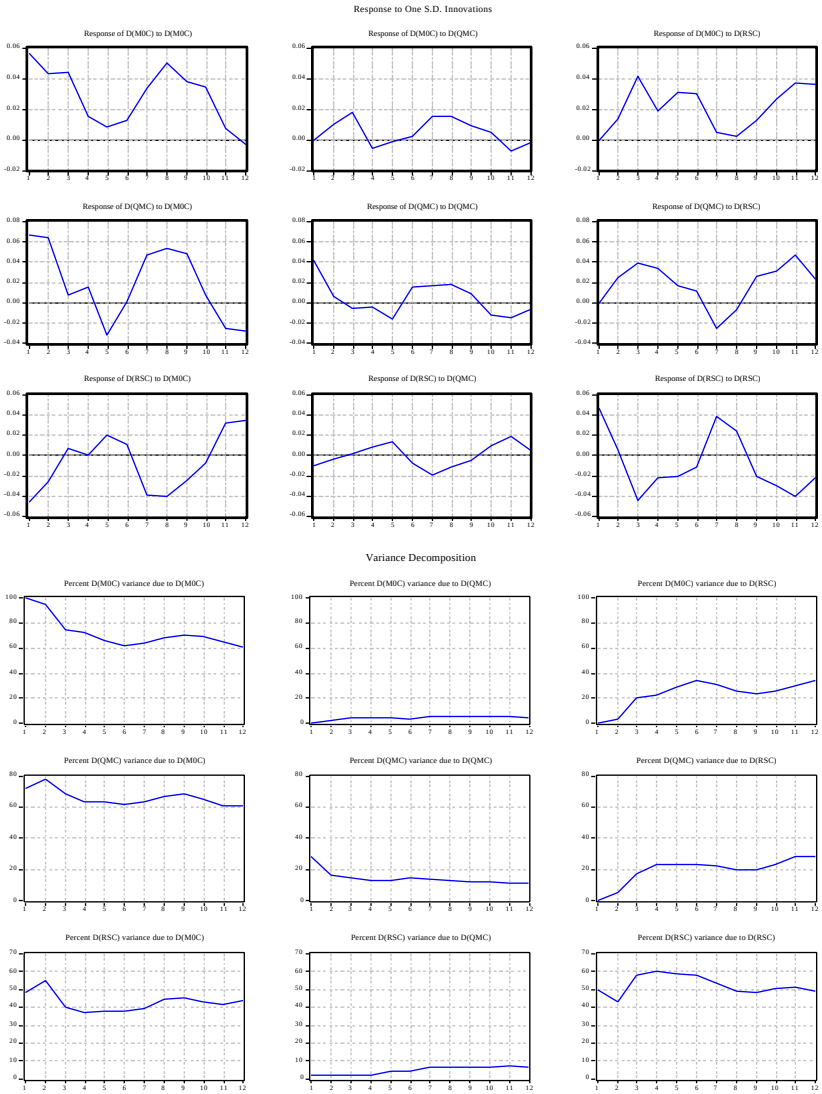


Chart 2

Relationship between Cyclical Components of Reserve Money, Quasi-money and Retail Sales Index (July 1997 – March 1999) VAR (m0c, qmc, rsc)

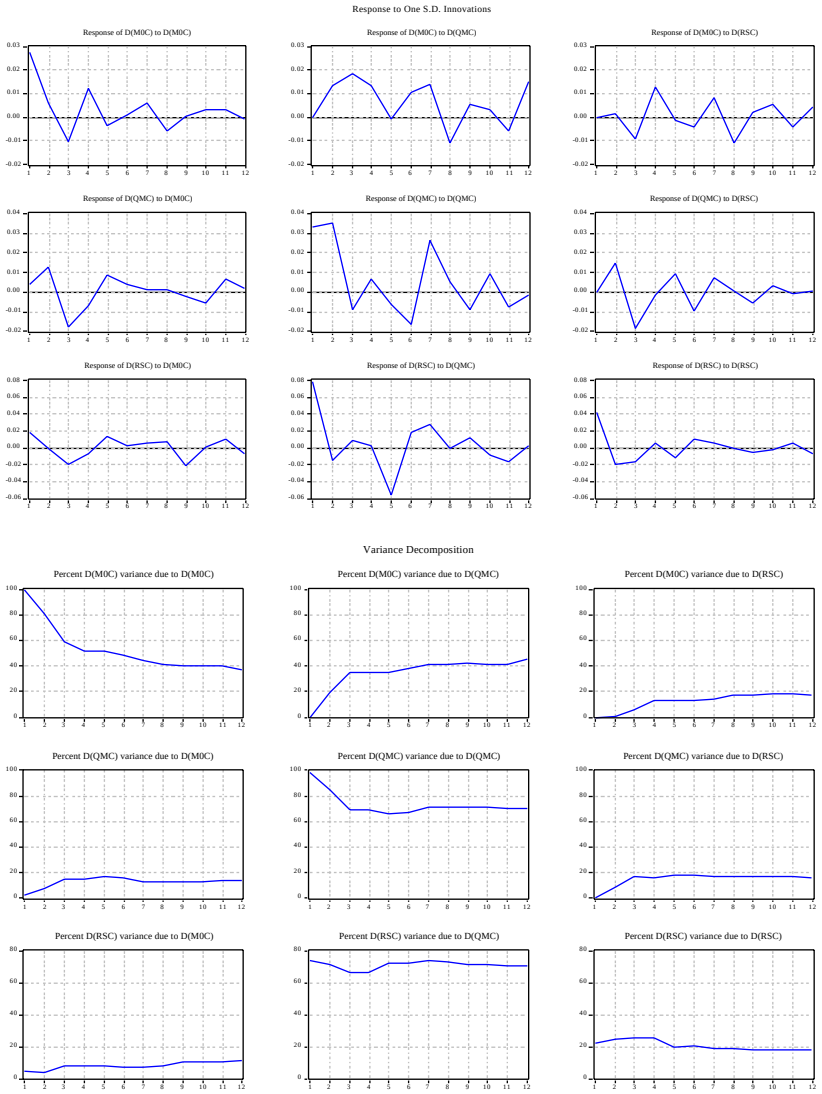


Chart 3

Relationship between Cyclical Components of Reserve Money, Quasi-money and Industrial Sales Index (July 1997 – March 1999) VAR (pmc, smc, isc)

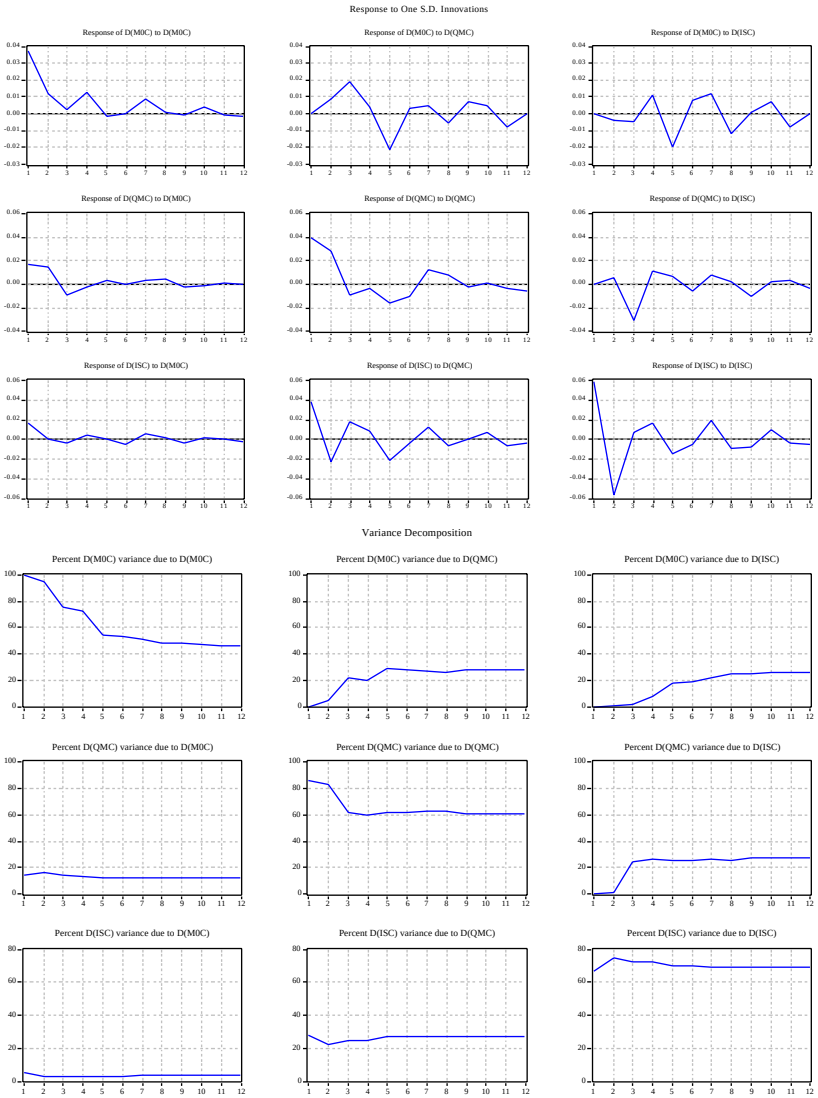


Chart 4

Relationship between Cyclical Components of Primary Money, Secondary Money and Retail Sales Index (January 1995 – June 1997) VAR (pmc, smc, rsc)

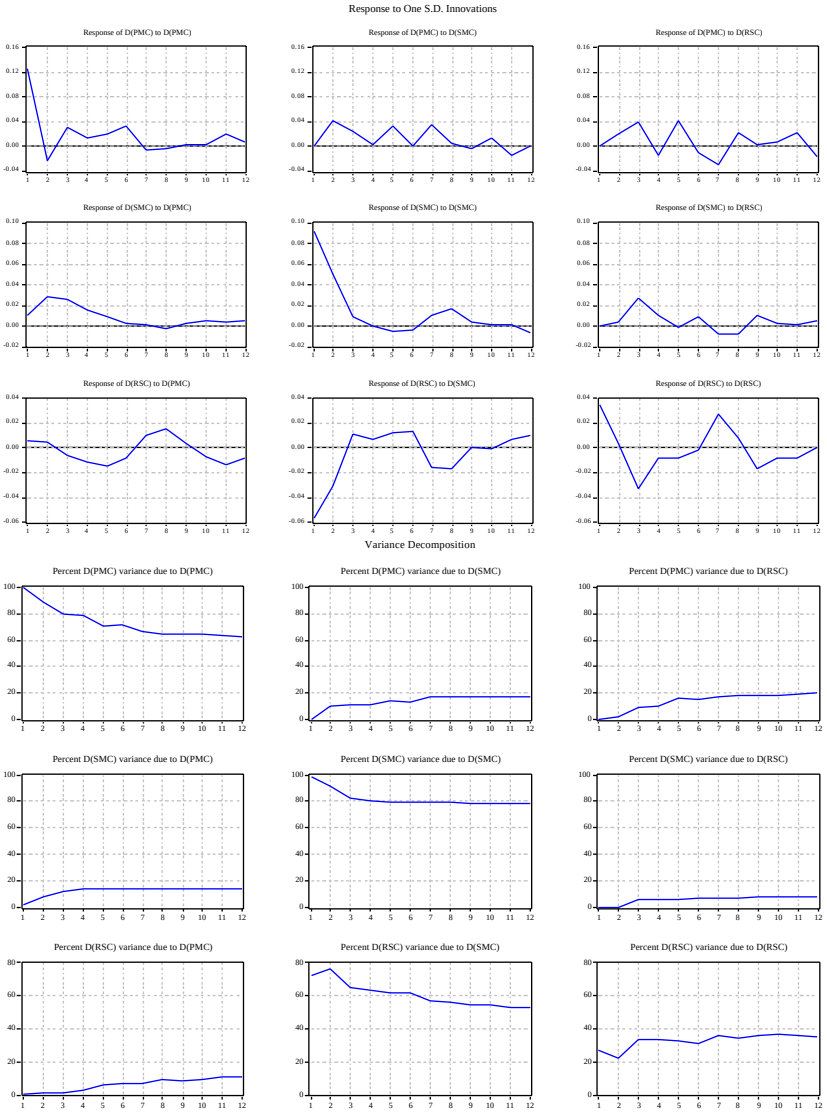


Chart 5

Relationship between Cyclical Components of Primary Money, Secondary Money and Retail Sales Index (July 1997 – March 1999) VAR (pmc, smc, rsc)

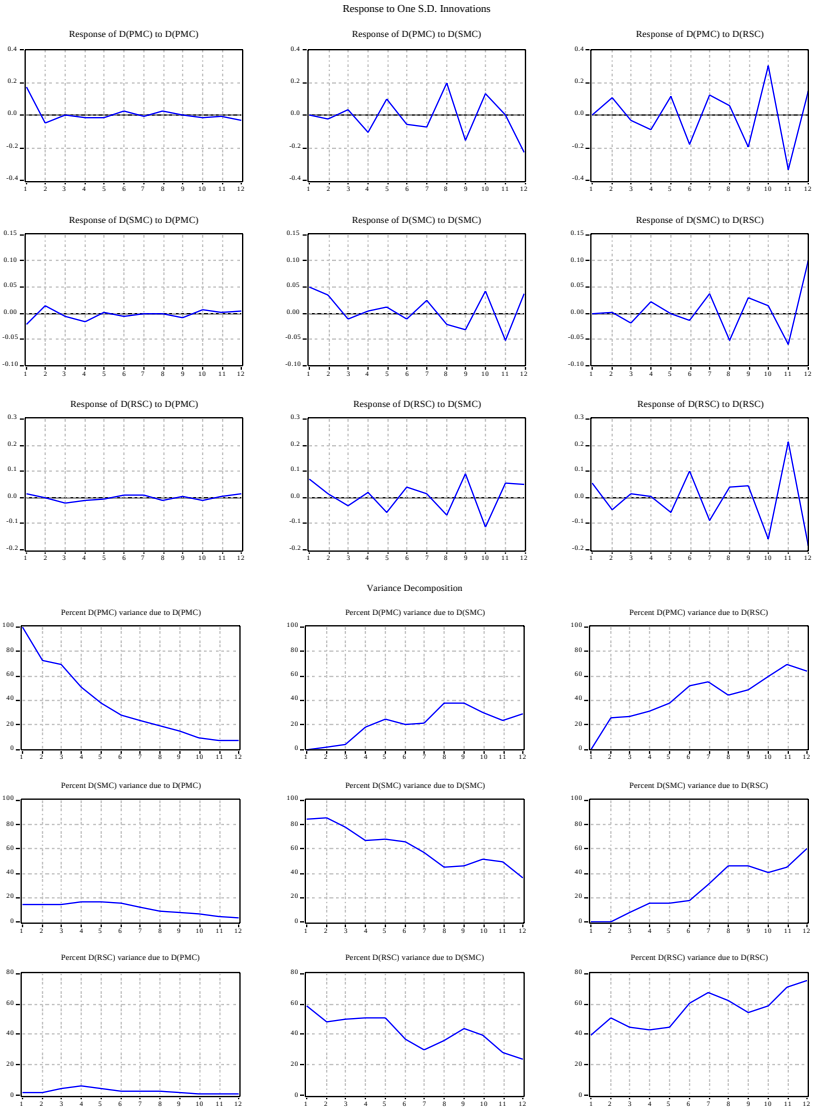
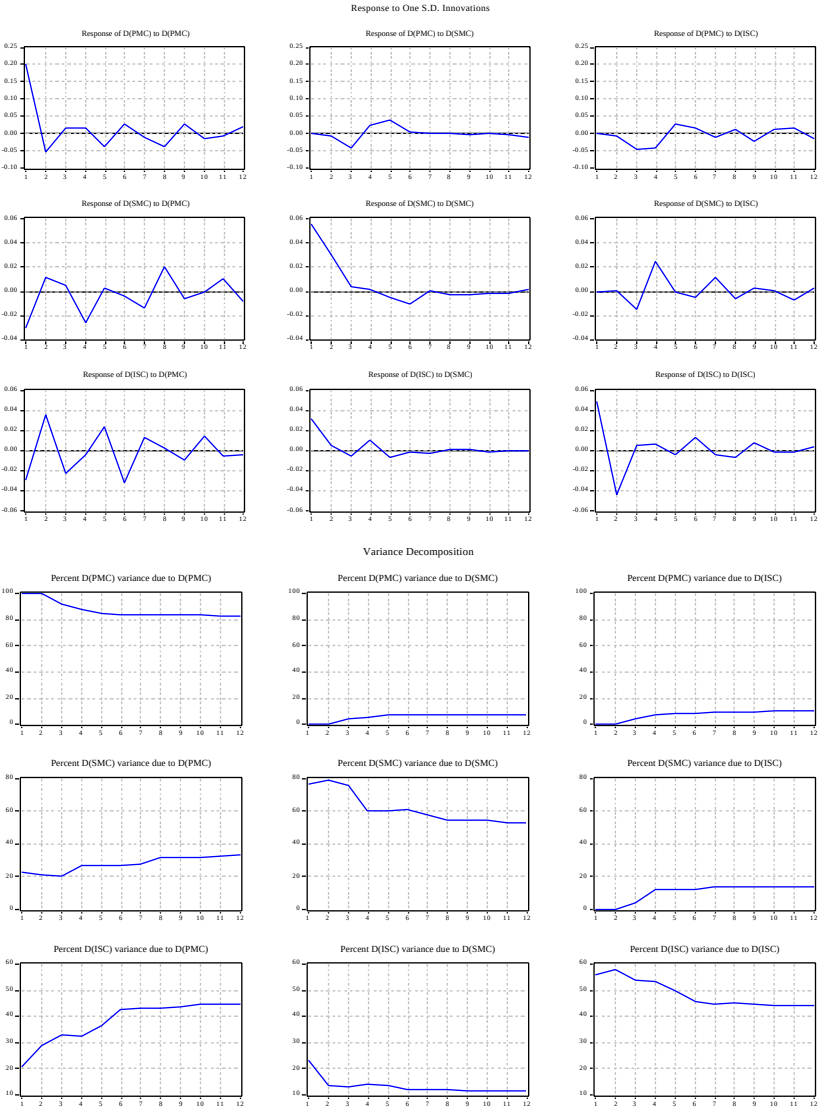


Chart 6

Relationship between Cyclical Components of Primary Money, Secondary Money and Industrial Sales Index (July 1997 – March 1999) VAR (pmc, smc, isc)



According to the real business cycle theory the positive relationship between money and real sector developments is explained by the fact that they are subject to one and the same real shocks. Money is neutral, does not impact the real sector and follows the dynamics of real variables (reverse causation). Dividing money into money determined by monetary authorities (reserve money and/or primary money) and money determined by the real sector behavior (quasi-money and/or secondary money) allows to test the neutrality of the former and the reverse causation of the latter through the VAR hypothesis.

The results of the VAR model prior to the introduction of a currency board suggest that reserve money variance is attributable to a greater extent to the retail sales variance (about 40%) rather than to the quasi-money variance (about 30%). The analysis of shocks shows similar response of reserve money and quasi-money in respect of a shock caused by retail sales. This contradicts to some extent the real business cycle theory.

After the introduction of a currency board the results diverge significantly from those obtained under the previous monetary regime. In fact, they refute to a great extent reverse causation, since only an insignificant percentage of the quasi-money variance is caused by the variance of retail and industrial sales indices (approximately 20%). On the other hand, the bulk of the variance of the two indices is determined by the quasi-money variance which seriously contradicts the results obtained from *Wald* causation tests. These results did not allow to confirm or reject the hypothesis of reverse causation of the real business cycle theory using conventional monetary aggregates in the analysis.

The test of the VAR model by using *primary* and *secondary* money almost mirrors the results obtained by using reserve and quasi-money. The only exception is the model studying the relationship between retail sales and primary and secondary money after the introduction of a currency board where the function of variance decomposition confirms the hypothesis of reverse causation.

IV. Conclusions and Policy Implications

The major objective of this article is to give elements of the answer whether the currency board halts real sector development. This objective is a part of a broader discussion on the effect of money and monetary policy on the dynamics of real variables under various monetary regimes. A comparative analysis of the money to real sector relationship under a discretionary central bank and a currency board is made.

The empirical analysis was limited to the use of four approaches: variation and correlation analysis, monetary analysis and correlation between money and real variables, decomposition of anticipated and unanticipated monetary shocks within the theory of rational expectations, and finally analysis of the relationship between cyclical components of studied variables within the real business cycle theory.

For the purposes of the analysis money is additionally classified into primary (exogenous for the real sector) and secondary (endogenous for the real sector).

Despite some differences the arguments of all four empirical approaches applied are in favor of the following conclusions:

- The currency board does not halt real economy development but follows it. Money has a service function and shocks caused by money supply are minimized. The currency board is impacted by the real economy and not vice versa.
- Fluctuations in monetary aggregates and real variables under a currency board are significantly weaker than under a discretionary central bank.
- The correlation between monetary and real variables was strong and had a negative sign prior to the introduction of a currency board, while it is insignificant and with a positive sign under a currency board arrangement. The negative correlation prior to the currency board introduction rejects the possibilities of stimulating the real sector through monetary expansion.
- Secondary money closely follows the real development under both monetary regimes.
- Primary money under both a discretionary central bank and a currency board has no permanent effect on the real sector. In most cases primary money dynamics, reflecting discretionary decisions, has a destabilizing effect on the real economy.
- In general under both monetary regimes money supply is beyond

the control of monetary authorities. The discretionary money supply management under a traditional central bank causes uncertainty, thus additionally worsening real sector problems. Automated rules under a currency board result in a smoother balancing of monetary and real sectors, since the money supply dynamics follows the real sector behavior. In this case the destabilizing effect of monetary shocks is minimized.[37]

- The volume of money under a currency board is significantly closer to that under a market mechanism, a result of the interaction of economic agents. In this respect it is closer to the 'optimum' volume. Our answer to the well known question of S. Hanke and Kurt Schuler (*Hanke, S., K. Schuler,* 1999) if it is possible to sit in an armchair and determine an optimum currency area is: no. We think that it is absolutely impossible to say what is the 'optimum volume of money' with a pen in your hand and a statement in front of you as it was done under a discretionary central bank.
- If any insignificant problems related to fast and gradual balancing of money and the real sector occur, they should be sought in the specific design of the currency board in Bulgaria and deviation from complete liberalization which is a fundamental requirement for the rule-bound operation of a currency board.
- Our practical recommendation to the currency board is: the operation of the currency board should be improved and confidence strengthened. An exit is out of the question. The direction is clear. The government should stay away from money.

[37] *In* ***Nenovsky, N.*** *(1998) the author argues and empirically tests the idea of the impossibility to exercise control over money supply under a discretionary central bank in Bulgaria prior to the introduction of a currency board. The mechanism of exogenous money supply for the central bank is described in detail. The central bank was unable to control neither reserve money sources, nor the money multiplier which is a behavioral variable.*

APPENDICES

Appendix 1

Analyzing the dependences between real and monetary variables a new classification of money supply components (different from that in monetary statistics) is introduced: money determined by monetary authorities and money determined by real economy development, a result of household and companies' behavior. The former is defined as ***primary money*** and the latter as ***secondary money***.

Primary money includes reserve money without overhang of commercial bank reserves in the period of conducting a discretionary monetary policy (1991 − July 1997) and minimum required reserves of commercial banks (excess reserves excluded) after the introduction of a currency board.

Secondary money emerges spontaneously reflecting the needs of households, companies and financial intermediaries. In this paper secondary money includes all types of deposits and the overhang of commercial bank reserves prior to the introduction of a currency board. After June 1997 secondary money includes deposits in the banking system, banknotes and coins in circulation (since they are unconditionally exchangeable into reserve currency) and overhang of commercial bank reserves.

(million BGL)

Before CB			After CB		
	Primary money	Secondary money		Primary money	Secondary money
I'95	80 318	378 713	VII'97	215 641	4 833 006
II'95	80 016	388 379	VIII'97	250 915	5 076 409
III'95	82 796	402 790	IX'97	273 469	5 064 680
IV'95	94 426	408 562	X'97	273 828	5 170 912
V'95	102 959	427 494	XI'97	281 526	5 376 746
VI'95	105 427	443 521	XII'97	319 364	6 043 359
VII'95	108 522	453 853	I'98	314 132	5 832 025
VIII'95	112 146	465 853	II'98	319 364	5 737 232
IX'95	115 069	477 071	III'98	327 647	5 873 530
X'95	118 238	482 054	IV'98	347 308	5 696 585
XI'95	116 462	487 899	V'98	288 265	5 593 562
XII'95	124 714	514 113	VI'98	353 900	5 774 517
I'96	113 196	510 099	VII'98	323 513	5 886 250
II'96	111 399	515 326	VIII'98	366 393	5 964 159
III'96	111 838	512 255	IX'98	379 798	5 743 576
IV'96	115 967	527 526	X'98	360 966	5 751 089
V'96	124 094	595 102	XI'98	394 188	6 009 236
VI'96	132 354	602 898	XII'98	309 961	6 398 907
VII'96	146 975	654 903	I'99	351 607	6 088 764
VIII'96	158 607	699 628	II'99	348 326	6 132 409
IX'96	169 022	703 895	III'99	303 241	6 076 242
X'96	167 326	721 659			
XI'96	194 928	862 972			
XII'96	263 269	1 102 149			
I'97	318 583	1 773 207			
II'97	469 864	3 049 243			
III'97	568 846	2 728 670			
IV'97	673 727	2 743 626			
V'97	746 518	3 007 268			
VI'97	952 420	3 401 425			

Appendix 2

DECOMPOSITION OF VARIABLES INTO CYCLICAL COMPONENT AND TREND THROUGH HODRICK – PRESCOTT FILTER

Chart 1

Reserve Money Decomposition

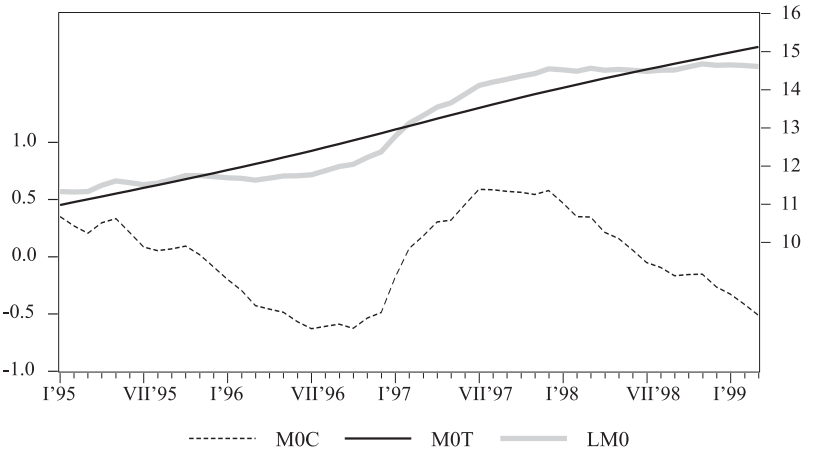


Chart 2

Quasi-money Decomposition

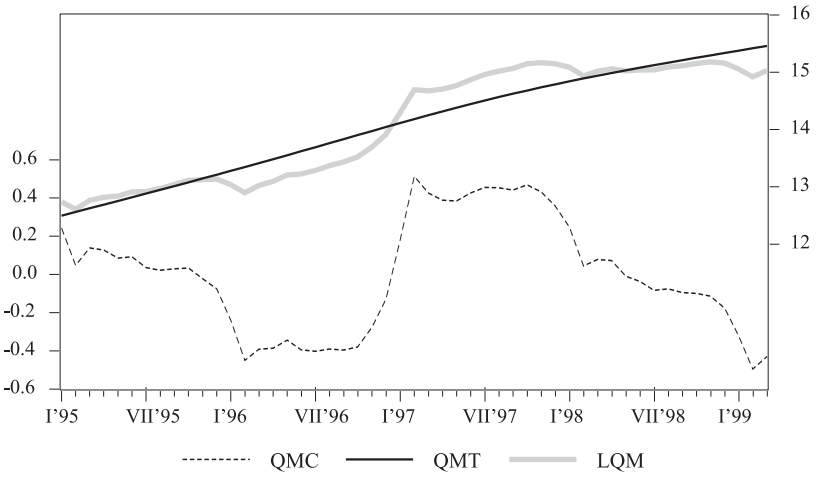


Chart 3

Broad Money (M3) Decomposition

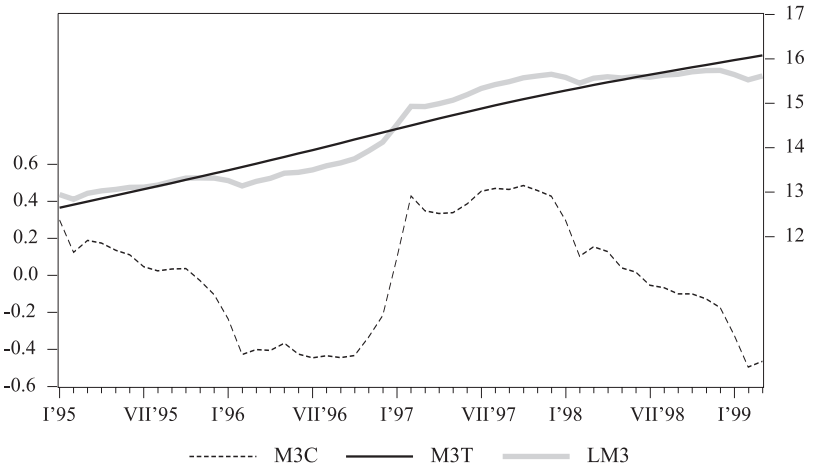


Chart 4

Primary Money Decomposition

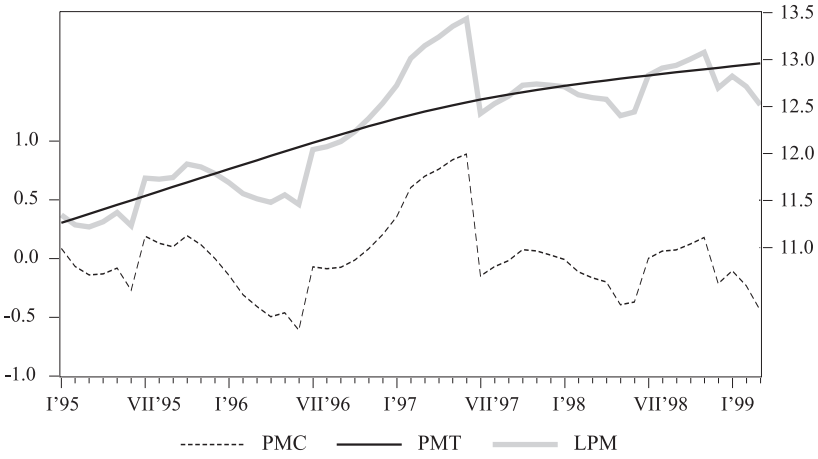


Chart 5

Secondary Money Decomposition

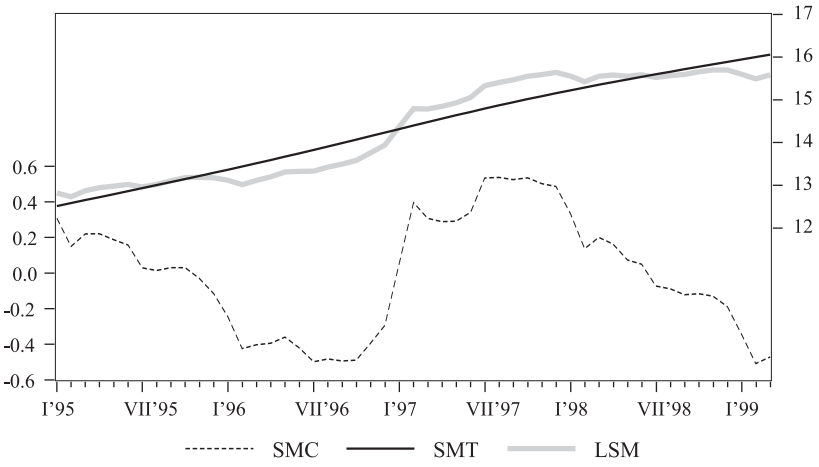


Chart 6

Industrial Sales Index Decomposition

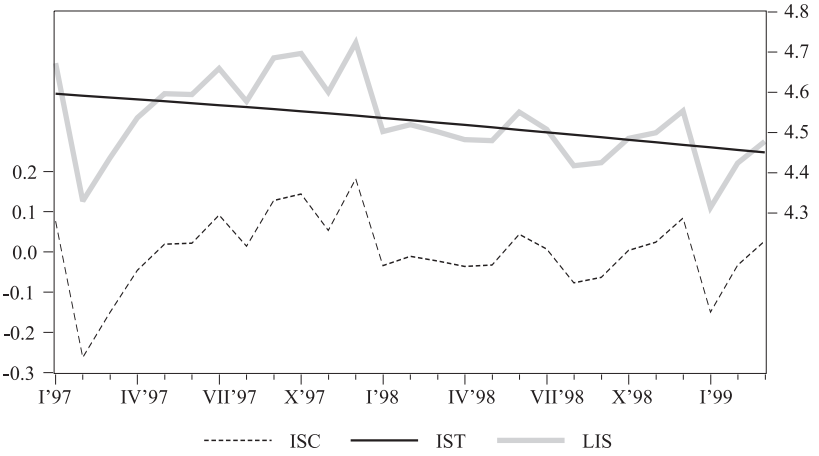
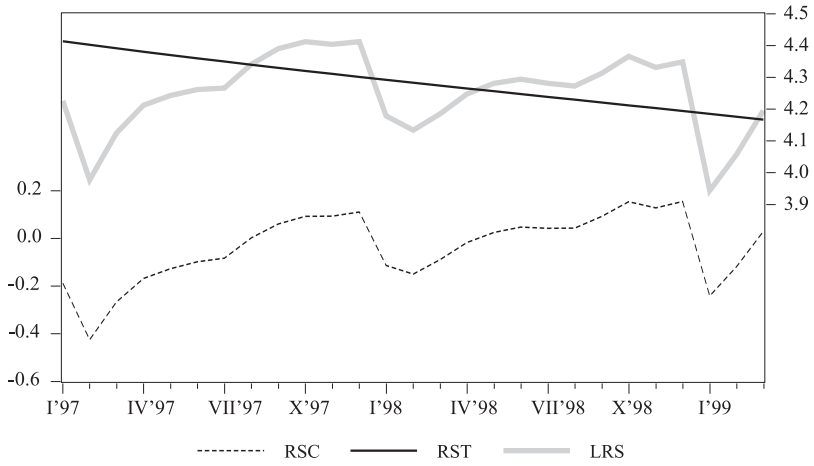


Chart 7

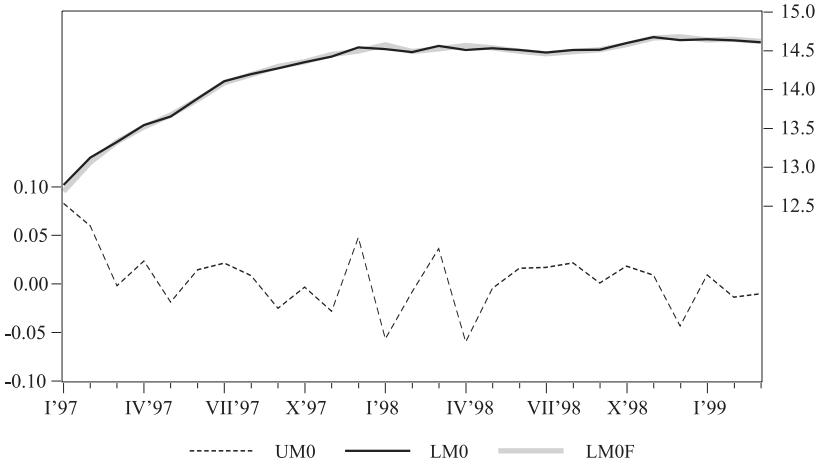
Retail Sales Index Decomposition



Appendix 3[38]

Chart 1

Estimated Anticipated and Unanticipated Components and Actual Value of Reserve Money



[38] *Files on ARIMA models are available with the authors and may be obtained at request (E-Views 3.1 format).*

Chart 2

Estimated Anticipated and Unanticipated Components and Actual Value of Quasi-money

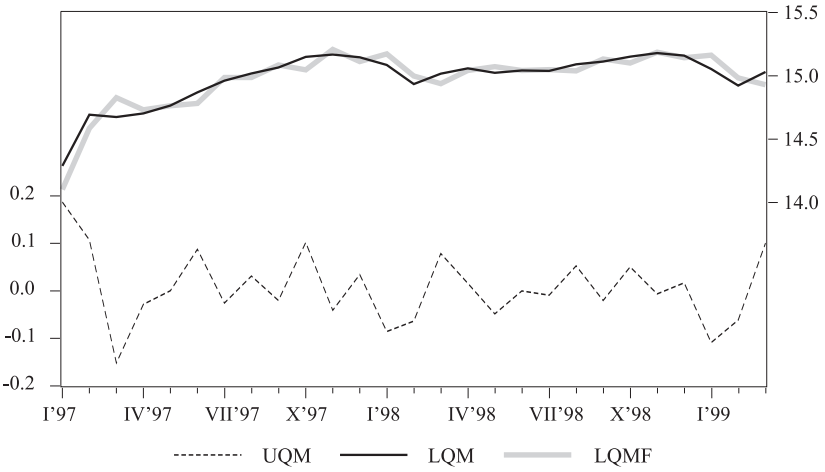


Chart 3

Estimated Anticipated and Unanticipated Components and Actual Value of Broad Money

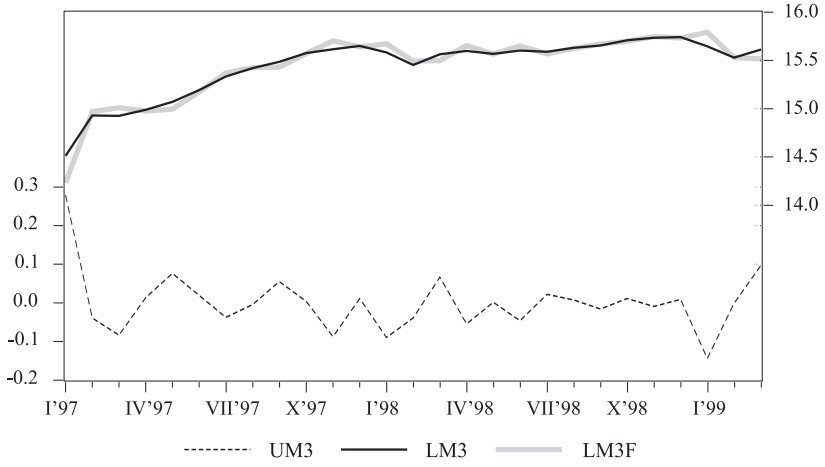


Chart 4

Estimated Anticipated and Unanticipated Components and Actual Value of Primary Money

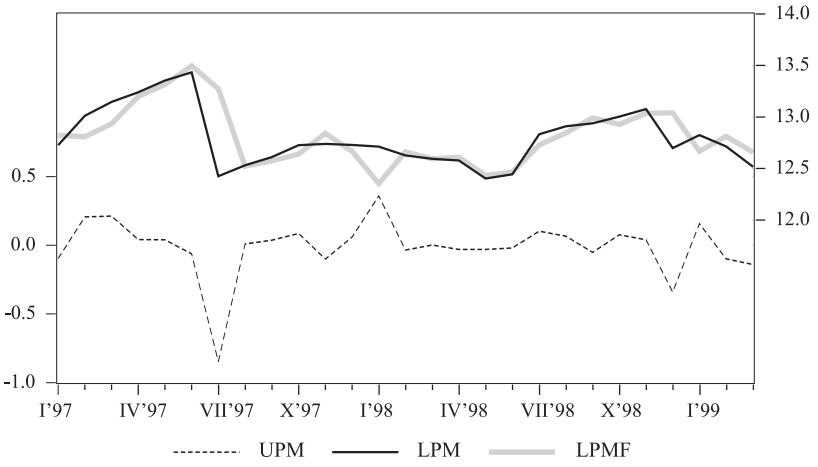
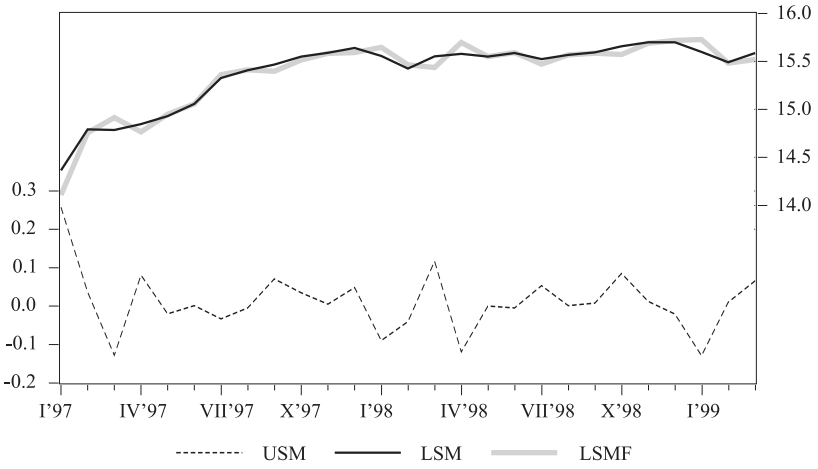


Chart 5

Estimated Anticipated and Unanticipated Components and Actual Value of Secondary Money



Appendix 4

Chart 1

Effect of Anticipated Components of Primary and Secondary Money on Retail Sales Index (January 1995 – June 1997)

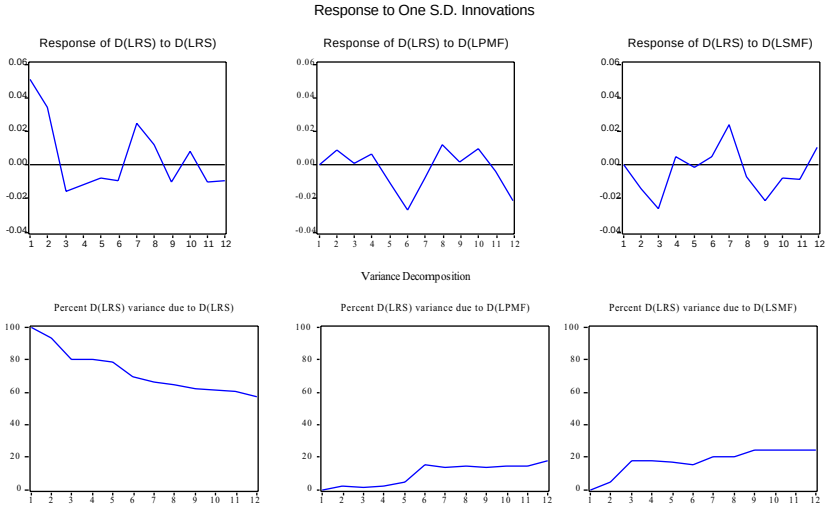
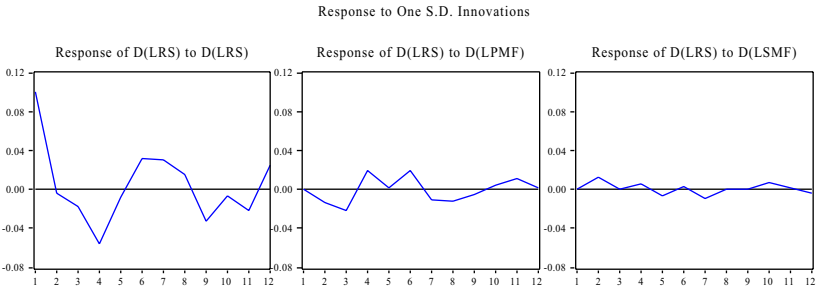


Chart 2

Effect of Anticipated Components of Primary and Secondary Money on Retail Sales Index (July 1997 – March 1999)



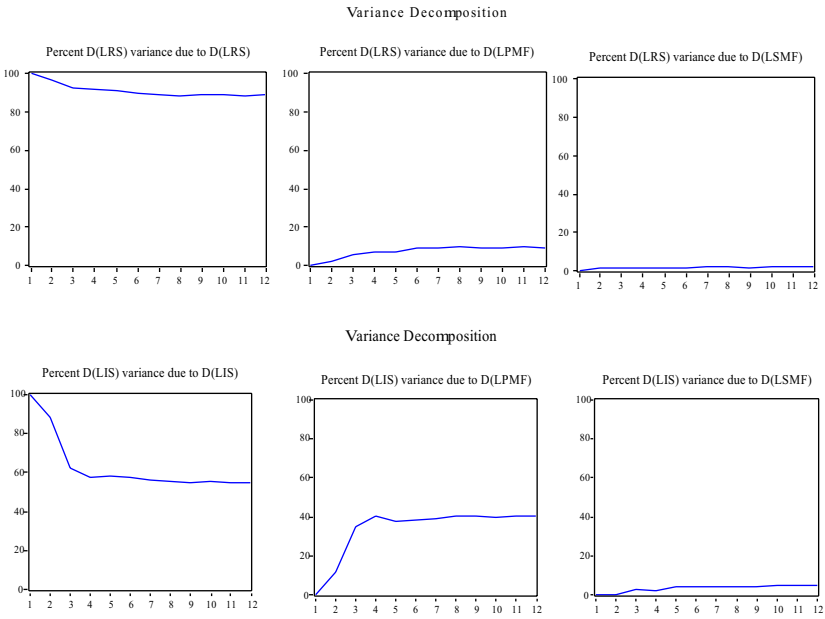


Chart 3

Effect of Anticipated Components of Primary and Secondary Money on Industrial Sales Index (July 1997 – March 1999)

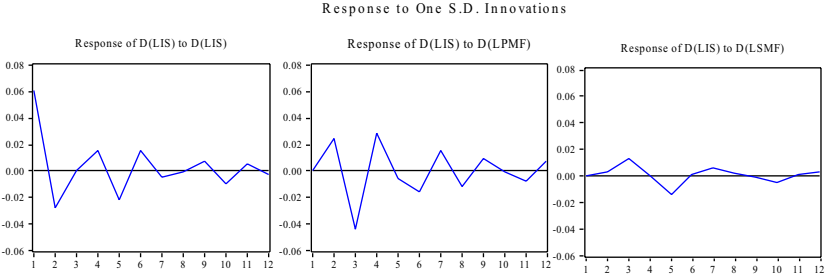


Chart 4

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (January 1995 – June 1997)

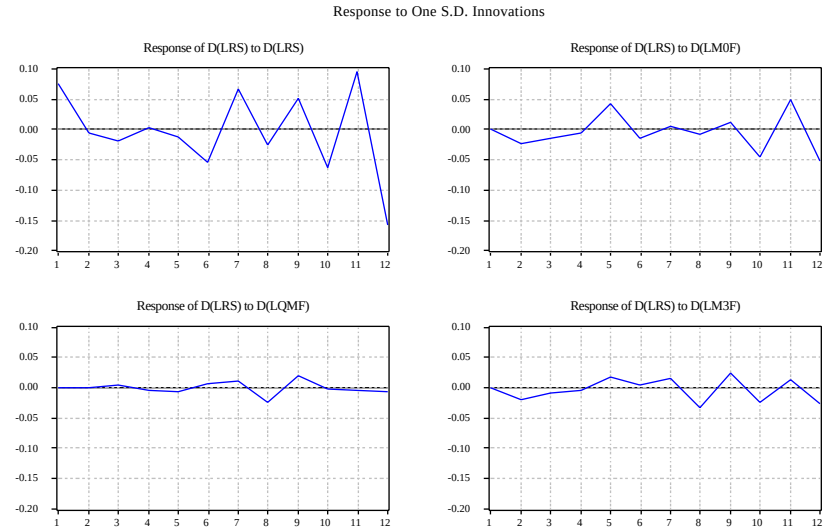


Chart 5

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (July 1997 – March 1999)

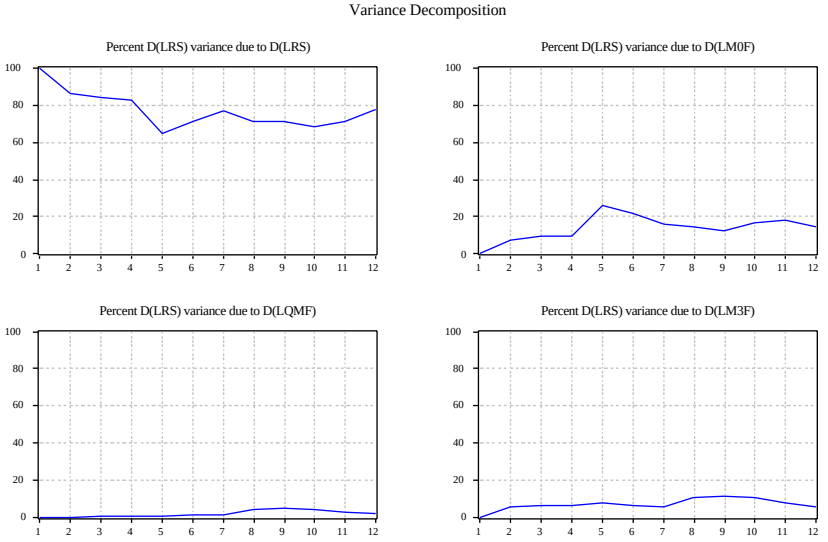


Chart 6

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Industrial Sales Index (July 1997 – March 1999)

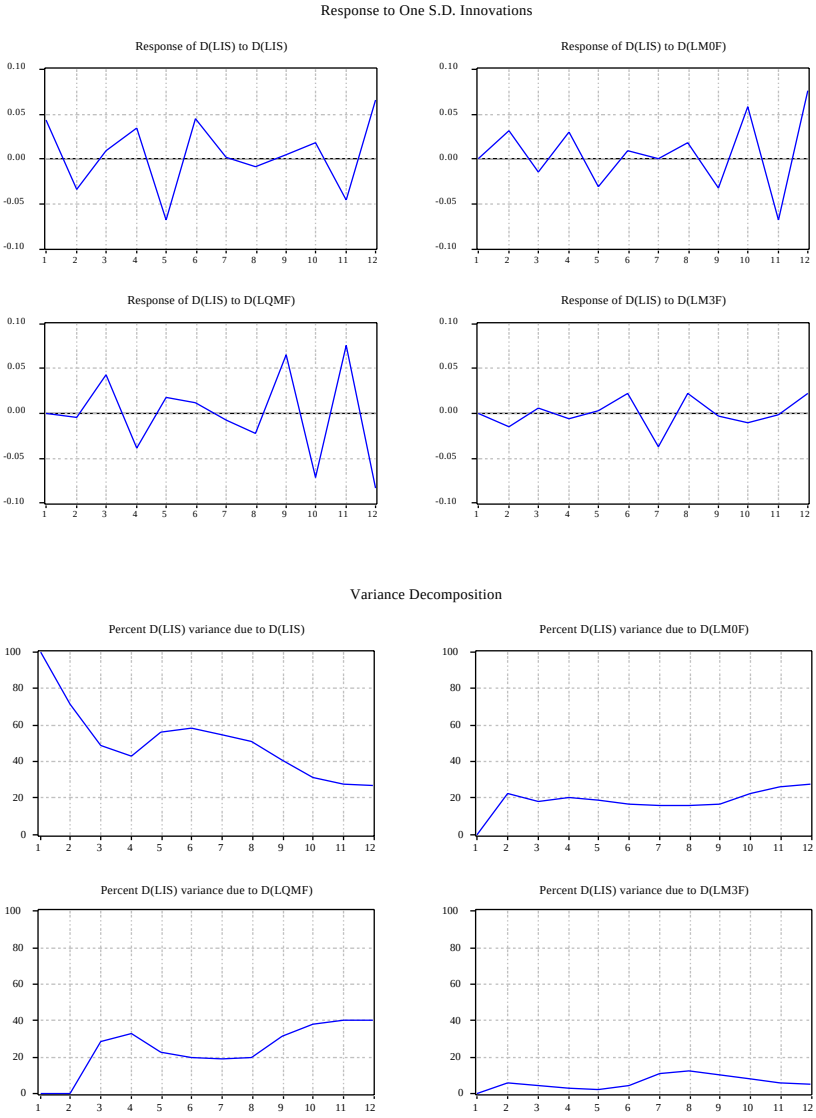


Chart 7

Effect of Unanticipated Components of Primary and Secondary Money on Retail Sales Index (January 1995 – June 1997)

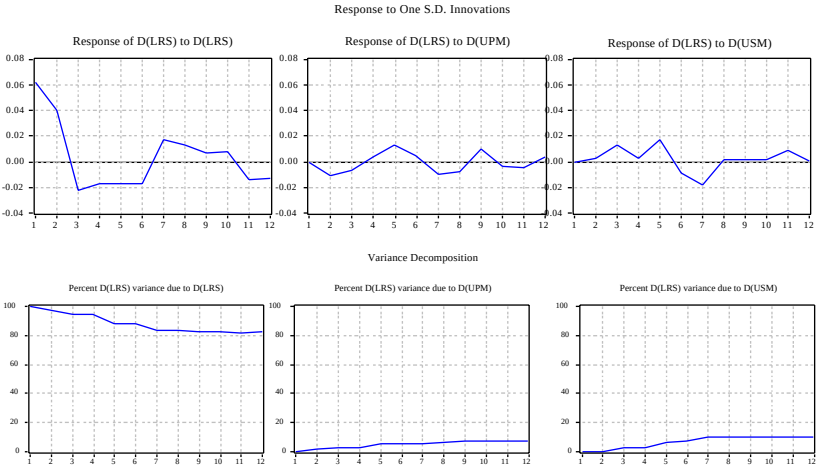


Chart 8

Effect of Unanticipated Components of Primary and Secondary Money on Retail Sales Index (July 1997 – March 1999)

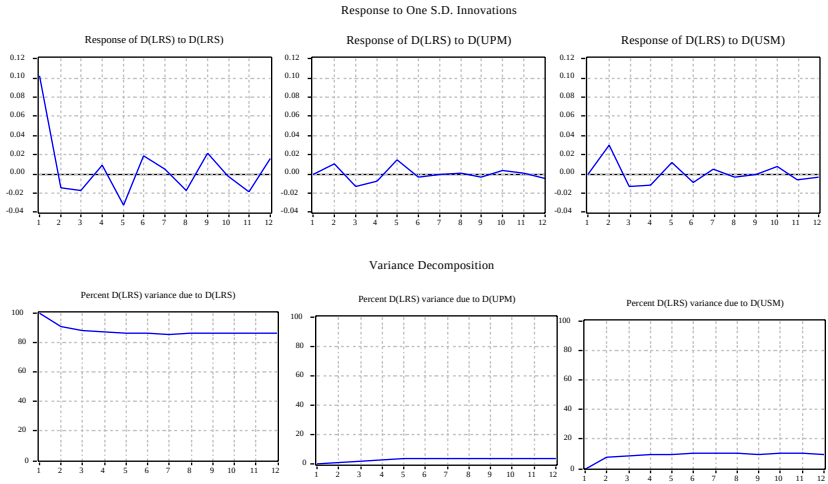


Chart 9

Effect of Unanticipated Components of Primary and Secondary Money on Industrial Sales Index (July 1997 – March 1999)

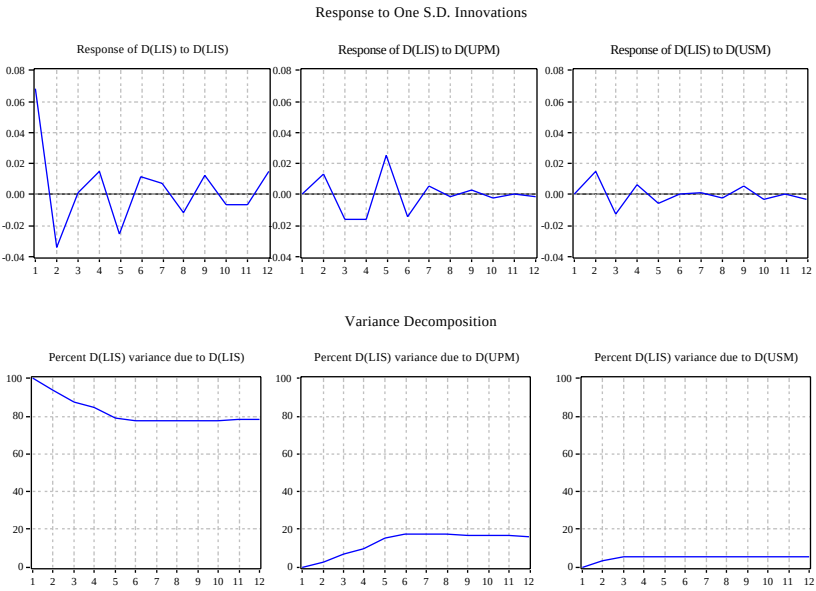


Chart 10

Effect of Unanticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (January 1995 – June 1997)

Chart 11

Effect of Unanticipated Components of Reserve Money, Quasi-money and M3 on Retail Sales Index (July 1997 – March 1999)

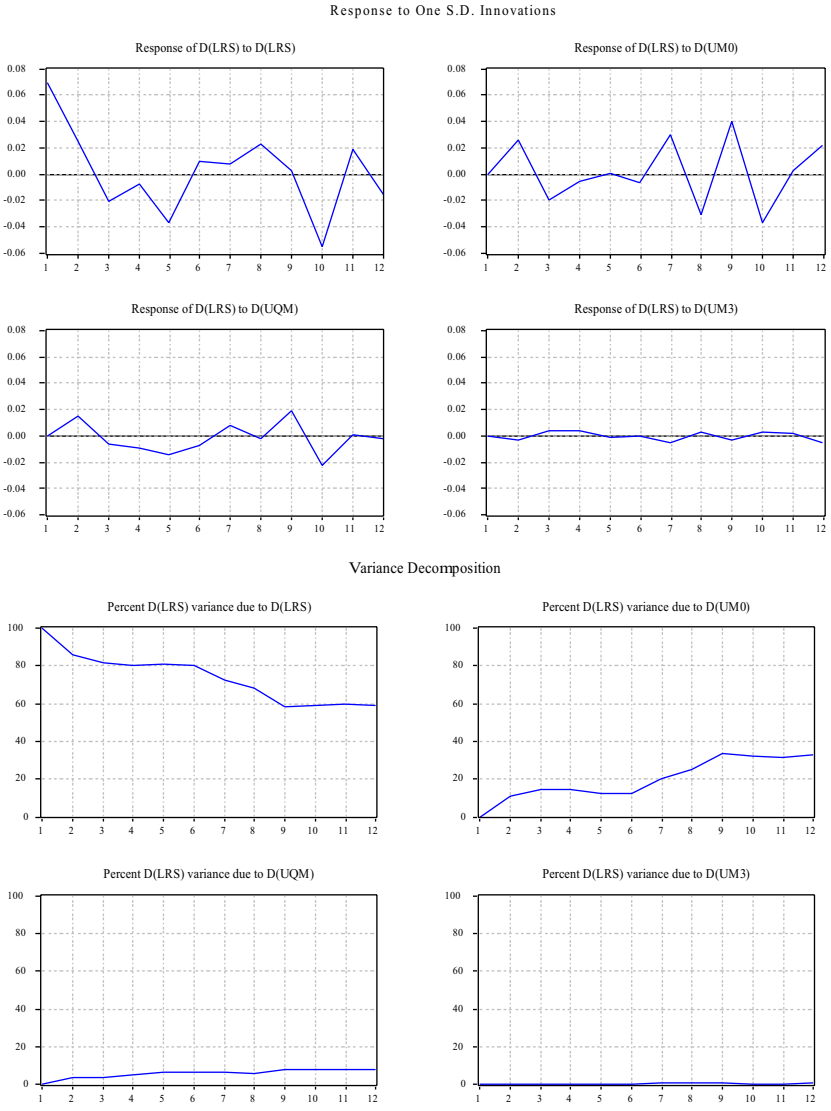
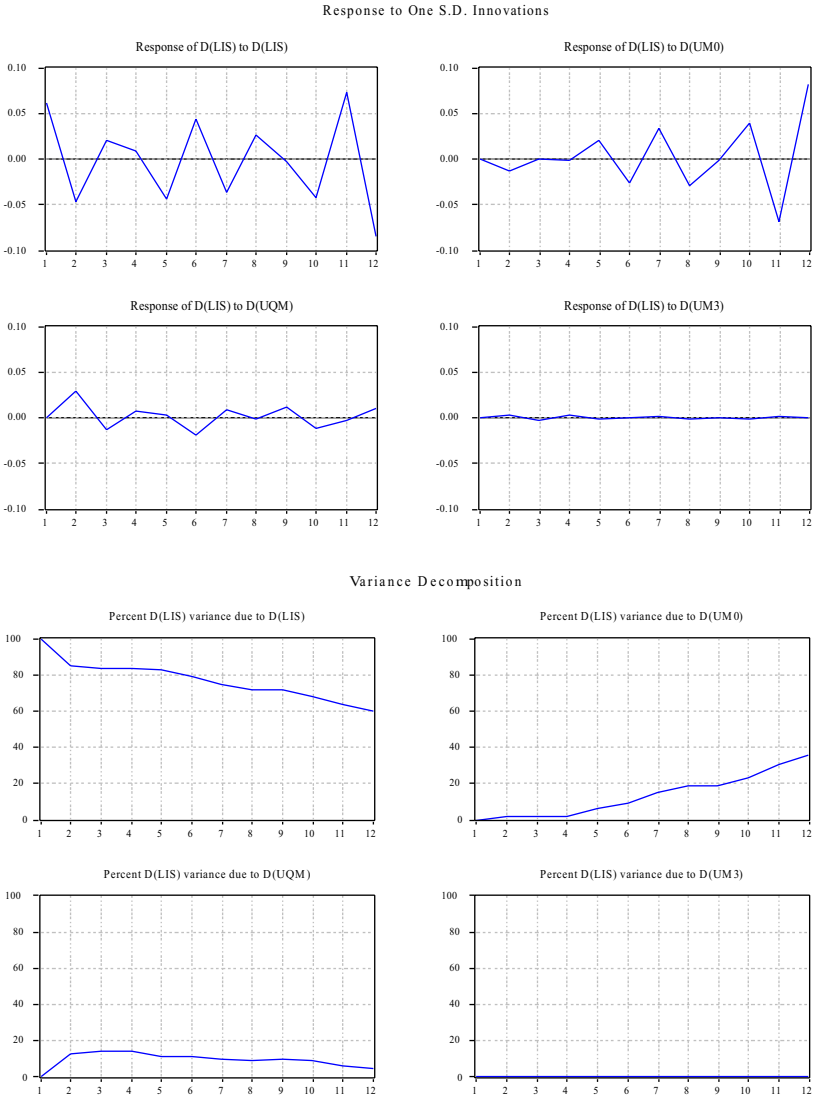


Chart 12

Effect of Anticipated Components of Reserve Money, Quasi-money and M3 on Industrial Sales Index (July 1997 – March 1999)



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