Original scientific paper
UDC 336.711.61: 514.742.4

The determinants and stability of money demand in the Republic of Macedonia*

Jordan Kjosevski[1]

Abstract

The goal of this paper is to examine the long and short-run determinants, and stability of money demand (M1) in the Republic of Macedonia using monthly data from January 2005 to October 2012. The Johansen cointegration technique and VECM model were used to find the long-run and short-term dynamic relationships in money demand model. Empirical results provide the evidence that exchange rate and interest rate payable on denar time deposits up to one month explains the most variations of money demand in the long-run, while interest rate is significant only in short-run. Long-run money demand function is estimated to indicate slow speed of adjustment of removing the disequilibrium. Our finding shows that real money demand M1 in the Republic of Macedonia is stable in the analyzed period. The results obtained in this study suggest that the National Bank should carefully monitor the exchange rate and inflation as two most important indicators of monetary policy, because these two determinants are the main drivers of demand for money in the short and long term.

Key words: *money demand, cointegration, vector error correction model, stability, Republic of Macedonia*

JEL classification: *C32, E41, E52, E 58*

1. Introduction

The importance of a well-specified demand for money to the implementation of monetary policy is of paramount importance in the existing literature. According to Goldfeld (1994), the relation between the demand for money and its main determinants is an important building block in macroeconomic theories and is a crucial component in the conduct of monetary policy. Therefore, the demand for

* Received: 21-03-2013; accepted: 14-06-2013

1 *PhD, Stopanska Banka AD – Skopje, Pitu Guli 5, Ohrid, Republic of Macedonia. Scientific affiliation: macroeconomics, financial management. Phone: +389 070 247 772. E-mail: jordan_kos@yahoo.com.*

money is one of the topical issues that have attracted the most attention in the literature both in developed and developing countries.

But, according to Laidler, in the context of the OECD countries, which pursue inflation-targeting policy, posits that monetary aggregates should not be used "as the only target of monetary policy, but rather as a supplementary intermediate target variable in a regime whose principal anchor is an inflation goal" (Laidler 1999:26).

Given that the output gap is deemed to be an important factor in determining the official interest rate, one can conclude that the real money gap indirectly affects the interest rate via its direct influence over the output gap and/or inflation. Therefore, a well functioning and stable money demand function is still important in this era of inflation targeting. It is essential to track both the interest rates and the money stock in order to assess precisely how monetary policy impacts upon the economy (Valadkhani and Alauddin, 2003).

A stable money demand allows for better predictions of the effect of monetary policy on interest rates, output, and inflation, and therefore reduces the possibility of an inflation bias (Cziraky and Gillman, 2006). A stable demand function for money means that the quantity of money is predictably related to a small set of key variables linking money to the real sector of the economy (Judd and Scadding, 1982).

The importance of the money demand function has encouraged a wide range of economists to empirically study its determinants and stability. But, while the money demand literature has focused on both industrialized as well as developed countries, there are relatively few studies examining the money demand function in transition economies. The relative absence of empirical money demand studies for transition economies is partly due to the relative instability of these economies in the transition process itself as well as concerns over the reliability and frequency of the time series data (Payne, 2003).

In this context, Republic of Macedonia may provide an interesting case study for transition countries. Like many other transition countries, in the past two decades, the Macedonian economy has experienced a number of significant economic events such as: decline in GDP of about 50% of GDP in 1989, price instability, high inflation in the early years of independence, the economic blockade by Greece, the wars in the former Yugoslavia, increasing the level of unemployment of over 30%, shadow economy, the conflict in 2001, the global economic crisis, European debt crisis. These factors are considered as the main factors that have contributed to the instability of money demand function in the Republic of Macedonia. Estimating a stable money demand function is essential for the National Bank of the Republic of Macedonia with respect to its target of sustainable growth and price stability. Thus, the main objective of this paper is to examine two aspects that are related to the demand for money in the Republic of Macedonia: to examine the long and short-run determinants, and stability of money demand.

The basic hypothesis of this paper is that the estimated coefficients in the model is stable and well-defined, because inability to identify a stable money demand function may be attributed to the omission of price stability and inflation bias in the Republic of Macedonia.

The results of these paper will help the National Bank of the Republic of Macedonia in its efforts to maintain price stability and keeping inflation at projected level by determining the key variables that influence the demand for money.

The structure of the paper is as follows. After the Introduction, Section 2 highlights literature on empirical findings of demand for money. Definitions of the determinants, sources of the montly data employed as well as methodology are presented in Section 3. Section 4 presents the empirical econometric results for the long- and short-run demand for money, and stability of the money demand. Section 5 provides some concluding remarks

2. Literature review

A considerable body of literature has investigated the demand for money in developing countries (Sanjay, 1998; Omotor, 2009;Vuong and Tran, 2010) such as developed countries (Hamburger 1977; Andreas Beyer 1988; Brand and Cassola, 2000; Calza, et al., 2001).

Since the purpose of this paper is not to make review of the empirical literature in sequel of the paper we made short sublimate of the empirical literature that emphasizes the demand for money in Central and Southeast Europe, where belong Republic of Macedonia. All of these countries in the early nineties of the twenty century began its transition and faced with the same problems-mainly increased external gully, high budget deficits, high inflation rates, and some of the countries affected by military actions.

Klacek and Smidkova (1995) estimated the long-run demand for broad and narrow money in the Czech Republic since transition. The authors initially include GDP as a scale, but the estimated function did not characterize a money demand function due to incorrectly signed parameters. Private consumption was then used, since it may give a better approximate of the volume of transactions. This estimated model had the correct signs, with private consumption having a significant effect. The inflation term was significant for narrow money, while the interest rate on foreign (German) bonds was significant for broad money.

Cuthbertson and Brendin (2001) criticize the model of (Klacek and Smidkova, 1995) because in their choice of determinants, is not included the degree of dollarization of the economy as a factor for money demand (problem dollarization in Czech economy was evident in the analyzed period). Cuthbertson and Brendin (2001) analyze the demand of money for the period 1992-1997, also using VECM method. The results of their study show that the level of GDP, the inflation rate and the degree of dollarization of the economy have an impact on the demand for money. Coefficients of the above determinants in their model are statistically significant and have the expected sign, according to the theoretical assumptions.

Poland's transition process began in conditions of great economic instability, high levels of external debt and high budget deficit. Therefore, the stabilization of the economy, pursued mainly through price control and suppression of high inflation as the main goal of monetary policy. Klos and Wrobel (2001) analyze the effects of monetary shocks in Poland caused by exchange rate changes on GDP, credit, prices and demand for money, and the effect of these shocks proved to be statistically significant in all cases. The strongest effect of monetary shocks on prices was observed 20 months after the occurrence of the shock.

Among the first were the analyses that explore the demand for money in Croatia (Anusic,1994; Sonje, 1999; Babic, 2000). Anusic (1994) applied the method of ordinary least squares based on monthly data from January 1991 to November 1993. Results of the study indicate that the main determinants of the demand for money in a period of hyperinflation in Croatia were inflation, real economic activity, while the interest rate had no significant impact on the demand for money. On the other hand (Sonje, 1999), in his analysis makes the post-hyperinflation, and the results indicate that inflation has no significant impact analyzes demand money. In his study Babic (2000) also implies that inflation is statistically insignificant variable and has no impact on the demand for money in Croatia.

Maravić and Palić (2005) analyze the long-term and short-term money demand in Serbia for the period January 1996 to March 2005, using Johansen cointegration technique and VECM. As an indicator of the real demand for money they were using real M1. The cointegration analysis shows that there is a strong cointegration relationship between real money, overall economic activity, inflation and interest rate on deposits in denar. Short-term model (ECM) shows that the most important determinant of real money demand is inflation and exchange rate. The analysis has proved that the interest rate on deposits in denar, is statistically insignificant determinant and does not have significant role in money demand. The results of the empirical analysis suggest that the demand for money in the whole analized period is unstable.

3. Data and methodology

According to the bulk of theories the empirical modelling of the money demand depends on scale variable and opportunity cost of holding money (Ericsson 1998; Sriram 1999)

$$\frac{M}{P} = F(Y, OC) \tag{1}$$

where *M* denotes nominal money, *P* price level, *Y* a scale variable representing the transaction volume in the economy and *OC* denotes opportunity costs of holding money.

The choice of the appropriate measure of money, the scale variable and the opportunity cost variable are very important. In this study, we refer to the studies (Babic, 2000; Payne, 2003; Maravić and Palić, 2005; Skrabic and Tomic-Plazibat, 2009) as the most relevant for setting the proper model on this topic. From these studies we conceptualized the most suitable determinants for this study: the M1 monetary aggregate (monetary aggregate, which covers currency in circulation and sight deposits, industrial production index which determinant is a measure of the level of economic activity, the exchange rate, interest rate payable on dEnar time deposits up to one month and inflation.

Data of the dependent determinant the M1 monetary aggregate are taken from the website of the National Bank of the Republic of Macedonia. The data of independent determinants (industrial production index, the consumer price index and inflation are taken from the website of the State Statistical Office, while remaining dependent determinants (interest rate payable on denar time deposits up to one month and the exchange rate) are taken from the website National Bank of the Republic of Macedonia. In this paper we used monthly data from January 2005 to October 2012. The choice of the time period in this paper was contingent upon the availability of time series data on all the variables included in the model, particularly the iinterest rate payable on denar time deposits up to one month, which is the most limiting constraint. Some of the above determinants, such as industrial production index, exchange rate and inflation are seasonally adjusted by using the Census X11 method. For these determinants, visual studies suggest that they have seasonal patterns, and hence the seasonal adjustment is probably justified. Apart from the actual variables in the empirical model will include two dummy variables. Therefore, global economic crisis will be marked with DUM that has value 1 for the period from October 2008 to December 2009 and 0 for all other periods. With DUM1 the European debt crisis will be designated having value 1 for the period from January 2011 to October 2012, and 0 for all other periods.

Basic problem in the empirical analysis is that in the literature there is extensive discussion of whether it is better to use a narrower or broader definition of the money supply. Studies carried out in transition and postransition countries suggest that the narrower concept of money supply better reflect the state with a relatively low level of development of financial systems (Payne, 2003; Skrabic and Tomic-Plazibat, 2009). For the purposes of this paper, and bearing in mind the current development of the banking and financial system in the Republic of Macedonia as measure for money we will use M1 monetary aggregate, which covers currency in circulation and sight deposits. As the consumer price index (CPI) is conventionally used to measure price level in macroeconomic analyses of the Macedonian economy, we deflate M1 with CPI to get the measure of real money balance of M1.

The problem of specification and the structure of the transaction variable or economic activity variable (including a problem of regular statistical coverage and estimating activity in the shadow economy) has occurred in most empirical studies of money demand (Anusic, 1994). Some authors emphasize that using GDP figures leads to overestimation of the level of transactions in the economy and suggest alternative measures such as the level of consumption (Mankiw and Summers, 1986), the ratio of total expenditures and demand deposits (Goldfeld and Sichel, 1990), or the index of industrial production (Payne, 2003; 2001; Skrabic and Tomic-Plazibat, 2009). In these paper as a scale variable we use the the industrial production index (base 2005 = 100).

Exchange rate is an important factor in the demand for money in transition economies (Payne, 2003). Arango and Nadiri (1981) indicate the importance that has the exchange rate on the demand for money and according to them, the depreciation of the domestic currency causes domestic and foreign residents to replace domestic with foreign currency. If there is an expected appreciation of the domestic currency, the demand for it will grow, and in case of the expected depreciation, the demand for domestic currency will decline. As a determinant of the exchange rate in this paper we use the nominal exchange rate of denar per euro.

As the measure of opportunity cost on narrow money we employ the interest rate on denar deposits up to one month. We choose this variable because the portfolio motive of holding such money plays only a minority role relative to the transaction motive. Komárek and Melecký (2001) and Ericsson (1998) suggest that long-run rates should not be included in the demand equation for M1.

The last determinant which will be used in the model is the rate of inflation. This variable serves as a measure of monetary stability of the country. The rate of inflation in this paper is presented as annual increase in CPI (annual percentage base 2005 = 100). In most empirical studies (Hosein 2007; Mehrotra 2008) inflation is defined as the opportunity cost of holding money instead of physical goods with inflation has a negative impact on the demand for money (Ericsson, 1999; Dreger and Wolters, 2009).

All data excluding interest rate and inflation rate were transformed into natural logs. The specification of the model to be estimated is as under

$$L(Mt\ /\ CPIt) = f(\ L(IIP)(+), L(ER)(+-), (IRDD1)(-), INF(-)) \tag{2}$$

where

Mt / CPI*t* = Real money (M1 deflated with consumer price index CPIt);

IIP= Industrial production index (base 2005=100);

ER= Exchange rate of denar per euro;

IRDD1= Interest rate payable on denar time deposits up to one month;

INF = Rate of inflation. (base 2005=100).

An analysis of the time-series properties of variables used in macroeconomic research is particularly important when examining the causal relationship between variables that exhibit a common trend (Clive W. J. Granger 1986; Robert Engle and Clive Granger 1987; Soren Johansen 1991). In the first step, we check order of the variables by using unit root tests. Before proceeding to the cointegration analysis and the estimation of long-run money demand, the time-series properties of the individual variables were examined by conducting stationarity or unit root tests. Although several methods have been proposed by considering different assumptions, there is no uniformly powerful test for unit root. Nevertheless, it seems that there are two approaches more popular than the rest: Augmented Dickey – Fuller (ADF) and Phillips and Perron test. The ADF adds lagged difference terms of the dependent variable y to the right-hand side of the regression:

$$\Delta Y_t = \mu + \gamma Y_{t-1} + \delta \Delta Y_{t-1} + \delta \Delta Y_{t-2} + ... + \delta_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \tag{3}$$

This augmented specification is then used to test

$$H_0 : \gamma = 0 \qquad H_1 : \gamma < 0$$

The null hypothesis (H_0) in unit root tests is that of nonstationarity. In the theory of testing of hypothesis the null hypothesis and the alternative are not on the same footing. The null hypothesis is rejected only when there is overwhelming evidence against it. That is why one uses a 5% and a 1% significance level. Performing the ADF test yields two practical issues: first one should decide the number of lagged first difference terms to add to the test regression and second the decision about whether to include other exogenous variables in the test.

Phillips and Perron (1988) proposed a non parametric approach with respect to nuisance parameters and thereby allowed for a very wide class of time series models in which there is a unit root. Their model seems to have significant advantage when there are moving average components in the time series. They replaced standard errors of regression which measures scale effects in the conventional *t* ratios by the general standard errors estimates which had allowed for serial covariance as well as variance. By using this method, they allowed for some heterogeneity and serial correlations in errors. Each statistic involving an additive correction term shows that magnitude had depended on the difference between the corresponding variance estimates.

In order to have a valid model for the money demand function, there should be at least one cointegrating vector in the system. Tests for cointegration seek to discern whether or not a stable long-run relationship exists among such a set of variables. The existence of a common trend among the monetary aggregate and the determinants of money demand means that in the long run the behavior of the common trend will drive the behavior of the variables. Shocks that are unique to one time series will die out as the variables adjust back to their common trend. In the context of this study, a finding of cointegration would simply mean that the transmission mechanism between the monetary aggregate and its determinants are stable, and thus, more predictable over long periods. For this study we chose to use the (Johansen,1991, 1995) multivariate cointegration technique to test the existence of a long-run equilibrium relationship among the variables. This technique is preferred to the Engle-Granger (1987) method for several reasons. First, the Engle-Granger procedure depends upon the normalization of the variables and may be sensitive to the choice of dependent and independent variables in the cointegrating equation. The estimation of the long run equilibrium regression requires the researcher to place one variable on the left-hand side of the equation and use the other as a regressor. In practice, it is possible that the arbitrary choice of one variable as the dependent variable and the other as the independent variable may lead to the conclusion that the variables are cointegrated, whereas reversing the choice of dependent and independent variables may indicate no cointegration. Further, because the Engle-Granger procedure relies on a two-step estimator in which the first step is to generate the residuals from the cointegration regression and the second step is to use the residuals generated from it to test for unit roots, any error introduced by the researcher in the first step also affects the second step. This is a classic case of the generated regressor problem documented by Pagan (1984) and may lead to incorrect inference about the cointegrating properties among the variables. Another advantage is that, unlike the Engle-Granger cointegration methodology, the Johansen- cointegration technique is capable of determining the number of cointegrating vectors in the relationship.

The Johansen approach start at model yt unrestricted vector auto-regression (VAR) involving up to q -lags of yt

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + ... + Aqy_{t-q} + \beta x_t + w_t \tag{4}$$

where *yt* is a *k*-vector of I(1) variables (*e.g.* in this study k = 5 and the variables are M1/CPI, IIP, ER, IRDD1 and INF), and *xt* is a *d*-vector of exogenous variables (*e.g.* in this study we have only two exogenous variable and that is *DUM and DUM1*), and *wt* is a vector of white noise residuals.

Following Johansen (1991, 1995), equation (3) can also be rewritten as

$$\Delta y_t = \Pi y_{t-1} + \Sigma_{i=1}^{q-1} \Gamma_i \Delta y_{t-1} + \mathrm{B} x_t + \varepsilon_t \tag{5}$$

$$\Pi = \Sigma_{i=1}^{q} \mathrm{A}_i - \mathrm{I} \qquad \Gamma_i = -\Sigma_{j=i+1}^{q} \mathrm{A}_j \tag{6}$$

The rank (*r*) of Π determines the number of cointegrating vectors. If the rank r = n this means that the VAR is stationary. If r = 0 it means that VAR is without cointegrating vectors, and if the range is between 0 < r < n it means that the model has r cointegrating vectors. Matrix Π can be written as Π = αβ, where α = n × r and represents the load coefficients (adjustment) of the link when it goes out of balance (as is the value closer to zero, so the adjustment is slower) and β = n × r which contains cointegrating connections and determine the long-term part of the model.

The next step in the implementation of Johansen cointegration technique is to establish the number of cointegration vectors, ie testing the rank of the cointegration vector. Two test statistics are available for this purpose. First, λmax statistics test the null hypothesis that the rank of the cointegration vector (r) is equal to the rank which is given by the hypothesis (s), against the alternative that r = s +1, whereas λtrace statistics test the null hypothesis that r = s against the alternative that r ≥ s +1. In both cases, the null hypothesis is rejected if the test statistic is higher than the critical value. In case a different value of the two tests, the results obtained from the Maximal Eigenvalue of the Stochastic Matrix preferred (Banerjee et al., 1993).

As a final experiment in our study, we follow Bentzen and Engsted's, (1993) method of examining the short-run elasticities of money demand. The position of this model, for the purpose of this paper will have the following form

$$\Delta L(M1)_t = \sum_{k=1}^{n} \mu' \Delta L(M1)_{t-k} + \sum_{k=0}^{n} \gamma' \Delta F_{t-k} + \alpha ECM_{t-1} + DUM + DUM1 \tag{7}$$

where F is a vector of the stationary forms for four vectors related to industrial production index, exchange rate of denar per euro, interest rate on denar deposits up to one month, rate of inflation). In the model we add two dummy variables. The dummy variable of *DUM* is entered in order to capture the effect of the 2008/09 global economic crisis, while with DUM1 will be designated European debt crisis. The error-correction-term ECTt-1 is defined as the difference between the actual demand for money at time t-1 and its estimate from the long-run equation in the same period. The presence of ECTt-1 in this equation demonstrates the dynamic short-run adjustment. When the demand for money deviates from its long-run equilibrium, the ECT term will subsequently work to bring it back to the equilibrium level. Therefore, its coefficient is expected to be negative.

Next, we examine the structural stability of the error correction model of money demand using cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) of recursive residuals test (Brown et al., 1975). These tests are commonly used by authors who explore the demand for money (Payne 2000; Bahmani-Oskooee and Shin, 2002; Owoye and Onafowora, 2007). The cumulative sum test is useful for detecting systematic changes in the regression coefficients whereas the cumulative sum of squares test is useful in situation where the departure from the constancy of regression coefficients is abrupt and sudden. Figures 1 and 2 display the cumulative sum and the cumulative sum of squares, respectively for M1 error correction model. Both the cumulative sum and the cumulative sum of squares statistics lie with 5% critical values suggesting the M1 error correction model stability.

4. Empirical results and discussion

A necessary condition for cointegration between variables is that if the individual time series under study contains a unit root, then it is appropriate to proceed to cointegration analysis.

From the Tables 1 and 2 it can be concluded that the results of both Augmented Dickey-Fuller (ADF) and Phillips-Perron unit tests suggest that almost all determinants become stationary after their first differentiation, with the exception of the industrial production index. In this determinant, both tests point to a different conclusion. Namely, ADF test indicates that the series is I (1) while the by PP test series is stationary, i.e. I (0). However, despite the divergent conclusions tests of stationarity of this variable should not be excluded from the analysis (Dickey and Rossana, 1994).

Table 1**:** Augmented Dickey-Fuller Unit Root Test results

Variable	ADF-test						
	At level			First-Differences			Con-clusion
	Number of time lag*	t-statistics	Critical value at 5% significance level	Number of time lag*	t-statistics	Critical value at 5% significance level	
LM1	1	-1.338365	-2.893230	1	-14.44616	-2.893230	I (1)
LIIP	3	-1.000287	-2.893589	1	-15.13641	-2.893584	I (1)
LER	4	-0.240079	-2.894332	3	-8.997319	-2.894332	I (1)
IRDD1	1	1.688475	-2.892879	1	-4.601604	-2.893584	I (1)
INF	0	-1.400424	-2.892879	0	-4.875678	-2.893230	I (1)

* number of time lag based on Akaike's information criterion.

Source: Authors' calculations

Table 2: Phillips-Perron Unit Root Test results

Variable	Phillips-Perron-test				
	At level		First-Differences		Con-clusion
	t-statistics	Critical value at 5% significance level	t-statistics	Critical value at 5% significance level	
LM1	-1.684961	-2.892879	-16.22552	-2.893230	I (1)
LIIP	-5.638613	-2.892879		-2.893230	I (0)
LER	-2.392879	-2.892879	-17.93053	-2.893230	I (1)
IRDD1	0.896241	-2.892879	-8.481500	-2.893230	I (1)
INF	-2.245520	-2.892879	-5.068031	-2.893230	I (1)

Source: Authors' calculations

Since we cannot reject that our time series contain a unit root, we feel legitimized to apply the ordinary VAR-based cointegration test which sticks to the methodology developed by Johansen (1991). Owing to the short–length of the available of time–series we began with a general six order (six months). This makes sense intuitively taking into account that the data is monthly and the sample is relatively short. From the table 3 it is evident that on the basis of the LR, FPE, AIC и HQ criteria, the optimal number of lags to be included in the VAR is four, while only one of the information criteria SC indicates a time lag of one period. For our model the lag length of VAR was chosen $k = 4$, because diagnostic tests of vector autoregression model of order one, according to other criteria's, were not satisfied.

Table 3: VAR lag order selection criteria’s

Lag	LogL	LR	FPE	AIC	SC	HQ
0	326.7744	NA	4.59e-10	-7.313053	-7.172296	-7.256346
1	803.9382	889.2598	1.58e-14	-17.58950	-16.74496*	-17.24926
2	845.0333	71.91656	1.10e-14	-17.95530	-16.40697	-17.33152
3	889.2292	72.32054	7.23e-15	-18.39157	-16.13945	-17.48425*
4	915.4395	39.91112*	7.22e-15*	-18.41908*	-15.46317	-17.22822
5	927.2810	16.68576	1.02e-14	-18.12002	-14.46032	-16.64562
6	939.4684	15.78825	1.46e-14	-17.82883	-13.46534	-16.07089

Source: Authors’ calculations

Next, the Johansen cointegration procedure is used to test for the presence of cointegration among real money M1, industrial production index, exchange rate of denar per euro, interest rate payable on denar time deposits up to one month and rate of inflation.Table 4 reports the results of the Johansen multivariate cointegration test on the demand for M1. According to trace test there is one cointegration vector at 1 and 5 per cent level, while max-eigenvalue tests indicate one cointegration vector at the 5 per cent level.

Table 4: Cointegration rank test: Trace and maximum Eigenvalue statistics

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value Trace Statistic	1 Percent Critical Value Trace Statistic	Max- Eigen Statistic	5 Percent Critical Value Max-Eigen Statistic	1 Percent Critical Value Max-Eigen Statistic
None*	0.344158	103.4088	87.31	96.58	37.54331	37.52	42.36
At most 1	0.229015	55.86544	62.99	70.05	23.14767	31.46	36.65
At most 2	0.185594	41.71777	42.44	48.45	18.27140	25.54	30.34
At most 3	0.179249	24.44637	25.32	30.45	17.58068	18.96	23.65
At most 4	0.074242	6.865688	12.25	16.26	6.865688	12.25	16.26

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Source: Authors’ calculations

In case of multiple cointegrating vectors, it is difficult to explain the results. Following the literature (Bradley and Payne, 1999) we normalized the estimated long-run money demand function by normalising the cointegrating vector on M1 in the following table.

Table 5: Normalized cointegrating vectors M1 money demand specifications

Variable	Coefficient	Standard error	t-value
LM1	1.00		
LIIP	0.929	0.932	0.997
LER	-6.899	2.685	-2.569**
IRDD1	-0.254	0.056	- 4.566***
INF	-0.005	0.017	-0.291
C	-29.134		

Null hypothesis that estimated coefficient is equal to zero can be rejected at 1% level (***), at 5% level (**) or at 10% level (*).

Source: Authors' calculations

Coefficients obtained in the long-term relationship indicate that from the selected determinants exchange rate and interest rate payable on denar time deposits up to one month have a negative impact on the demand for money, i.e. the monetary aggregate M1. If exchange rate is increased by 1%, the money demand will decrease by 6.9 percentage points ceteris paribus. The negative coefficient on the exchange rate in the case of M1 is suggestive of the notion that after depreciation of the domestic currency, and if the public expects further depreciation, then the public would demand more foreign currency and less domestic currency, thus leading to a decrease in M1 money demand (Bahmani-Oskooee and Shabsigh, 1996).

Table 6: VECM system coefficients

Variable	ΔLOG (*M*1)
Correction mechanism	
Coefficient	-0.08**
Speed of adjustment	12,5 months
ΣΔLOG (*M*1)	23.831
ΣΔLOG (*IIP*)	2.754
ΣΔLOG (*DEVK*)	-4.813**
ΣΔ(*IRDD*1)	-0.697*
ΣΔINF	-2.780**
R^2	59.94
DUM	-0.009
DUM1	0.030***
Breusch-Godfrey Serial Correlation LM Test (p-value)	0.628
Autoregressive Conditional Heteroscedasticity (ARCH) (p-value)	0.941

Source: Authors' calculations

The exchange rate has a much higher impact on the demand for money in the long term in relation to the impact of interest rates. By increasing interest rates on term deposits by 1 percentage point, the population will be encouraged to save more and reduce the demand for cash by 0.25 percentage points ceteris paribus.

As we expected, the short-term adjustment coefficient has a negative sign and is statistically significant in the short-term model. The negative sign and the value ECMt-1 means that the impact of long-term imbalance of short-term demand of M1 adjusted 0.08% in one month, or long run equilibrium is corrected for a period of 12-13 months. In the short term the greatest impact of the determinants used in the model has inflation. According to the results, if there is a 1% increase in inflation, money demand for the same period will be decrease by 2.78 percentage points, ceteris paribus. Inflation growth will lead to increased return on alternative forms of assets (real estate, commodities and foreign currencies), which will reduce demand for denars. The result of exchange rate of denar per euro is significant and is negative, indicating that depreciation of the exchange rate of 1% the demand for denar will decline by 4.81 percentage points, ceteris paribus. The results indicate that a possible depreciation of the exchange rate expected return from holding foreign currency will decrease, which will reduce the demand for money (local currency). The significance of this determinant in the model is confirmed by the high degree of euroization in Macedonia. The sign of the coefficient of interest rate payable on denar time deposits up to one month is negative (as expected, given that based on the underlying theory the interest rate elasticity of money demand should be negative) but it has a low absolute value 0.70, denoting that the agents didn't perceived during the studied period the interest rate term of denar deposits as a guide for whether or not to keep their wealth in cash or deposits.

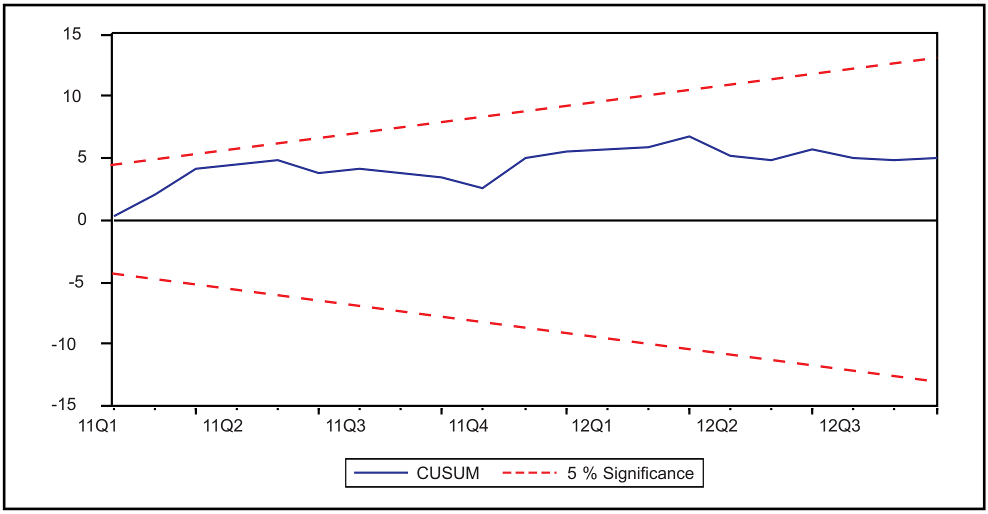
From the dummy variables in the short-term model, only dummy variable that is introduced in order to cover the European debt crisis is statistically significant at the 1% level of significance and points to 0.03 percentage higher demand for real M1 money only as a result of the European debt crisis. This result is not surprising, because European debt crisis and the lack of confidence in the euro caused a growth in demand for denar cash and short-term denar deposits NBRM 2012.

The coefficient of determination is high and explains 59% of the variance independent determinants. Estimated value of the F-statistics indicates that it is statistically significant at the 1% level, indicating that the model is well specified and can give reliable results.

The model is also checked for serial correlation, normality and heteroscedasticity. Residual heteroscedasticity Autoregressive Conditional Heteroscedasticity (ARCH) test (p-value 0.941) indicates no heteroscedasticity in the system. Moreover, Lagrange Multiplier (LM) test showed that there is no serial correlation between residuals at any lag, including up to lag 6. However, based on joint Jarque-Bera (JB) test multivariate normality of residuals is rejected at p-value less than 1%.

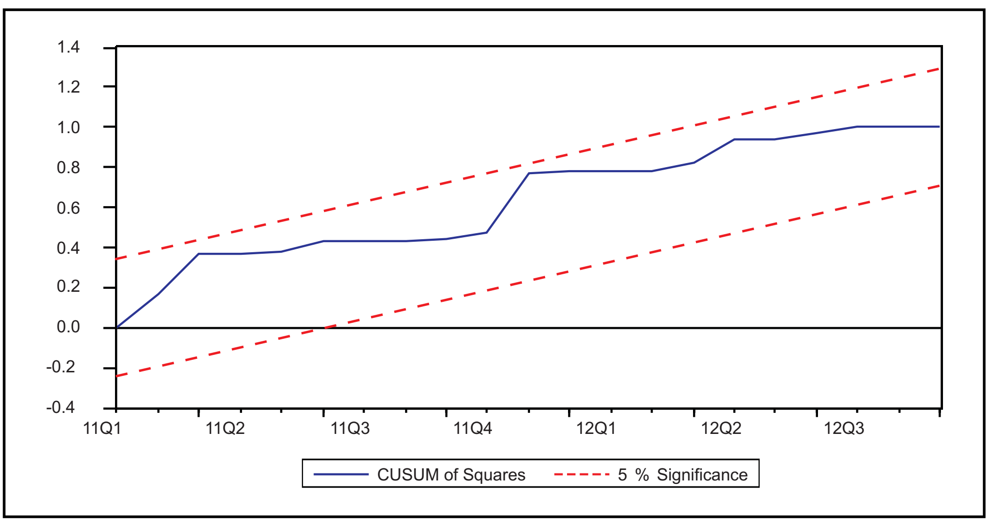
Since we are particularly interested in whether the estimations achieved are stable over time and therefore useful for forecasting purposes (in the sense of equilibrium money growth predictions), we proceed with CUSUM, CUSUMQ tests. The results of the test statistics for evaluating the cointegration vector stability are presented in Figure 1 and 2.

Figure 1: CUSUM Statistics



Source: Authors' calculations

Figure 2: CUSUMSQ Statistics



Source: Authors' calculations

For both specifications in this model according to the CUSUM and CUSUMSQ tests determin that no indication of the possible instability of the estimated coefficients in the model imply that the demand for money in the Republic of Macedonia is stable. Based on the test results, we can say that the demand for M1 monetary aggregate in Macedonia is predictable and they can be used for effective implementation of monetary policy, i.e. the National Bank may determine the money supply in line of the economic conditions in the country.

5. Conclusions

Based on the presented results, the hypothesis that the estimated coefficients in the model are stable and well-defined could be confirmed. The empirical findings of this study show that the demand for M1 in the analyzed period in the Republic of Macedonia is stable, indicating that on the basis of selected determinants, its long-term prediction can be carried out. This study complements the existent economic literature by analyzing the determinants and stability of money demand in the Republic of Macedonia. According to the knowledge of the author, it is the first empirical study that analyzes the money demand in the Republic of Macedonia. The results of the empirical results provide the evidence that exchange rate and interest rate payable on denar time deposits up to one month explains the most variations of money demand in the long-run, while interest rate is significant only in short-run. Long-run money demand function is estimated indicating slow speed of adjustment of removing the disequilibrium.

This study does not face significant limitations, but their removal will certainly contribute to broader results. First, there is a lack of available data on selected determinants for longer period. The existence of long time series of data would enable obtaining more accurate and more reliable results. Second, there is the absence of monthly data for exchange rate and index of industrial production index. Limitation was overcome by using a linear interpolation of their quarterly data.

The future research in the analysis should include the other monetary aggregates such as M2 and M4 in addition to money supply M1. Moreover, future research may include other determinants such as interest rates on long-term domestic and foreign currency deposits and interest rates on treasury bills. As econometric techniques in the future, the researchers can apply the method of two or three least squares, generalized method of moments or panel cointegration to examine this relationship in panels of countries and thus determine which determinants influence the supply of money in countries at the same level of development as the Republic of Macedonia.

The results obtained in this study suggest that the National Bank should carefully monitor the exchange rate and inflation as two most important indicators of monetary policy, because these two determinants are the main drivers of demand for money in the short and long term.

References

Anusic, Z. (1994) "The Determinants of Money Demand in Croatia and Simulation of the Post-Stabilization Period", *Croatian Economic Survey*, No. 2, pp. 85-120.

Arango, S., Nadiri, M. (1981) "Demand for Money in Open Economies", *Journal of Monetary Economics*, 7, pp. 69-83.

Babic, A. (2000) "The monthly Transaction Money Demand in Croatia", *Working paper*, Croatian National Bank, pp. 1-46.

Banerjee, et al. (1993) *Co-integration, Error Correction, and the Econometric Analysis of Non-Stationary Data,* London: Oxford University Press.

Bahmani-Oskooee, M., Shabsigh, G. (1996) "The Demand for Money in Japan: Evidence from Cointegration Analysis", *Japan and the World Economy*, 8, pp. 1-10.

Bahmani-Oskooe, M., Shin, S. (2002) "Stability of the Demand for Money in Korea", *International Economic Journal*, 16 (2), pp. 85-95.

Bentzen, J., Engsted, T. (1993) "Short and long run elasticities in energy demand: A cointegration approach." *Energy Economics* Elsevier, Vol. 15(1), pp. 9-16.

Beyer, A. (1998) "Modelling money demand in Germany", *Journal of Applied Econometrics*, Vol. 13, pp. 57-76.

Brand, C.,Cassola, N. (2000) "A Money Demand System for the Euro Area."*ECB Working Paper* No. 39.

Brown, R.L., Durbin, J., Evans, J. M. (1975) "Techniques for Testing the Constancy of Regression Relationships over Time", *Journal of the Royal Statistical Society*, Series B, 37, pp.149–192.

Bradley, T. E., Payne, E. J. (1999) "Long-run Money Demand in Chile", *Journal of Economic Development* Vol. 24, No 2.

Calza, A., Gerdesmeier, D., Levy, J. (2001) "Euro Area Money Demand: Measuring the Opportunity Costs Appropriately", IMF *Working Paper* No. 01/179.

Cuthbertson, K., Brendin, D. (2001) "Money demand in the Czech republic since transition", *Journal of policy Reform* 4(4), pp. 271-290.

Cziraky, D., Gillman, M. (2006) "Money Demand in an EU Accession Country: A VECM Study of Croatia", *Bulletin of Economic Research* 58(2), pp.73-159.

Dickey, D. A. and Rossana, J. R. (1994) "Cointegrated Time Series: A Guide to Estimation and Hypothesis Testing", *Oxford Bulletin of Economics and Statistics Department*.

Dreger C, Wolters J (2009) “M3 velocity and asset prices in the euro area”, *Empirica* 36, pp. 51-63.

Engle, F. R., Granger, C. W. J. (1987) “Cointegration and Error-correction: Representation, Estimation, and Testing”, *Econometrica*, 55, pp. 251-276.

Ericsson, N. (1998) “Empirical modeling of money demand”, *Empirical Economics* 232, pp. 95-315.

Ericsson, N. R. (1999) “Empirical modeling of money demand, Money Demand in Europe”, Physica-Verlag, Heidelberg, pp. 29-49.

Goldfeld, S. M. and D. E. Sichel (1990) “The Demand for Money, in B. M.”, Friedman and F. H. Hahn (eds.), *Handbook of Monetary Economics,* Vol. 1, Elsevier Science Publishers.

Granger, W. J. C. (1986) “Developments in the Study of Cointegrated Economic Variables”, *Oxford Bulletin of Economics and Statistics*, 48(3), pp. 213-228.

Hamburger, J. M. (1977) “The demand for money in an open economy: Germany and the United Kingdom”, *Journal of Monetary Economics,* 3, pp. 25–40.

Judd, J. P. and Scadding, J. L. (1982) “The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature”, *Journal of Economic Literature* 20, No. 3, pp. 993-1023.

Johansen, S. (1991) “Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models”, *Econometrica,* 59(6), pp.1551-1580.

Johansen, S. (1995) *Likelihood-based inference in cointegrated vector autoregressive models,* Oxford University Press, Oxford, New York.

Klacek, J., and Smidkova, K. (1995) “The demand for money function, The case of the Czech Economy”, *Working paper,* series 41, Czech National Bank Praha.

Klos, B., Wrobel, E. (2001) “The monetary transmission mechanism and the structural modelling of inflation at the National Bank of Poland”, *National Bank of Poland.*

Laidler, D. (1999) “The quantity of money and monetary policy.” *Working Paper Series* No. 99-5, Bank of Canada.

Maravić, J., Palić, M. (2005) “Analiza tražnje za novcem u Srbiji.” *Narodna Banka Srbije*.

Mankiw, N. G. and Summers, L. H. (1986) “Money Demand and the Effects of Fiscal Policies”, *Journal of Money, Credit and Banking,* 18, pp. 415-429.

Mehrotra A. N. (2008) “Demand for money in transition: Evidence from China’s disinflation”, *International Advances in Economic Research*, 14(1), pp. 36-47.

National Bank of the Republic of Macedonia (2012) *Annual Report.*

Omotor, G. D. (2009) “Money Demand and Foreign Exchange Risk for Nigeria: A Cointegration Analysis using ARDL Test”, *IIUM Journal of Economics and Management,* 18(1), pp. 45-72.

Owoye, O. and Onafowora, O. A. (2007) "M2 Targeting, Money Demand, and Real GDP Growth in Nigeria: Do Rules Apply?" *Journal of Business and Public Affairs*, 1(2), pp. 1-20.

Pagan, R. A. (1984) "Econometric Issues in the Analysis of Regressions with Generated Regressors", *International Economic Review*, 25(1).

Payne, E. J. (2000) "Post Stabilization Estimates of Money Demand in Croatia: The role of Exchange Rate and Currency Substitution", *Ekonomski pregled*, 51, pp. 1352-1368.

Payne, E. J. (2003) "Post stabilization estimates of money demand in Croatia: error correction model using the bounds testing approach." *Applied Economics*, 35, pp.1723–1727.

Phillips, C. B. P., Perron, P. (1988) "Testing for a unit root in time series regression", *Biometrika,* 75(2), pp. 335-346.

Sanjay, K. (1998) "Inflation and Money Demand in Albania", *Working Paper*/98/101, IMF.

Skrabic, B., Tomic-Plazibat, N. (2009) "Evidence of the Long-run Equilibrium between Money Demand Determinants in Croatia", *International Journal of Human and Social Sciences*, Vol.4, No 16, pp.1177-1181.

Sonje, V. (1999) "Esej o monetarnim eksperimentima, ili: kako izabrati monetarni rezim u kasnoj fazi tranzicije", *Economic Trends and Economic Policy*, Vol. 9, No. 74, pp. 41-72.

Sriram, S. S. (1999) "Survey of Literature on Demand for Money: Theoretical and Empirical Work with Special Reference to Error-Correction Models", IMF *Working Paper* WP/99/64.

Valadkhani, A., Alauddin, M. (2003) "Demand for M2 in Developing Countries: An Empirical Panel Investigation", *Discussion Paper* No 149.

Vuong, Q. H., Tran, T. D. (2010) "Corporate Bond Market in the Transition Economy of Vietnam, 1990 – 2010." *Working Paper* 10/001, Centre Emile Bernheim Research Institute in Management Sciences.

Determinante i stabilnost potražnje za novcem u Republici Makedoniji

Jordan Kjosevski[1]

Sažetak

Cilj ovog rada je ispitati duge i kratkoročne odrednice te stabilnost potražnje za novcem (M1) u Republici Makedoniji pomoću mjesečnih podataka od siječnja 2005. do listopada 2012. Korišteni su Johansenova tehnika kointegracije i VECM model kako bi pronašli dugoročne i kratkoročne dinamičke odnose u modelu potražnje novca. Empirijski rezultati dokazuju da su tečaj i kamatna stopa plativi na oročene dinarske depozite do mjesec dana. Dugoročna potražnja za novcem ukazuje na sporost prilagodbe i uklanjanja neravnoteže. Naše istraživanje potvrđuje da je potražnja za realnim novcem M1 u Republici Makedoniji stabilna u analiziranom razdoblju. Dobiveni rezultati u ovom istraživanju ukazuju na to da Narodna banka treba pažljivo pratiti tečaj i inflaciju, kao dva najvažnija pokazatelja monetarne politike, jer su ove dvije odrednice glavni pokretači potražnje za novcem u kratkoročnom i dugoročnom periodu.

Ključne riječi: *potražnja za novcem, kointegracija, vektorski model korekcije, stabilnost, Republika Makedonija*

JEL klasifikacija: *C32, E41, E52, E 58*

[1] *Doktor ekonomskih znanosti, Stopanska Banka AD – Skopje, Pitu Guli 5, Ohrid, Republika Makedonija. Znanstveni interes: makroekonomija, financijski menadžment. Tel.: +389 070 247 772. E-mail: jordan_kos@yahoo.com.*