IVARS TILLERS

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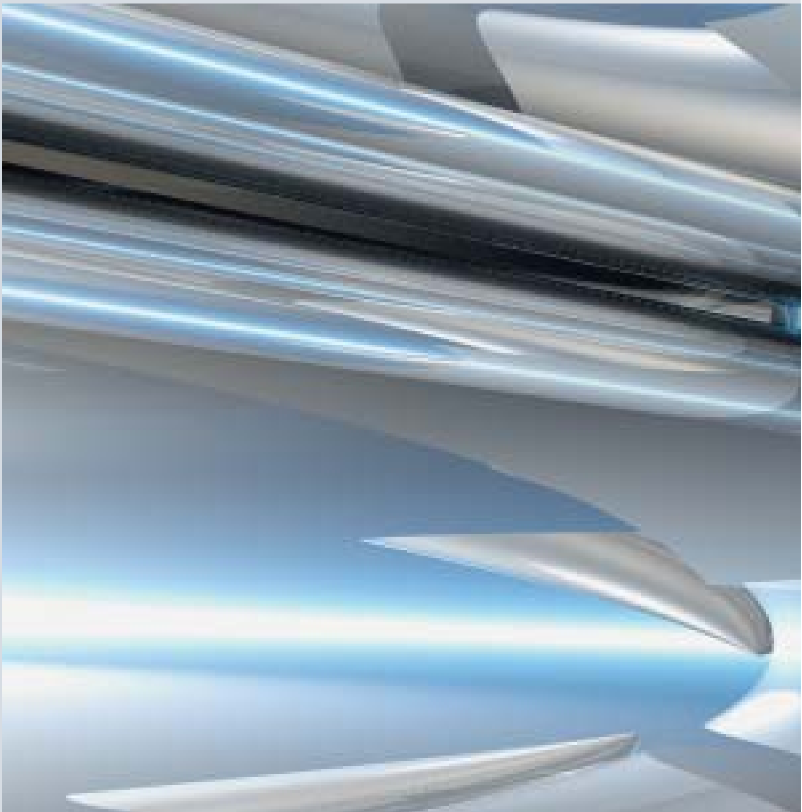

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ABSTRACT

The econometric analysis of the demand for broad money in Latvia suggests a stable relationship of money demand. The analysis of parameter exogeneity indicates that the equilibrium adjustment is driven solely by the changes in the amount of money. The demand for money in Latvia is characterised by relatively high income elasticity typical for the economy in a monetary expansion phase. Due to stability, close fit of the money demand function and rapid equilibrium adjustment, broad money aggregates can be used as indicators of the economic activity.

Key words: *money demand, co-integration, exogeneity, vector error correction*

JEL classification codes: *C22, C32, E41*

The views expressed in this publication are those of the author, senior econometrist of the Bank of Latvia Monetary Policy Department. The author assumes responsibility for any errors and omissions.

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INTRODUCTION

The main objective of the Bank of Latvia is to maintain price stability. In pursuit of this objective, the Bank of Latvia has set external stability of the national currency as an intermediate policy goal and is implementing a fixed exchange rate system in Latvia. Under a maturing financial system and deepening monetisation of the economy, the Bank of Latvia's policy aimed at regulating bank liquidity to minimise interest rate fluctuations on the money market is constantly gaining in importance. Studies dedicated to the demand for money are relevant for the monetary policy decision-making process.

Interest rates on the financial market are determined by the interrelation between demand and supply. The supply of money is not constant and changes with the Bank of Latvia intervening in the foreign exchange market and employing monetary instruments. In recent years, the Bank of Latvia has played an active part in the formation of the money supply. If in the 1990s interventions in the foreign exchange market were primary drivers of changes, in 2002 and 2003, with an exception of short-lived periods of buying currency, the growth in the monetary base was affected by the Bank of Latvia's foreign exchange swap and repo transactions.

In the country with a small and open economy where no restrictions are set for capital flows and a fixed exchange rate regime is implemented, the supply of money depends on the demand for it, and the central bank acts under constraints to pursue independent interest rate targets. A pre-requisite for such a situation is a perfect mobility of capital; however, capital mobility typical for the financial markets of advanced economies does not exist in transition economies. Though the spread between risks related to financial instruments in Latvia and the advanced countries is narrowing, the Latvian financial market is not yet sufficiently developed and does not have an adequate number of liquid financial instruments to become attractive to international short-term investments. Hence, at least in the short run, the correlation between money market interest rates of lats and currencies of the basket to which the lats is pegged is not close.

In periods when capital flows are not sufficient to achieve interest rate equilibrium, extra volatility of interest rates is possible. With lending playing an ever-increasing role in the economy, the relationship between money market interest rates and the aggregated domestic demand becomes tighter; hence the significance of liquidity regulatory policy is constantly growing. On the other hand, trade-off is to be found between a more flexible liquidity management policy and stability of the exchange rate peg; this adds to the importance of money demand studies for the purpose of enhancing stability on the money market in the circumstances of a pegged currency. Moreover, the assessment of stability or instability of the money demand in Latvia and the factors influencing it will be valid also after Latvia joins the Economic and Monetary Union (EMU), as the European Central Bank (ECB), alongside the analysis of general macroeconomic data, places a particular focus on the growth of monetary aggregates that are an important indicator the ECB's monetary policy relies on.

The first two Chapters of the paper are devoted to some major theories related to the demand for money and methods of their potential empirical application; Chapter 3 presents country-specific analysis of the demand for money. The assessment of the demand for money in Latvia is given in Chapter 4, whereas the concluding part of the paper contains basic inferences resulting from the study.

1. THEORIES OF THE DEMAND FOR MONEY

1.1 The quantity theory of money

The economic theory advances a great number of money demand theories that share a common stance: the major function of money is it being a medium of exchange; hence these theories treat the quantity of money in demand as dependent on the volume of transactions in the economy. Economists are not unanimous to what extent the demand for money depends on changes in interest rates, and the analysis of this issue deserves particular attention in the money theory.

The quantity theory of money was developed in the 19th and early 20th century, and it shows the relationship between the quantity of money in circulation and aggregate income. This theory provides an explanation how much money will be held at a definite level of aggregate income; hence the quantity theory of money is also a theory of the demand for money. The view that interest rates do not affect the demand for money is an essential feature of this theory.

1.1.1 The Fisher quantity theory of money

American economist I. Fisher ranks among the developers of the classical quantity theory of money. His theory (14) explains the relation between the quantity of money in circulation and the volume of transactions in the economy. As measuring the volume of transactions is complicated, the Fisher theory has been modified to link the quantity of money with the amount of spending on goods and services produced in the economy. The quantity of money is dependent on both the total amount of spending and the intensity of using money in settlements. In the Fisher theory, this dependence is expressed by the velocity of money V, which measures the average number of times per year a unit of money is used to settle up for goods and services:

$$V = \frac{P \cdot Y}{M} \qquad [1],$$

where
M is the quantity of money;
P is the price level;
Y is the output.

The Fisher equation $M \cdot V = P \cdot Y$ expressing the relation between the quantity of money in circulation and nominal income of the economy is obtained from the definition of the money velocity. The Fisher equation, without any additional assumption on the velocity of money, is an identity – a relation that always holds by definition, therefore the Fisher quantity theory of money is based on the analysis of factors affecting the velocity of money.

The velocity of money is affected by institutional and technological factors that determine the type of payment (cash, settlement accounts). According to Fisher's stance, effects of institutional factors change slowly over time, and the velocity of money is relatively constant; hence in the shorter run, the quantity of money depends only on the nominal income level. Where the money market is in equilibrium, the quantity of money in the economy is equal to the demanded amount of money M^d. Assuming that the velocity of money is constant, the equation of the demand for money is obtained from the Fisher equation:

$$M^d = k \cdot P \cdot Y \qquad [2],$$

where the constant k is inversely proportional to the velocity of money. As this theory builds on the assumption that money functions only as a medium of exchange and is held in the amount needed for settlements, the Fisher theory rejects the dependence of the demand for money on interest rates.

1.1.2 The demand for money: analysis by Cambridge economists

Independently of I. Fisher, Cambridge economists A. Marshall and A. C. Pigou discovered an identical relation between money and the volume of transactions. Consistency of the two equations notwithstanding, the analyses conducted by I. Fisher and the Cambridge economists differ noticeably.

First, the theories developed by I. Fisher and the Cambridge economists use distinctive approaches to the problem. The focus of the Cambridge quantity theory of money is not on the analysis of market equilibrium but on the choice of individual economic agents. In contrast to the Fisher theory concerning factors that affect the quantity of money needed for conducting transactions, the Cambridge theory focuses on the quantity of money that economic agents would like to hold under certain circumstances.

Second, in addition to an argument in the Fisher theory that money serves as a medium of exchange, the Cambridge economists view money also as a store of value; hence the volume of transactions is a significant yet not the only factor having an impact on the demand for money. The Cambridge theory deals also with the role of wealth and interest rates. With wealth of economic agents increasing, the volume of financial assets (including money) held for storing wealth should have grown. Assuming that wealth, the volume of transactions and the level of income are proportional, the demand for money is also proportional to the nominal income.

Emphasising the significance of the transaction volume for the formation of the demand for money, the Cambridge economists treated the coefficient k as constant; however, the values of this coefficient may be subject to short-term fluctuations, as the choice of economic agents to use money as a store of value will be influenced by interest rates and the expected return on other assets.

1.2 The Keynes liquidity preference theory

Until the Great Depression, economists shared the view that in the longer run the velocity of money is affected by technological changes, and in the shorter run instability is not typical for it. Following the notable fall in the velocity of money during the Great Depression, other determinants of the demand for money were sought to explain variability of the velocity of money. J. M. Keynes scrapped the view that the velocity of money was constant and developed a theory in which he placed a particular emphasis on the role of interest rates. However, his theory not only deals with the factors influencing the money demand but provides also a deeper insight into causes for holding money. Proceeding from the analysis of these causes, J. M. Keynes arrived at three motives: the transaction, precautionary and speculative motive.

Pointing out that the need for money is determined by its function as a medium of exchange, the Keynes theory argues that the demand for money basically depends on the volume of transactions. Assuming that the volume of transactions is proportional to income, this component of the money demand should also be proportional to income. Acknowledging that money functions as a store of value, J. M. Keynes proposed that in addition to using money for making planned payments there is a need to use money to cover unforeseen expenses. According to J. M. Keynes, the quantity of money held for the precautionary motive is mainly affected by the level of planned costs in proportion to the income level. Consequently, this component of the money demand is proportional to income.

J. M. Keynes adopted the stance of the classics of the economic theory that money is a medium of storing value. This function of money gives rise to the so-called speculative motive for holding money. In addition to the argument about the close relation between the stored wealth and the income level, J. M. Keynes emphasised the importance of interest rates for economic agents to make decisions on the amount of money to be allocated for storing wealth. When changes in interest rates are anticipated and when resulting from such changes the placement of speculative capital does not ensure the largest possible return, economic agents would act reasonably and move their capital to such financial assets that yield the largest return. In J. M. Keynes' view, the assets that can be used to store wealth are money and bonds.

Regarding the financial assets to be used for storing value, the Keynes theory assumes that economic agents anticipate a move of interest rates toward some "normal" level. The interest rates that are above such a "normal" level are expected to fall; the return expected on current investment in bonds could be a good reason to use bonds, not money for storing value. When, in turn, a rise in interest rates is expected, the demand for money would increase, as due to higher interest rates the former investment in bonds would bring about losses.

The value of money is in its purchasing power; hence the money demand is the demand for its real value. It follows from J. M. Keynes' analysis that the real demand for money

M^d/P should be positively related to the real income Y and negatively related to the interest rate r, with the following general money demand function:

$$\frac{M^d}{P} = f(\underset{+}{Y}, \underset{-}{r}) \qquad [3],$$

where signs (+ or –) of respective derivations are showed beneath variables.

The speculative money demand model of the Keynes theory produces two explanations for fluctuations in the velocity of money. Using the definition of money velocity and the Keynes money demand function, it is possible to show that under money market equilibrium the velocity of money increases due to rising interest rates. The Keynes model implies that money demand depends on the normal level of interest rates that cannot be directly observed. Changes in this level may figure as a second cause for unstable velocity of money.

1.3 The Tobin model

Criticism of J. M. Keynes' analysis of the speculative money demand most often focuses on more straightforward assumptions, as the condition regarding the individual choice to either place capital in bonds or hold it as monetary assets does not foresee a portfolio diversification possibility. Eliminating this shortcoming, J. Tobin created a speculative money demand model in which, along the expected return on assets, he incorporated risk of return on assets as an additional portfolio-formation factor. According to this model, economic agents are not willing to assume risk. A constant expected return is a significant feature of monetary assets (J. Tobin considered a case of a zero expected return). Bond prices, in turn, may be subject to fluctuations, the return on them comprises risk, and a negative return is also possible. Hence risk-averse economic agents may still wish to use monetary assets also for storing value, because in this way the portfolio volatility would be limited. J. Tobin's analysis shows that portfolio diversification is possible by involving monetary assets, and hence, despite the zero return, money may serve as a medium for storing value.

1.4 The Baumol–Tobin money demand model

W. Baumol (3) and J. Tobin (31) independently of each other advanced similar money demand models, which showed that monetary assets held for conducting transactions might be affected by interest rates. This model deals with an economy where two types of financial assets are available – monetary assets that do not yield interest, and one other type of interest bearing liquid assets, e.g. bonds that cannot be used for settlements. Only money can be used in transactions, while bond trading is associated with transaction costs. In such circumstances, two types of costs are possible – costs related to holding money and a brokerage fee, offsetting the shortage of monetary assets with the income from trading bonds. Economic agents face the problem how to minimise effects of the lost interest and reduce the amount of brokerage fees. If the total value of transactions made in a particular period is Y, the brokerage fee related to trading bonds is b and the interest rate is r, the minimisation of total expenses leads to the amount of money required for transaction purposes:

$$M = \sqrt{\frac{b \cdot Y}{2 \cdot r}} \qquad [4].$$

1.5 The Friedman modern quantity theory of money

M. Friedman developed a theory in 1956 in which he defined the function of the demand for money on the basis of the theory of demand for assets.

According to this theory, the demand for monetary assets should be related to resources at the disposal of an economic agent, i.e. the total amount of assets and the expected return on alternative-to-money assets in comparison with the return on monetary assets. The demand for assets is positively related to wealth; hence the same relation exists also between the demand for money and the indicator of permanent wealth, a measure of accumulated wealth introduced by M. Friedman. Permanent income is calculated as the present value of the expected average future income, and, in contrast to income, this indicator shows less pronounced short-term volatility.

Next to money, also bonds, shares and goods can be used for storing value. The reason behind using other alternative-to-money assets for storing value is the expected return on such other assets against the expected return on money deposits; hence an increase in return on alternative assets relative to monetary assets would result in a diminishing demand for money. These considerations lead to an assumption that the function of the real demand for money is as follows:

$$\frac{M^d}{P} = f(\underset{+}{Y_p}, \underset{-}{r_b - r_m}, \underset{-}{r_e - r_m}, \underset{-}{\pi^e - r_m}) \qquad [5],$$

where
Y_p is the permanent income;
r_m is the expected return on monetary assets;
r_b is the expected return on bonds;
r_e is the expected return on shares;
π^e is the expected inflation.

By contrast to J. M. Keynes, M. Friedman considered that goods and money are substitutes, and his theory does not treat the expected return on money deposits as a constant variable. With interest rates rising in the economy, banks' income from lending also increases; in such circumstances, banks, aiming to attract new funds, push up interest rates on deposits. Competition in the banking sector is the factor driving up deposit interest rates until there is no excess profit. Under the impact of these processes, the difference $|r_b - r_m|$ is rather stable. Due to it, interest rates are likely to have little impact on the demand for money.

2. EMPIRICAL MODELS OF MONEY DEMAND

Theoretical studies of the demand for money indicate that the demand-formation mechanism is complicated and the money demand function can be derived analytically only for highly straightforward models. Theory, however, ranks prominent in empirical studies of the money demand, as it furnishes information on variables, derivation signs and values of parameters of the demand function that can be used in advancing statistically verifiable hypotheses and interpreting economically empirical results.

According to theoretical models, the money demand could be determined by the price level P, the volume of transactions T made in the economy, opportunity costs of holding money r, and the interest rate R on money deposit. Expecting a stable long run equilibrium, the demand theory for money postulates the relation of the money demand equilibrium and justifies derivation signs of the function:

$$M^d = f(\underset{+}{T}, \underset{+}{P}, \underset{-}{r}, \underset{+}{R}) \qquad [6].$$

Due to stochastic deviations, the equilibrium, in fact, is never achieved, yet in the event of a stable equilibrium an adjustment to equilibrium should take place.

The theoretically substantiated function of the demand for money is an equilibrium relation, yet due to changes in the determinants of money demand, equilibrium would be attained with a certain lag. As a rule, economic modelling uses time series with such periodicity of observations that does not allow for assuming the adjustment to equilibrium as proceeding without lags; the time series of economic variables comprise information on both structural relations of variables and dynamics. Hence specification of the model, which is appropriate for forecasting, should take into account also dynamic properties of variables, and it is important to seek for a correct specification of both the model structure and dynamics.

2.1 The partial adjustment model

The error-correction model is generally accepted for analysing the demand for money. Early studies of the money demand widely exploited the so-called partial adjustment model advanced by G. C. Chow, which can be considered to be a special case of the single equation error-correction model. This model extends the conventional money demand model by assuming that the actual amount of money may differ from the equilibrium money demand, yet with time the equilibrium is recovered. Even though the conditions for adjustment to equilibrium incorporated in the partial adjustment model are too specific, and volatility of money demand functions has been often observed in empirical studies, this model underpinned the development of dynamic models of the demand for money.

The partial adjustment model for money demand has been developed on the basis of the equilibrium approach to the demand for money. The demand equilibrium model assumes that any factor changes with an impact on the demand for money are immediately followed by an action of economic agents aimed at complete adjustment of money balances to the new equilibrium level. The most widely used formulation of the money demand long-run equilibrium relation is as follows:

$$m_t^* = a_0 + a_1 y_t + a_2 r_t \qquad [7],$$

where
m_t^* is the real demand for money under conditions of equilibrium;
y_t is the real income;
r_t is variables representing opportunity costs.

All components of the equation are logarithms of corresponding variables in the period t.

The partial adjustment model assumes that the adjustment to equilibrium money market is hindered by portfolio adjustment costs, which do not allow for the adjustment of the actual money stock to the desired level in one period of time. According to the scheme proposed by G. C. Chow, for the purpose of describing the equilibrium adjustment dynamics (9), the difference between the actual and equilibrium stock of money diminishes as showed by the following relation:

$$m_t - m_{t-1} = \delta (m_t^* - m_{t-1}) \qquad [8],$$

where m_t is the actually demanded quantity of money and the partial adjustment coefficient $0 < \delta < 1$. When the long-run money demand equilibrium relation is combined with the equilibrium adjustment relation, the following equation is obtained:

$$m_t = \delta a_0 + \delta a_1 y_t + \delta a_2 r_t + (1 - \delta) m_{t-1} \qquad [9],$$

where coefficients a_1 and a_2 denote the long-run elasticity of money demand, whereas δa_1 and δa_2 denote the short run elasticity of money demand.

Until the beginning of the 1970s, the partial adjustment model performed well in the studies of money demand; however, later its application was associated with insurmountable problems, instability of demand functions for money and the subsequent inaccurate forecasts of the money stock in particular. However, the application of weighted monetary aggregates in an attempt to avoid volatility of the money demand, which stemmed also from an inaccurate definition of monetary aggregates, did not eliminate regular forecast errors of the partial adjustment model.

The partial adjustment model is characterised by an extremely low estimation of the interest rate short-run elasticity, which on average was one order lower than the estimation of interest rate long-run elasticity. The adequacy of the model specification becomes highly questionable also due to the fact that the main explanatory factor is the lagged monetary variable implying a very long period of adjustment to equilibrium. Critical remarks in the address of this model focus also on the current econometric problems, among which central are the simultaneity bias of parameter estimates and the spurious regression problem associated with non-stationarity of time series.

2.2 The buffer stock model

In the 1980s, the buffer stock model was developed as an alternative approach for the estimation of parameters of the demand function for money with the aim to offset the poor performance of the partial adjustment model. The precautionary motive of holding money underpinned the development of the buffer stock model to justify the proposed dynamic specification. Transaction costs limit the portfolio adjustment process; hence, due to unexpected inflows of money, surplus cash balances may form. As the buffer stock of money allows for offsetting unexpected outflows and inflows of money, economic agents accept temporary fluctuations of the money stock from the optimum level m^*. In contrast to the partial adjustment model where a short-term money supply in the economy is determined mainly by the demand, money supply under the buffer stock model is exogenous, and it is the money supply factors – open market operations and expansionary lending of the banking system – that primarily influence the money stock.

J. Carr and M. R. Darby created a shock-absorbing model (8), which is one of the most popular buffer stock approaches widely used in empirical studies. Under this model, a variable representing a money supply shock is additionally included in the demand function for money, while the specification of dynamics is equivalent to the partial adjustment model. The first equation of the model by J. Carr and M. R. Darby is as follows:

$$(m_t - p_t) = \beta_0 + \beta_1 y_t + \beta_2 r_t + \beta_3(m_{t-1} - p_{t-1}) + \alpha(m_t - m_t^*) + u_t \qquad [10],$$

where $(m_t - m_t^*)$ is the unexpected supply but $(m_t - p_t)$ is the logarithm of the actual supply of money. The unexpected supply of money m_t^* is described by the following equation:

$$m_t^* = gZ_t + \varepsilon_t \qquad [11].$$

Z is the vector of variables with a regular effect on money supply as viewed by the economic agents, while g denotes model parameters. Criticism of this model so far has mainly focused on econometric problems implied by its specification. By including the variable m_t on both sides of the equation, the residual variable u_t and m_t cannot be viewed as non-correlated.

Even though the buffer stock model is theoretically sound, its quality has not been sufficiently appropriate for empirical research, and the model has been scrapped. The basic failure of the model consists in its equilibrium-adjustment dynamics, which is more complicated than can be captured by the partial adjustment and buffer stock models. Nowadays, the analysis of the demand for money most often rests on the error-correction model.

2.3 The error-correction model

In empirical money demand studies, the error-correction model has taken its place as the most appropriate instrument of investigation. This approach combines two relations – the adjustment to the long-run equilibrium upset by the effects of stochastic factors (error-correction) and the description of short-run dynamics – in a single equation. The error-correction model represents a methodological trend according to which an appropriate specification of the data dynamic structure plays an essential part in economic modelling. Over a longer term, the model should represent structural relations of the economy, whereas the specification of the short-run dynamics is derived from the analysis of data. The studies of the equilibrium adjustment dynamics have shown that the process is more complicated than implied by the partial adjustment and buffer stock models, and it has determined the failure of the two.

In comparison with the above-described models used in analysing the demand for money, the error-correction model has a number of advantages, of which the possibility to avoid spurious statistical inferences when analysing the regression of non-stationary variables is the first to be mentioned. In contrast to models with only differentiated time series, information on long-run relation among variables is not lost when using the error-correction model; moreover, the specification allows for distinguishing between the short-run and the long-run effect.

Initially, the error-correction model was a single equation model, yet its evolution resulted in an extended model of several equations or the so-called vector error-correction (VEC) model. This model respects endogeneity properties of variables, and it is an advantage that often supports building of a stable money demand model.

3. THE DEMAND FOR MONEY: PROBLEM INVESTIGATION IN OTHER COUNTRIES

Since the end of the 1970s, when economists in the US and other advanced countries were unable to explain the actual development of money aggregates by means of the money demand function, they have plunged into extensive studies of the demand for money. Search for causes of and solutions to volatile money demand deepened the overall perception of the demand for money and fostered the appearance of new methods of econometric analysis.

Money demand is a significant subject of research for central banks. In Finland, the research by A. Ripatti (28) which investigates the demand for money, the models for the monetary aggregates M1 and M2 have been created using the specification of the vector auto regression (VAR) model, which, on the basis of test results, can be reduced to a single equation model. The advantage of such a modelling strategy is the possibility to identify, by statistical methods, exogenous factors and simplify the model structure avoiding initial possibly erroneous assumptions regarding exogeneity of variables. The study discloses exogeneity of interest rates and prices. The findings of the study are consistent with the inference of the economic theory that in a small and open economy with a fixed exchange rate regime interest rate fluctuations in a long-run are not caused by money supply but rather by foreign interest rate developments and currency risk.

The research paper developed by S. Hendry at the central bank of Canada (21) is among the numerous studies of the 1990s using the co-integration analysis method of S. Johansen. The aim of the analysis is to examine long-term relationships among the monetary aggregate M1, prices, output and interest rates in Canada, questioning the existence of a stable relation that could be interpreted as a long-run demand for money. Quarterly data (1956–1993) have been used in the estimation of co-integration relationships. The VEC model analysis has led to the following finding: if M1 exceeds the long-run demand, M1 will decline and prices will go up, adjusting to equilibrium. The effect is insignificant in terms of output and interest rates, pointing to weak exogeneity of the given variables. Though the outcomes indicate that the adjustment to monetary equilibrium is determined by fluctuations in money stock and prices, the existence of real effects of short-run monetary changes are not ruled out. The parameter analysis of the short-run dynamics leads to a conclusion that changes in the quantity of money do have an effect on the economy over a shorter horison.

The 1980s was the period, when the majority of world central banks scrapped the strategy of intermediate monetary targets. The main reason for this change of the monetary policy strategy was the growing instability of the relation among the money supply, interest rates, income and prices caused by structural changes of the financial markets. The central bank of Germany was among those banks that continued to pursue the monetary targeting strategy; hence the demand for money has been extensively examined in this country. D. Gerdesmeier's research (16) is dedicated to comprehensive studies of the part played by wealth in the German demand for money.

M. Scharnagl's paper (29) provides a detailed discussion of suitability of the monetary aggregate M3 for monetary policy strategy, building on the P^* approach developed by J. J. Hallmann, R. D. Porter and D. H. Small (18). The study provides a comprehensive insight in suitability of the definition of money aggregates, stability of the money demand, controllability of the monetary intermediate target and the level of its linkage with the ultimate goal of monetary policy. When defining monetary aggregates, the question whether from the point of view of economic agents financial assets included in a monetary aggregate belong to the same category of assets (money) is usually omitted. The choice of a particular combination of financial assets is determined by preferences of economic agents that can be described by the utility function. Financial assets m are characterised by the weak separability property in relation to commodities c, if arguments of the utility function

$$u = u(c_1, c_2, \ldots, c_M, m_1, m_2, \ldots, m_N) \qquad [12]$$

can be sub-grouped and the utility function written as follows:

$$u = u(C(c_1, c_2, \ldots, c_M), M(m_1, m_2, \ldots, m_N)) \qquad [13].$$

Weakly separable groups can be viewed as elementary commodities, for the marginal rate of substitution of elements within one group depends only on the amount of elements within this particular group. If the weak separability property is inherent in a particular financial asset group, open preferences of economic agents should not be contradictory to GARP – the Generalised Axiom of Revealed Preference. The monetary aggregate satisfies GARP, if under the inequality:

$$p^j m^j \geqslant p^j m^i \qquad [14],$$

the following inequality does not hold:

$$p^i m^i > p^i m^j \qquad [15],$$

where m^i, m^j are financial assets and p^i, p^j are their prices. Interpreting i and j as time indices, H. R. Varian proposed verification of this axiom as a non-parametric test for identification of the weak separability of the financial asset group (32), in such a way avoiding problems associated with the selection of a certain utility function. Though the period (1977–1995) selected for the study contains observations that do not meet GARP terms for the monetary aggregate M3, the axiom is not violated in the shortened selected period (1983–1995). It must be admitted that when selecting components of a monetary aggregate, reliability of this test should not be overestimated because of its low power.

When selecting the monetary targeting strategy, the stability of the money demand function is a decisive precondition to use the monetary aggregate as an intermediate monetary policy goal. The outcomes of testing stability of the demand for money confirm that the narrow monetary aggregate M1 is not appropriate for an intermediate target of monetary policy (16), while the demand function of the monetary aggregate M3 is stable and interest rates may be used as a policy instrument in controlling the amount of money.(4)

When certain unanimity regarding theoretical aspects of the formation of the demand for money was achieved and given the diminishing confidence in monetary aggregates as sound intermediate targets of monetary policy, economists started to lose interest in the demand for money. Nevertheless, data quality of the monetary sector's indicators and a comparatively small number of variables needed for an adequate model formulation enhanced the application of the money demand analysis when demonstrating the practical application of new econometric methods. The research conducted by S. Johansen and K. Juselius (23), which demonstrates the maximum likelihood method using models of the demand for money in Denmark and Finland, is ranked among the classical works of economic science.

The analysis of money demand is used for the purpose of demonstrating a new theoretical approach to defining and testing variable exogeneity concepts. The paper by N. R. Ericsson, D. F. Hendry and G. E. Mizon (13) deals with the concepts of exogeneity, causality and invariance, reflecting the application of the exogeneity concept in econometric models with co-integrated variables. The given issues of econometric modelling are illustrated using the UK money demand model.

The money demand studies have not lost their importance. As countries with unstable money demand are also members of the EMU, issues of the money demand stability in the euro area, despite the prominent share of Germany, are still in the focus of research. Investigations conducted (5) confirm stability of the demand for the monetary aggregate M3, which can be explained by both the part Germany plays in the euro area and the stabilising effect of pooling monetary aggregates of different EMU countries.

4. MODELLING MONEY DEMAND FOR LATVIA

The modelling of the demand for money in Latvia follows three stages. At the first stage, appropriate variables for the money demand model are selected; estimation of their stationarity and co-integration is conducted at the second stage, and, finally, proceeding from several statistical tests the optimum specification of the model is derived.

4.1 Selection of model variables

When engaging in money demand investigations, researchers in Latvia face a major problem of economic empirical studies, i.e. the selection of statistically measurable indicators that would be compatible with theoretically presented ones. In the modern economy, a great many of liquid financial instruments can perform functions of money, and the demand function for narrow monetary aggregates may be instable. Of less liquid assets with monetary properties, only the share of time deposits is significant for the Latvian economy. Given the share of deposits in foreign currencies in total deposits (almost 40% in early 2004) and the use of foreign currencies in settlements, broad money M2X incorporating deposits in both lats and foreign currencies is the best measure of the money supply. As the value of money consists in its purchasing power and the real demand for money is the object of this study, the real quantity of money computed by dividing the nominal indicator with the consumer price index (CPI) is used to characterise the supply of money. Gross domestic product (GDP) at constant prices of 2000 has been chosen as the income-representing variable.

An important issue of the money demand studies is opportunity costs of holding money, which stem from different rates of return on money and alternative assets. Government bonds, whose liquidity on the secondary market of securities compares well to time deposits, can be considered the most significant alternative for storing wealth. Nevertheless, due to the relatively low level of wealth and income, private persons most often prefer bank time deposits; therefore, the yield on government bonds in Latvia is not the best indicator for opportunity costs of holding money.

Attempting to incorporate financial sector indicators in the models, one encounters serious additional problems, of which the major one is heterogeneity of data typical for the indicators of Latvia's financial markets even over a short period of time. It is associated with both the dynamic evolution of the Latvian financial sector and the low level of overall development in the mid-1990s to which the time series used in macroeconomic studies refer. Hence the possibility to ascribe the results obtained by statistical methods to the current situation is limited. The length of the financial sector time series is another problem. Data on the secondary market quotations of the government debt instruments became available in 1999 starting with the conduct of such transactions on the Riga Stock Exchange. Though technically these data permit the assessment of regression parameters for several factors, opportunity costs of cash deposits, according to the theory, are a weak indicator of the money demand and its effects cannot be observed over such a short period.

Opportunity costs of holding money are incurred also due to a rise in prices. The indicator of expected inflation might be a considerably more important source of opportunity costs of holding money than the yield on financial instruments. The deposit interest rate, in turn, pushes up the demand for money. As the time series of annual inflation and interest rates are relatively tightly correlated, the multicollinearity problem will emerge and reduce the efficiency of parameter assessment if these indicators are included as separate variables. Another factor of the empirical money demand function is the real interest rate on deposits, which is calculated by approximately assessing the expected inflation rate in the up-coming year on the basis of the current inflation rate.

In the selected period (1996–2003), money supply was not the key factor affecting prices, while inflation in Latvia was mainly driven by price convergence processes and changes in administratively regulated prices and tax rates. Therefore, the vector of endogenous variables does not comprise the price level component, as the latter is affected by factors not included in the model. The model specification assumes that in the long run the so-called money illusion is non-existent and, therefore, the real demand for money does not depend on the price level.

The vector of model variables used in the study, thus, is made up of the real supply of the broad money using the consumer price index as deflator: $m - p$ = ln(M2X/CPI), GDP at constant prices of 2000: y = ln(GDP) and the real long-term deposit rate: $r = i_D - \pi^e$ (graphic charts of indicators' time series are given in Appendix 1). The first quarter of 1996 is used as the initial sample period, with macroeconomic indicators during the 1995 banking crisis, when the Latvian economy experienced serious shocks due to which statistical relationships between indicators were loose, being omitted.

4.2 Co-integration analysis

Though theoretically money demand factors can be reduced to comparatively few accurately measurable economic indicators (GDP, CPI and interest rates), the latter reflect economic sectors that are mutually interacting with each other. Single equation error correction methods developed at the initial stage of co-integration analysis are applicable only if the involved variables are linked by a single co-integration vector; however, even in such cases unbiased parameter estimates are not always obtainable. The estimation of the money demand parameters using the single equation error correction model is applied if the demand factors can be treated as exogenous. The validity of the single equation error correction model and exogeneity properties of its explanatory factors can be investigated on the basis of the general co-integration analysis developed by S. Johansen.(22)

The Johansen co-integration analysis theory, which is not limited by a priori assumptions regarding the number of co-integration relations and exogeneity of regression variables, is developed using the VAR model:

$$X_t = \Pi_1 X_{t-1} + \ldots + \Pi_k X_{t-k} + \varepsilon_t; \quad t = 1, \ldots, T \qquad [16],$$

where the number of equations is p, X_t is the $(p \times 1)$ vector of variables, Π_i are $(p \times p)$ matrices of coefficients, but $\varepsilon_t \sim N(0, \Sigma)$ is the $(p \times 1)$ matrix of independently and identically distributed residuals with covariation matrix Σ. This model can be transformed into the following equivalent equilibrium correction model:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_k \Delta X_{t-k+1} - \Pi X_{t-k} + \varepsilon_t \qquad [17].$$

The coefficient matrices of both models are linked by relations $\Gamma_i = \Pi_1 + \ldots + \Pi_i - \mathrm{I}$ and $\Pi = \mathrm{I} - \Pi_1 - \ldots - \Pi_k$. If indicators involved in the vector X_t are integrated processes, and stationary linear combinations of the indicators' time series exist, the time series are called co-integrated and their coefficient vectors are known as co-integration vectors. The Johansen co-integration analysis is based on the relation between the rank of matrix Π and stationarity properties of time series included in the vector X_t. According to the Granger representation theorem (11), if the rank of the coefficient matrix Π is smaller than its order $r < p$, $(r \times p)$ matrices α and β with the rank r exist, and the matrix Π can be expressed as follows:

$$\Pi = \alpha \beta' \qquad [18],$$

hence time series $\beta' X_t$ are stationary. The columns of matrix β form co-integration vectors, which can be economically interpreted as parameters of equilibrium relation, while elements of the matrix α describe the speed of adjustment to equilibrium.

Estimations of matrices α and β are obtained by solving the eigenvalue problem:

$$\left| \lambda S_{11} - S_{10} S_{00}^{-1} S_{01} \right| = 0 \qquad [19],$$

where matrices

$$S_{ij} = T^{-1} \sum_{t=1}^{T} e_{it} e_{jt}; \quad i, j = 0, 1 \qquad [20]$$

are calculated from the ordinary least square estimates of residuals of regressions:

$$\Delta X_t = \Gamma_{01} \Delta X_{t-1} + \ldots + \Gamma_{01} \Delta X_{t-k+1} + e_{01} \qquad [21]$$

and

$$X_{t-p} = \Gamma_{11}\Delta X_{t-1} + \ldots + \Gamma_{1k-1}\Delta X_{t-k+1} + e_{11} \quad [22].$$

When solving the matrix eigenvalue problem (see equation [19]), eigenvectors $\{\hat{v}_1, \ldots, \hat{v}_p\}$ and eigenvalues $\hat{\lambda}_1 > \ldots > \hat{\lambda}_p$ are obtained; the eigenvectors $\{\hat{v}_1, \ldots, \hat{v}_r\}$ corresponding to the largest values of r are the estimates of co-integration vectors.

For the purpose of determining the number r of co-integration vectors, S. Johansen and K. Juselius developed tests for the rank of the matrix Π.(23) The matrix trace test is used to check the null hypothesis $H_0 : rank(\Pi) \leq r$ on the basis of test statistics:

$$\lambda_{trace} = -T \sum_{i=r+1}^{p} \ln(1 - \hat{\lambda}_i^2) \quad [23],$$

where $\hat{\lambda}_{r+1}^2, \ldots, \lambda_p^2$ are the smallest eigenvalues of $p - r$. The hypothetical alternative of this test is the assumption that there are more co-integration vectors than r. The largest eigenvalue test appraises the hypothesis $H_0 : rank(\Pi) = r - 1$ against the alternative $rank(\Pi) = r$, using

$$\lambda_{max} = -T \ln(1 - \hat{\lambda}_r^2) \quad [24]$$

as test statistic.

4.3 Money demand models in Latvia

Proceeding from the arguments above, the money demand model is based on the VEC model, which allows for incorporation of information on the dynamic structure of long run interrelation of variables and rather general dynamic structure of data without imposing restrictions on exogeneity properties of variables. This approach ensures elimination of the spurious regression problem that emerges when using non-stationary time series in the estimation of parameters, and avoidance of simultaneity bias associated with potential endogeneity of variables.

In order to identify the co-integration matrix rank of the VEC model, the Johansen trace test has been applied, with its results summarised in Table 1.

Table 1

RESULTS OF THE CO-INTEGRATION MATRIX TRACE TEST

H_0	H_1	λ	λ_{trace}	α = 0.05	α = 0.01
$r = 0$*	$r > 0$	0.5139	32.7089	29.7971	35.4582
$r = 1$	$r > 1$	0.2242	8.9050	15.4947	19.9371
$r = 2$	$r > 2$	0.0159	0.5276	3.8415	6.6349

* The hypothesis is rejected at the significance level of 0.01.

The outcomes of the test show that the null hypothesis $H_0 : r = 0$ can be rejected at the criterion significance level $\alpha = 0.05$; by contrast, neither the hypothesis $H_0 : r = 1$ nor the hypothesis $H_0 : r = 2$ can be rejected. According to these results, the time series $m - p$, y and r are linked by the same co-integration vector, and it can be interpreted as the demand for money.

The optimum short run specification of the VAR model dynamics has been selected following AIC information criteria of H. Akaike and SC information criteria of G. Schwartz, which convincingly confirm that one quarter is the optimum period of lag (see Table 2).

Table 2

VALUES OF LAG LENGTH SELECTION CRITERIA

	Q1	Q2	Q3	Q4
AIC	**–4.5127**	–4.2761	–3.9133	–3.5406
SC	**–3.6883**	–3.0394	–2.2643	–1.4590

Weak exogeneity of variables in the VEC model can be verified using the coefficient restriction test of the adjustment-to-equilibrium velocity. Testing exogeneity of GDP and interest rates against co-integration vector parameters, statistics of the coefficient restriction test and the results of testing critical values of the null hypothesis are given in Table 3.

Table 3

RESULTS OF EXOGENEITY TEST

$H_0 : \gamma_2 = 0$	$H_0 : \gamma_3 = 0$	$H_0 : \gamma_2 = \gamma_3 = 0$
$W = 0.060$	$W = 0.005$	$W = 0.065$
$\chi^2_{0.95}(1) = 3.841$	$\chi^2_{0.95}(1) = 3.841$	$\chi^2_{0.95}(1) = 5.991$

The results of testing the weak exogeneity show that neither the restrictions on individual coefficients nor the null hypotheses of the related test can be rejected; hence it can be assumed with considerably high probability that the variables y and r are weakly exogenous relative to the parameters of co-integration relation, and the following single equation model can be applied to obtain consistent and unbiased parameter estimates of this relation:

$$\Delta(m-p)_t = c_1\Delta y_t + c_2\Delta r_t + c_3(m-p)_{t-1} + c_4 y_{t-1} + c_5 r_{t-1} + c_6 + u_t \qquad [25].$$

Parameter estimates of this equation are given in Table 4 (with coefficient t-statistic in brackets). Coefficients c_1 and c_2 denote short run elasticities, the coefficient c_3 stands for velocity at which model parameters adjust to equilibrium, whereas from coefficients c_4 and c_5 long run elasticities among the model parameters can be calculated. The findings summed up in the Table lead to two basic inferences. First, a relatively high

Table 4

MONEY DEMAND FUNCTION IN LATVIA (1996–2003)

Δy	Δy_{t-1}	Δr	Δr_{t-1}	$\Delta(m-p)_{t-1}$	$(m-p)_{t-1}$	y_{t-1}	r_{t-1}	c
1.0862					–0.5419	1.2729		–8.1455
(4.9103)					(–4.1396)	(4.0916)		(–4.072)
R^2adj = 0.48, DW = 1.93 Breusch–Godfrey AR(4): F-statistic = 0.21 (p-value = 0.93) Heteroscedasticity test: F-statistic = 0.67 (p-value = 0.67) ARCH(1): F-statistic = 0.31 (p-value = 0.58)								
1.0736	–0.3764	6.870×10^{-4}	1.188×10^{-3}	0.2230	–0.6644	1.5797	-1.714×10^{-3}	–10.124
(4.1628)	(–1.0192)	(0.2184)	(0.4420)	(1.501)	(–3.721)	(3.7004)	(–0.7480)	(–3.6894)
R^2adj = 0.43, DW = 2.31 Breusch–Godfrey AR(4): F-statistic = 1.27 (p-value = 0.31) Heteroscedasticity test: F-statistic = 0.70 (p-value = 0.76) ARCH(1): F-statistic = 0.17 (p-value = 0.68)								

long run elasticity of the money demand income was observed in Latvia in the sample period: with the real income rising by 1%, the broad money in circulation increased by 2.3%–2.4% on average, pressing money velocity down by 1.3%–1.4% on average in accord with the quantity theory of money. Second, as is seen from coefficient estimate t-statistic, real interest rate elasticities of both the short run and the long run money demand are statistically insignificant, and parameter estimates of the simplified regression equation are rather insensitive to the non-inclusion of interest rates in the model (i.e. the simplified specification of dynamics does not impair statistical properties of the model, as is shown by stability testing; see Appendix 2). The economic development trends of Latvia in this period are to a great extent an explanation for the two facts.

First, there is a mutual interrelation between bank lending to the economy and the formation of deposits, and, in periods of a lending boom, a steep rise in the quantity of money may be experienced. Long-term deposits, on the one hand, constitute credit resources of banks and enable them to engage more actively in long-term lending. On the other hand, lending, which over a shorter horison pushes up the volume of demand deposits, in the process of money circulation has an effect also on the volume of long-term deposits. An increase in longer-term deposits indicates that money is on the demand as a medium of storing value.

Second, an underdeveloped financial market that misses diversified opportunities for capital and stock formation and does not offer an alternative for depositing cash with banks can also drive the demand for money. The role of money as a store of value and the demand for money would strengthen, if during a more active period of lending, when an inflow of funds in the economy boosts cash flows and the income of economic agents, broad based alternatives for investing in more profitable and simultaneously liquid assets are not in place.

The second half of the 1990s was a complicated period of development, full of confusion and risks for the financial sector of Latvia and its overall economic growth. Notwithstanding the obvious successful macroeconomic stabilisation, mistrust toward the banking sector grew notably after the banking crisis of 1995, resulting in a shortage of banks' long-term credit resources. Relatively mixed economic growth trends and the outlook for development, in turn, encumbered the assessment of business projects, limiting the access to credit for a vast range of economic agents. Long-term credit was mainly extended to low-risk projects; large enterprises won a significant share of the funding. Lending to private persons was at the initial stage of development, real estate market was underdeveloped, while mortgage lending did not gain momentum due to excessively high interest rates. Consequently, the interest rates on long-term loans were more volatile and lower on average than those on short-term loans and hence less representative as a credit price measure.

The limited demand for low risk project financing and the relatively tight competition among banks in the market sector of large enterprise financing compelled banks to seek for alternative investment opportunities outside Latvia. The short-term debt instruments of Russia whose yield rates became more and more attractive due to deepening of Russia's financial dependence on additionally attracted foreign financial resources, were seen by Latvia's banks as such an apparently low risk alternative. However, the favorable situation for short-term financial investment did not last long. As a result of the 1998 financial crisis in Russia, Latvia's banks incurred significant losses, and confidence in the banking sector was shaken. Depositors' response further weakened the banking sector whose credit policy became particularly cautious.

The beginning of 2000 marked a turning point between the periods of economic restructuring and dynamic growth. Re-assessing the risk-adjusted performance of foreign markets and recovering from losses incurred on the Russian market, Latvian banks engaged in domestic lending that escalated competition and, with interest rates on loans dropping, enhanced an overall accessibility to credits. The activity of foreign banks considerably stiffened the competition among banks and facilitated the attraction of long-term financial resources. These factors were supported by falling interest rates on global financial markets that caused also a drop in interest rates on loans. These processes served as a starting point for vast-scale lending to the Latvian economy that improved the economic outlook, promoted the development of the real estate market and pushed up the contribution of the domestic demand to the overall economic growth.

Taking due account of the distinctive performance of the banking sector in the late 1990s and the last four-year period, it is appropriate to distinguish the two periods and to assess potential differences of the money demand parameters in them.

By dividing the time series of macroeconomic indicators into two periods, the sample selection is reduced to 16 observations, and no analysis is possible using previously used approaches. Taking into account the findings of the previous analysis that confirm the tightness of the money demand equilibrium equation, a simpler model, limited to the analysis of the money demand equilibrium relation for each period as is shown in Table 5, can be used.

Table 5

MONEY DEMAND IN LATVIA IN TWO SAMPLES

1996–1999			2000–2003		
c	*y*	*r*	*c*	*y*	*r*
–15.714	2.4408	1.0770×10^{-3}	–14.449	2.2652	-3.0270×10^{-3}
(–8.9024)	(9.4939)	(0.3147)	(–9.2474)	(13.008)	(–0.2910)
$R^2 = 0.95$			$R^2 = 0.98$		
DW = 1.38			DW = 1.88		

As the outcomes of the regression analysis indicate, the money demand income elasticity for both periods does not differ within the margins of the statistical error, confirming stability of the money demand and the income level relation. Though interest rate elasticity is not statistically significant in either of the periods, the elasticity sign of the money demand interest rate for the sample period of 2000–2003 is consistent with the theory. According to the estimation of interest rate elasticity, an increase of one percentage point in real interest rates at a maintained monetary equilibrium causes a fall of approximately 0.3% in the volume of money. However, taking into account the rapid growth of the economy and the relatively small interest rate fluctuation margins in the reviewed period, including also the period of the dynamic development of lending, the contribution of interest rates to the demand for money is notably overcome by the effects of changes in the income level. The fact that the influence of interest rates in the second sample period has increased (statistical insignificance of this increase notwithstanding, the small sample hinders from obtaining a reliable inference about the significance of interest rates) suggests that with the economy developing and lending increasing, interest rate effects are likely to strengthen in the future.

The velocity of broad money has fallen in both sample periods (see Chart 1), and the fall has been particularly notable in the last four years due to the robust economic and lending growth in circumstances of the persisting low inflation rate.

Despite a considerable recent fall in the velocity of broad money, it still notably exceeds the level in Central European countries and in particular that of advanced western economies (see Table 6). It can well be explained by differences in income and savings levels: according to Eurostat estimates, the average income level in Latvia was still the lowest among the EU countries in 2003.

Chart 1

BROAD MONEY VELOCITY IN LATVIA

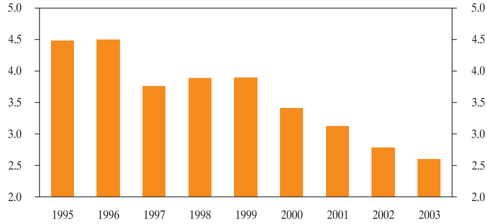


Table 6

BROAD MONEY VELOCITY

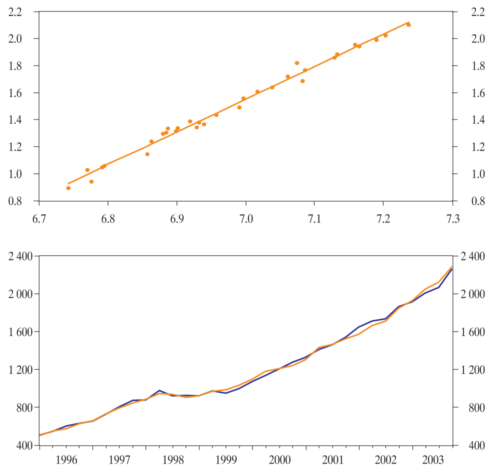
Latvia*	Poland*	Estonia*	Hungary*	Slovakia*	Germany**	US**	UK***
2.60	2.38	2.31	2.11	1.59	1.44	1.25	1.03

* M2
** M3
*** M4

Assessing forecasting properties of the broad money model, the notable explanatory power of the money demand equilibrium relation ensuring high model forecast precision within the sample deserves attention. In combination with the so far observed robust relation between the amount of money in circulation and the income level, it allows for the application of the estimated money demand function for forecasting purposes (see Chart 2).

Chart 2

FORECASTING OF BROAD MONEY USING MONEY DEMAND MODEL
$(m - p = a + by)$



M2X
M2X model forecast

The money demand function can be used in forecasting monetary aggregates, and its combination with the money supply model for predicting the monetary multiplier permits a timely forecast of liquidity developments. Taking into account robustness of the demand for money and the comparatively short monetary equilibrium adjustment time, broad money can be used as an effective indicator of economic activity, because broad money aggregates are published earlier than are those of the GDP dynamics.

The observed relations indicate that with the economic growth in Latvia continuing, the income level is likely to rise also in the future triggering an increase in the quantity of money. Notwithstanding the intensive lending, the amount of funds extended as credit has not yet reached the level of saturation, and the outlook for economic development implies that further monetisation of the economy is expected. Likewise, a further fall in the velocity of broad money (a precondition for the current robust money demand function) to the level of the other EU Member States may be experienced. Hence the fact that the quantity of money in circulation grows faster than the income level does not create direct inflationary pressure, and there are no grounds for concerns about the monetary policy being too loose. However, the fall in the velocity of broad money at the current pace is unlikely to persist in the future, and with the broad money velocity coming closer to the level of the advanced European countries, the fall would decelerate.[1] Consequently, the relation between the growth rate of the income level and the quantity of money in circulation in Latvia is likely to strengthen, and an excessively rapid growth of the quantity of money in circulation would signal potential inflationary pressures.

[1] For instance, ECB's monetary policy is based on the assumption that the velocity of broad money in EMU countries annually falls by 0.5%–1.0% on average.

CONCLUSIONS

The econometric analysis of the demand for broad money in Latvia has been conducted on the basis of economic theories that outline the basic determinants of the demand for money – changes in the income level and interest rates. The vector of variables in the model used is formed from the real demand for broad money, GDP at constant prices of 2000 and the real interest rate on long-term deposits.

The investigation led to a conclusion that a stable money demand equilibrium relation exists, and GDP and real interest rates on deposits are exogenous in respect to the parameters of the equilibrium relation. The testing equilibrium parameter restrictions of the equilibrium correction VEC model indicates that the equilibrium adjustment dynamics is determined solely by changes in the quantity of money, while short-run money supply changes are not accompanied by changes in GDP and interest rates. Consequently, parameter estimates of the single equation regression model will not have a bias associated with endogeneity of explanatory variables.

When analysing model parameter values, it should be noted that the high long-run income elasticity of money demand (around 2.3%–2.4%) implies a descending trend of the broad money velocity. In addition, fast adjustment to equilibrium, approximately estimated at 0.54, is typical for the money demand. High level income elasticity is characteristic for the economic development at the stage of fast monetisation, while, on the other hand, such elasticity should not be unequivocally interpreted as a long run elasticity. And though in the period dealt with in the paper a stable relationship links monetary aggregates and income, with the income level rising, the velocity of money is going to fall in the future, thus also reducing income elasticity of the money demand.

The findings of econometric estimations indicate that real interest rate elasticity of the demand for money is statistically insignificant. When analysing these outcomes it should be noted, however, that the power of statistical inference criteria depends on both the number of observations and the magnitude of the relation. When short sample periods are used, the relatively weak explanatory factors are difficult to distinguish from the insignificant ones; hence statistical inference procedures cannot lead to an unambiguous answer regarding the presence of such processes that according to the economic theory are rather weak yet significant for the analysis of monetary policy. It should be noted at the same time that with the strengthening of lending in the last 3–4 year period, the impact of interest rates on the money demand has been slightly growing.

Though, in order to arrive at a more effective estimation of statistically significant parameters, the exclusion of statistically insignificant factors from the models meant for forecasting is a widely accepted practice, quantitatively small relations are also important for models employed in macroeconomic analysis to provide economically interpretable and meaningful model simulation features. Taking into account that, from the quality aspect, the obtained interest rate elasticities are economically interpretable – with real interest rates on deposits falling, the demand for money also becomes weaker, though only slightly, and the long run elasticity notably exceeds the corresponding short run elasticity – the derived model can be used also in the estimation of the impact of monetary policy.

Notwithstanding the stable demand for money characterising Latvia's economy, the specific features of price and interest rate formation in a country with a small and open economy implementing a fixed foreign exchange rate regime should be considered when analysing the possibility to use the money demand for monetary policy purposes. In an open and small economy with a fixed exchange rate regime, there is little room for independent interest rate policy along maintaining the stability of the exchange rate peg.

In a long-term perspective, inflation is a monetary phenomenon, but in a medium term the price formation in Latvia is notably affected by the price level of marketable goods in trade partner countries and by changes in administratively regulated prices, while a rise in the quantity of money is likely to have a direct effect only on the prices of non-tradeables. Though in line with improvements in people's well-being the consumption basket share of prices for non-tradeables increases, the share of non-tradeable non-regulated goods is still almost two times below the level in advanced European countries. Hence the controlling of the amount of broad money cannot serve the purpose of accurate controlling of inflation in a medium term, during which the domestic demand may be regulated by means of monetary policy. Moreover, the low elasticity of interest rates and the limited ability of the Bank of Latvia to influence interest rates and simultaneously preserve exchange rate stability completely rule out the application of monetary aggregates as intermediate goals of monetary policy and support the assumption that the strategy of monetary aggregate control is not useful for a country with a small and open economy.

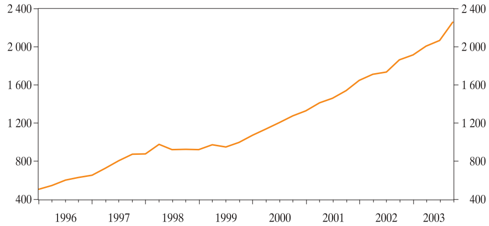
Despite the above-given limitations to the application of the money demand function, the stability of the demand for money allows for the money aggregates to be used as indicators of the economic activity. Taking into account the close relation between broad money and factors of the demand for money, the inverted money demand function can be used in effective estimation of GDP.

The money demand function can make a definite contribution to the monetary policy implementation. By using the money demand function and simulating the money multiplication process, it is possible to project the amount of the required bank reserves in line with expected developments in the economy and bank lending. Consequently, the money demand and supply models can be used in the process of liquidity management of the banking sector.

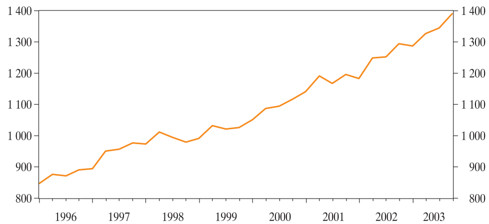
Appendix 1

CHARTS OF BASIC ECONOMIC INDICATORS

BROAD MONEY M2X
(in millions of lats)

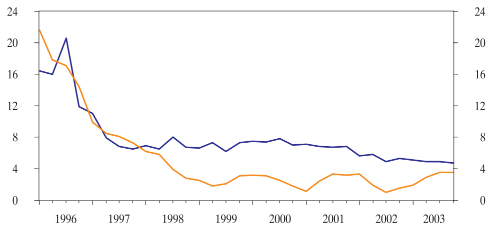


REAL GDP
(in millions of lats)



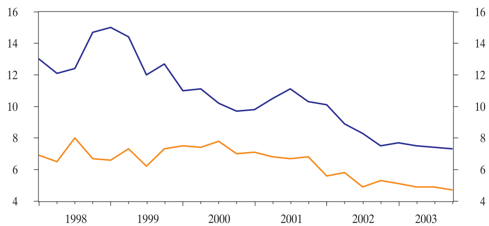
LONG-TERM DEPOSIT RATES AND INFLATION

i_D
π



LONG-TERM LENDING AND DEPOSIT RATES

Loans
Deposits

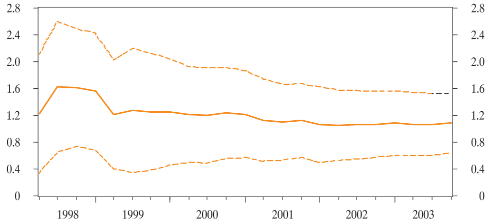


Appendix 2

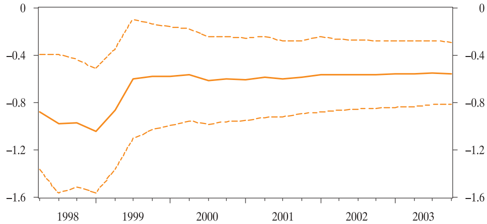
TESTS FOR THE MONEY DEMAND MODEL STABILITY

RECURSIVE COEFFICIENT STABILITY TESTS

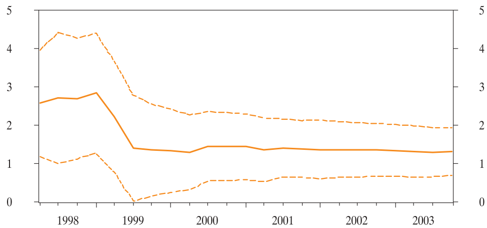
— Δy recursive coefficient
- - - ± 2 standard errors



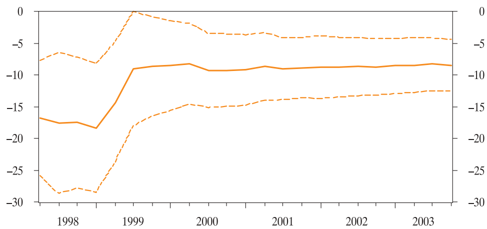
— $(m-p)_{t-1}$ recursive coefficient
- - - ± 2 standard errors



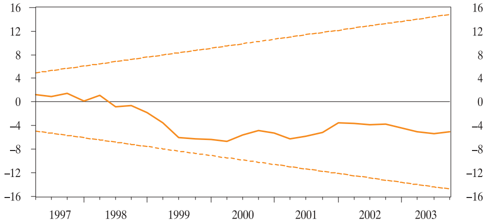
— y_{t-1} recursive coefficient
- - - ± 2 standard errors

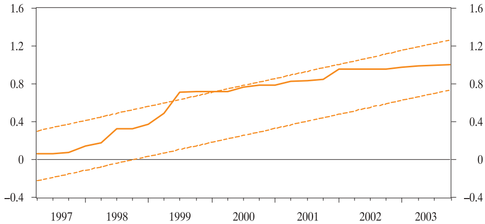


— c recursive coefficient
- - - ± 2 standard errors



CUMULATIVE SUM CUSUM AND CUSUMQ MODEL STABILITY TESTS





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