EMPIRICAL ANALYSIS OF DETERMINANTS OF MONEY DEMAND FUNCTION IN NORTH MACEDONIA

Luljeta Sadiku[1], Violeta Madzova[2] and Murat Sadiku[3]
[1]*Faculty of Economics and Administrative Sciences, International Balkan University, l.sadiku@ibu.edu.mk*
[2]*Faculty of Economics and Administrative Sciences, International Balkan University, v.madzova@ibu.edu.mk*
[3]*Faculty of Business and Economics, South East European University, m.sadiku@seeu.edu.mk*

ABSTRACT

Money demand function exerts a central role in macroeconomic policy of countries. Therefore, the purpose of this research paper is to examine how money demand responds to changes in income, interest rate, inflation and exchange rate for the case of North Macedonia using the quarterly data for the period 1998-2021. The research methodology consists of cointegration analysis that is performed to investigate the long run relationship between variables. Also, a Vector Error Correction model (VECM) was used to analyze both the long run and short run response of money demand to changes in its potential determinants. The real money balance was modelled as dependent variable on real GDP, interest rate, inflation, and exchange rate. Based on the cointegration results there exists a long run relationship between used variables. The long run empirical results disclose that the real GDP is positively related to money demand, whereas interest rate, inflation and exchange rate are negatively related. The short run results indicate that the exchange rate is not a significant determinant, whereas real GDP, and inflation are the most influencing factors. The empirical results also show that money demand in North Macedonia is unstable. This result implies that the country should implement prudent monetary policy to deal with the ambiguity of money demand.

KEYWORDS:

MONEY DEMAND, INCOME, INTEREST RATE, COINTEGRATION ANALYSIS, VECM

JEL CLASSIFICATION CODES:

E41, E47

1. INTRODUCTION

The determinants and the stability of the demand for money play a crucial role for formulating and implementing effective monetary policy in an economy. In other words, effective monetary policies can be made with the help of a stable and predictable money demand function, and at the other side a stable money demand function has a chief upshot on the main macroeconomic variables like money supply, inflation, interest rates and national income (Sriram, 1999; Cziraky and Gillman, 2006). Thus, it is of particular importance for the country to estimate the effect of the main determinants of the money demand function and test its stability using the most recent data. Therefore, this study aims to identify the short run and the long run factors that determine the demand for money for the case of North Macedonia and contribute to expand the existing literature on this matter.

Maintenance of price stability is the primary objective of the National Bank of North Macedonia. The establishment of this objective is in line with the empirically confirmed findings that price stability creates the most favorable macroeconomic environment for economic development sustainable in a long run (NBRM, 2022). However, despite the accommodative monetary policy in 2021, the Central Bank set out to tight in 2022 considering the speeding up of inflation, thus the policy rate was increased four times (European Commission, 2022). The uncertain economic situation can roundly influence the demand for money as individuals and firms favor less risker assets during such times.

The paper is structured as follows: the next section presents a brief literature review of the most prominent studies regarding the money demand function, concentrating first in developed countries and then in Central and Eastern European countries and last on the only study for North Macedonia. The third section displays the research methodology, the model, and the data, whereas in the fourth section are presented the empirical results, followed by a conclusion.

2. BRIEF LITERATURE REVIEW

Several studies have examined the money demand function and its main determinants for different countries, also investigating the stability of money demand function. However, an open issue remains which monetary aggregate M2 or M3 to consider as dependent variable as well as which variables to include as independent variables besides those in the conventional monetary theory. For instance, Bahmani-Oskooee and Bohl (2000) analyzed the stability of M3 demand for money for Germany and based on the obtained results concluded that money demand function is not stable for the case of Germany in the analyzed period. Another study also by Bahmani-Oskooee (2001) explored the stability of money demand function in Japan and based on ARDL estimation procedure found that M2, real income and interest are cointegrated indicating a long run relationship, and contrary to the case of Germany, they found that money demand function is stable for the case of Japan.

Bahmani-Oskooee and Rehman (2005) employ a CUSUM and CUSUMSQ analysis to inspect the stability of money demand function in some Asian countries. They found that real monetary aggregates M1 or M2 are cointegrated with their determinants, but the estimated parameters are unstable.

Dow (2019) analyzes the determinants of China's money demand using a linear econometric model and SVAR model. His results show that China's money demand is determined by income, interest rate and expected inflation rate. Whereas, financial innovation, government debt, capital mobility and currency substitution, have a low effect since the author argues that China's financial and monetary systems have been systematically under reform.

Bahmani and Kutan (2010) study the stability of money demand function in emerging economies of Eastern Europe. They use the bounds testing approach to error-correction modelling and cointegration, considering the countries of Armenia, Bulgaria, the Czech Republic, Hungary, Poland, Russia, and the Slovak Republic. Their results reveal that money demand is stable in these countries.

Dreger and Wolters (2011) analyzed the stability of money demand based on M3 monetary aggregate and inflation in the euro area by considering in their research the period of the global financial crisis. They found that the equilibrium evolution of M3 remained in a row with money demand. They revealed that the hypothesis of weak exogeneity should be rejected for real money balances and inflation and found that real income, real asset prices, and the term structure did not respond to deviations from the long-run equilibrium.

Dobnik (2013) examine the long-run money demand function for 11 OECD countries. They found that the exchange rate is a significant determinant of money demand, whereas the results regarding the stock of prices were ambiguous. Based on panel error-correction model, they found that several domestic money stocks converge to a common international equilibrium relationship.

Kjosevski and Petkovski (2017) investigate the determinants of money demand and its stability of seven South East European countries for the time spin 2005-2014 using the Pool Mean Group Estimation of ARDL. According to their results, the main determinants of money demand are real income, exchange rate of domestic currencies per euro and the dummy variable referring to European debt crisis, while real income and interest rate payable on domestic currency up to one month are significant in short-run. Long-run money demand function implied capability for relatively quick adjustment and recovery of the equilibrium. Besides, the estimated parameters in the model were stable, and they state that despite the turbulent times in the region in the past two decades, demand for money was relatively stable in the analyzed period.

Mera and Silaghi (2018) examine the relationship among the demand for money and several determinants, using the autoregressive distributed lag (ARDL) bounds-testing approach of six Central and East European countries (Bulgaria, Croatia, Czech Republic, Hungary, Poland, and Romania) for a period of twenty years. Their results suggest the existence of a long-term cointegration relationship between the demand for money and its determinants, except in Bulgaria and Croatia. They also have found a significant currency substitution effect in Bulgaria, Croatia, and Hungary, whereas for the case of Czech Republic, the wealth effect was even stronger.

Recently Nel et al. (2020) analyzed the stability of money demand function for the case of Hungary, using the quarterly data for 18 years. The results suggest a long run relationship among money demand and GPD, interest rate, inflation rate and the exchange rate. Also it was found that the demand for money is stable under the analyzed period.

Regarding the case of North Macedonia, the only study on this issue is that of Kjosevski (2013), where are examined the long and short-run determinants, and stability of money demand (M1) using monthly data from January 2005 to October 2012. He uses Johansen cointegration technique and VECM model to find the long-run and short-term dynamic relationships in money demand model. He found that the exchange rate and interest rate payable on deposits explain the most variations of money demand in the long-run, while interest rate is significant only in short-run. His results also confirmed that the demand for M1 in the analyzed period is stable. The present study uses the most recent data to examine the determinants of money demand considering a time spin of two decades.

3. RESEARCH METHODOLOGY

The determinants of money demand function for North Macedonia are firstly analyzed by various model specifications estimated by OLS method, considering the time series stationary properties, and then is used the VECM methodology. A Vector Error Correction Method (VECM) is formulated to bring back the information lost in the differencing process, thereby allowing for long-run equilibrium as well as short-run dynamics.

The following expression represents the general form of the VEC method:

$$\Delta Y_t = \delta + \prod Y_{t-1} + \sum_{i=1}^{p-1} \Phi_i \Delta Y_{t-i} + \varepsilon_t \tag{1}$$

where Δ is the differencing operator, such that: $\Delta Y_t = Y_t - Y_{t-1}$; Π is the coefficient matrix for Y_{t-1}, Π=αβ, where α represents the coefficient of adjustment to the equilibrium or the error correction term (loading parameters) and β represents the cointegration vectors, $\beta x Y_{t-1}$ captures the long-run relationships (cointegration equations). When we find the rank of cointegration we find, r=rank(Π), the number of cointegrating vectors β_i.

Based on the VECM method, it should be first investigated if cointegration exist among series. If the answer is yes, in such a case it can be concluded that there is a long-term equilibrium relationship between the series, thus we employ VECM to estimate the short run properties of the cointegrated series. At the other side when there is no cointegration among series, this method is not appropriate, thus we proceed with other methods to determine the relationships between them.

The cointegration rank shows the number of cointegrating vectors. For instance, a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary. Johansen and Julius (1990) determine the rank using the Maximal-Eigenvalue and Trace statistic test, calculated using the maximum likelihood estimates of the cointegrating vectors.

3.1 Theoretical model

The neoclassical theory on the demand for money starts with Fisher's (1909) quantity theory of money. The quantity theory assumes that the demand for real balances is proportional to income.

$$(\boldsymbol{M/P})^{\boldsymbol{d}} = \boldsymbol{kY} \tag{2}$$

where *k* is a constant measuring how much money people want to hold for every dollar of income. A more general and realistic money demand function that assumes the demand for real money balances depends on both the interest rate and income is:

$$(\boldsymbol{M/P})^{\boldsymbol{d}} = \boldsymbol{L(i,Y)} \tag{3}$$

The money demand function based on the portfolio theories is expressed as:

$$(\boldsymbol{M/P})^{\boldsymbol{d}} = \boldsymbol{L}(\, \boldsymbol{r_s},\ \boldsymbol{r_b},\ \boldsymbol{E\pi},\ \boldsymbol{W}) \tag{4}$$

where $\boldsymbol{r_s}$ is the expected real return on stock, $\boldsymbol{r_b}$ is the expected real return on bonds, $\boldsymbol{E\pi}$ is the expected inflation rate, and W is real wealth. An increase in $\boldsymbol{r_s}$ or $\boldsymbol{r_b}$ reduces money demand because other assets become more attractive. An increase in $\boldsymbol{E\pi}$ also reduces money demand because money becomes less attractive. An increase in W raises money demand, because greater wealth means a larger portfolio (Mankiew, 2010).

3.2 Specification of econometric model

Partly based on above theoretical framework of money demand function, the econometric model, for the purpose of this study is specified as in following form:

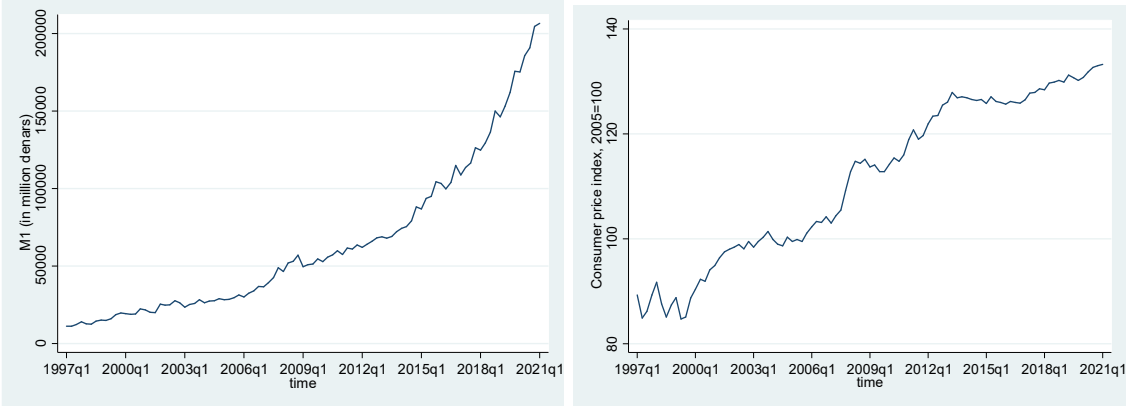
$$(lnM_1/P)^d = \beta_0 + \beta_1 lnGDP + \beta_2 lnDINT + \beta_3 INF + \beta_4 lnEXCHR + \delta_1 Dum1 + \delta_2 Dum2 + \varepsilon_t$$

Where M_1/P is the dependent variable - Real money (M1 deflated with consumer price index CPI). Unlike some studies where the monetary aggregate M2 or M3 is used as dependent variable (Valadkhani, 2006; Bahmani, 2014; Farazmand and Moradi, 2015; Heinrich, 2020), this study uses M1 monetary aggregate as it is applied by many other authors that attempt to identify the determinants of money demand for economies with less developed financial systems (Slok, 2002; Garcia-Hiernaux and Cerno, 2006; Rao and Kumar, 2008). This is also used and argued by Kjosevski (2013) and Kjosevski and Petkovski (2017) for SEE countries.

Independent variables are considered real GDP for measuring the economic activity of the country, even though in some studies is used the index of industrial production as a proxy of economic activity, whereas this study uses the real GDP as in the majority of empirical literature (see Rao and Kumar, 2008; Nyumah, 2017; Bahmani-Oskooee and Xi, 2014); for which we expect a positive sign; deposit interest rate for measuring the opportunity cost of holding money for which we expect a negative sign; the rate of inflation for measuring the monetary stability of the country that it is also expected a negative correlation with money demand. Exchange rate is another potential determinant of money demand that is used as independent variable. Besides the model estimated through OLS includes two dummy variables Dum1 and Dum2 to capture the effects of global financial crisis of 2008 and the health crisis of COVID-19, respectively, and ε_t is the error term.

It will be used in the empirical analysis the quarterly data for the time spin 1998q1-2021q4. The same are provided from the State Statistical Office of the country and National Bank of R. North Macedonia. The following graphs represent the pattern of the used variables over time. Since the study uses quarterly data, they are seasonally adjusted before running the regressions.

Figure 1. The pattern of used variables in the empirical research



Source: State Statistical Office and National Bank of R. North Macedonia

4. EMPIRICAL RESULTS

4.1. Time Series Properties of the Variables

The two applied tests of time series properties, ie examining the order of integration of series are those of Augmented Dickey Fuller (ADF) and Philip-Perron (PP) tests. These tests are used to determine if the time series are stationary or non-stationary. Time series usually are non- stationary. One should do is to make them stationary by taking first or second differences.

In the present study, the results suggest that the null hypothesis of a unit root cannot be rejected for all variables in their level, at 5% significance level or lower, except the series of inflation. However, the null hypothesis of a unit root is rejected when both tests are applied to the first difference for almost all variables at 1% significance level. This concludes that the variables are integrated of order one, I(1), whereas the variable of inflation does not contain a unit root (see Table 1). As the results indicate, the variables are non-stationary in their level, but turn to stationary in the first difference. The optimal test result comes up with a trend in regression and 4 lags into the ADF test.

Table 1. Augmented Dickey-Fuller and Philips Perron Unit Root Test results

Variables	Test	Levels		First Difference		Decision
(M1/P)	ADF	-2.164	0.5100	-4.067***	0.001	
	PP	-3.150	0.0948	-12.213***	0.000	I(1)
	ADF	-1.669	0.7644	-5.351***	0.000	
GDP	PP	-1.589	0.4891	-21.454***	0.000	I(1)
	ADF	1.411	0.9972	-2.982**	0.036	
DINT	PP	-4.143	0.0008***	-8.640***	0.000	I(1)
	ADF	-3.180	0.0212**	-	-	
INF	PP	-3.551	0.0553**	-	-	I(0)
	ADF	-1.030	0.7422	-6.619 ***	0.000	
EXCHR	PP	-2.171	0.0677*	-14.215***	0.000	I(1)

Note : ** represents the rejection of null hypotheses in the 5% level of significance. The critical value is - 2.917,
*** represents the rejection of null hypotheses in the 1% level of significance. The critical value is -3.783.
Source: Author's calculations

4.2 Regression Results

According to multiple regression outputs using the OLS estimation techniques, can be obviously observed that the coefficient of real GDP is highly significant in all three specifications (see Table 2). The obtained relationship with the real money balances is positive as it was expected, that implies that the increase of economic activity increases the demand for money. For one percentage increase of the real GDP, the demand for money increases approximately 2.4 percentage points, ceteris paribus. This finding is in line with the most studies on this issue for different countries or group of countries. Regarding the coefficient of interest rate is also statistically significant in the three models and with negative sign as it was expected, meaning that the increase of deposit interest rate, decreases the demand for money, ceteris paribus. However, the coefficient of inflation is with negative sign as expected but it is not statistically significant neither in Model 2, nor in Model 3, when the exchange rate is added in the model. Even the coefficient of exchange rate in Model 3 is statistically insignificant. Thus, based on the results obtained through OLS one can be concluded that the main determinants of money demand for the case of North Macedonia are real GDP that is used as a proxy of economic activity and the interest rate. Besides, two dummy variables are included in the model to investigate the effects of global financial crisis and Covid-19 on the demand for money. The coefficient of the first dummy denoting the global financial crisis of 2008 is with negative sign, but statistically insignificant, even though it was expected a substantial effect on the demand for money. This result is in line with the findings of Kjosevski (2013). He obtained quite similar result for another sample of data (2005-2012) and using the monthly data. The most surprising result is for the coefficient of the dummy variable referring to Covid-19 health crisis that is with positive sign and statistically significant. The positive sign indicates that the demand for money has been increased during that period. The economic uncertainty during that time pushed individuals and firms to increase the demand for real money balances. However, a shortcoming may be that only one year i.e., four quarters of 2021 year are considered with the value one and the other period with the value 0. The first two quarters of 2022 are not included in the data set.

The coefficient of determination is high in Model 3, indicating that 94% of the variance of real money balances can be explained by considered determinants. The F-statistics suggests that the model is statistically significant at the 1% level, indicating that the model is well specified, and the results are reliable.

The test of Durbin Watson indicates that the Model 3 does not suffer from the problem of autocorrelation, even the problem of heteroscedasticity was eliminated with the transformation of raw data into logarithmic. The overall performance of Model 3 where is included the exchange rate and the two dummy variables is better compared to two previous specifications without them and is considered as the most consistent model.

Table 2. OLS regression results

Variables	Model 1	Model 2	Model 3
ΔlnGDP	2.504829 (15.28)***	2.246584 (10.68)***	2.36164 (12.96)***
ΔlnDINT	-0.0791818 (-2.64)***	-0.0877094 (-2.68)***	-0.0539966 (-1.84)**
INF	-	-.0136807 (-1.20)	-0.0100798 (-1.05)
ΔlnEXCHR	-	9.408623 (1.26)	7.427176 (1.17)*
Dum 1	-	-	-0.0463331 (-0.73)
Dum 2	-	-	0.6222349 (5.28)
Constant	-22.33156 (-11.86)***	-58.09734 (-1.96)*	-51.29897 (-2.04)
R-Squared	0.9086	0.9139	0.9408
F-Statistic	333.00	172.38	166.97
Observations	93	93	93
Durbin Watson test	1.867	1.726	1.970

t-statistics are given in the parentheses. * ; **; and *** represent the rejection of null hypothesis in the level of significance of 10%; 5%; and 1%, respectively.
Source: Author's calculations

4.3 Cointegration and the VECM Results

In Table 3 are displayed the results of cointegration test based on the Johansen maximum likelihood estimation procedure (Johansen and Julius, 1990). Based on the obtained results there is only one cointegrating vector that implies the existence of the long run relationship between the used variables, i.e., the real money balances, real GDP, deposit interest rate, inflation, and exchange rate. The results imply that null hypothesis of the zero cointegrating vectors is rejected at the 5% significance level for both λmax and λtrac as both λmax and λtrac are greater than the 5% critical values. However, the null hypothesis of the, at most, one cointegrating vector is not rejected by both trace and maximum eigenvalue statistics because both statistics are smaller than the 5% critical values. Therefore, we can deduce that there is one cointegrating vector and the long run relationship exists.

Table 3. Cointegration test results based on the Johansen maximum likelihood procedure

	Eigenvalues	H_0	H_1	5% critical value	Test values
Trace tests					
λ1	0.5792	r = 0	r > 0	29.91	30.62*
λ2	0.4451	r ≤ 1	r > 1	26.73	19.67
λ3	0.3380	r ≤ 2	r > 2	19.31	14.89
λ4	0.3092	r ≤ 3	r > 3	18.56	13.44

Tests					
λ1	0.5792	r = 0	r = 1	28.34	29.19*
λ2	0.4451	r = 1	r = 2	23.96	18.12
λ3	0.3380	r = 2	r = 3	19.11	14.35
λ4	0.3092	r = 3	r = 4	14.56	13.44

Source: Author's calculations

The results obtained through the VECM model indicate that the long run demand function is normalized by the cointegrating vector M1/P, for this reason its value is one (see Table 4). Unlike the OLS estimates of coefficients, the long run results reveal that all considered determinants are highly statistically significant and with expected signs, i.e., real GDP positively affects the real money balances whereas the interest rate, the inflation rate and the exchange rate negatively affect the demand for money, implying that with their increase the demand for money decreases (beta coefficients in Table 4).

The short-term adjustment coefficient is with negative sign and statistically significant at 10% significance level. The negative sign and the value ECMt-1 implies that the impact of long-term imbalance of short-term demand of money is adjusted by 0.015% per quarter. Based on the short-term results (alpha coefficients in Table 4), the real GDP and the inflation rate are the determinants that mostly affect the money demand, as their coefficients are highly statistically significant, whereas the coefficient of interest rate is only statistically significant at 10% level of significance. Regarding the exchange rate, its coefficient is not statistically significant meaning that the exchange rate cannot be considered as a determinant of money demand over the short run. This is mainly due to the fixed exchange regime of denar against euro. This result is opposite of that of Kjosevski (2013), where it was concluded that exchange rate is a significant determinant on the short run.

Regarding the dummy variables, it was impossible to run a VECM model with inclusion of them because the model couldn't fit due to collinearity.

Table 4. VECM long run and short run results

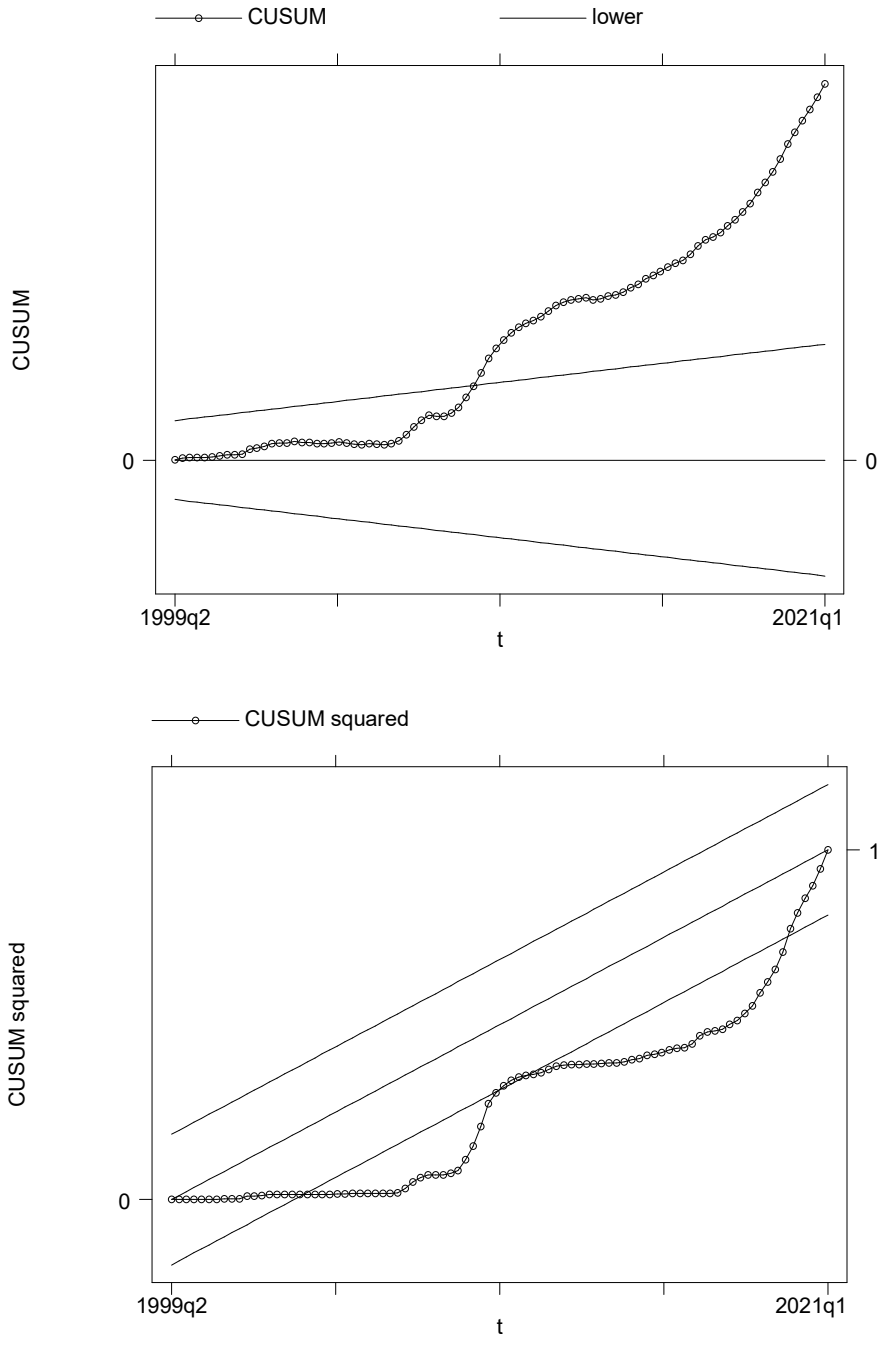
Variables	$\boldsymbol{\beta}$	$\boldsymbol{\alpha}$
ln(M1/P)	1.000	-0.0151119 [0.074]**
lnGDPC	3.613038 [0.000]***	0.0278078 [0.009]***
lnDINT	-0.2021356 [0.000]***	-0.7619835 [0.052]*
INF	-0.3703209 [0.000]***	-1.701188 [0.000]***
lnEXCHR	-2.971741 [0.000]***	0.0005204 [0.980]

P-values are given in parenthesis. *; **; and *** represent the rejection of null hypothesis in the level of significance of 10%; 5%; and 1%, respectively
Source: Author's calculations

After running the VECM model, the study attempts to test the stability of the money demand function using the CUSUM and CUSUMSQ stability test, but according to the obtained results we observe that plots cross the 5 percent critical boundaries, implying that the coefficients in the model are not stable, implying that the money demand function for the case of North Macedonia is unstable for the observed period (see Figure 2). This finding is also contradictory to that of Kjosevski (2013), that finds that money demand function is stable. However, this study considers a wider time span, and many external and internal shocks hit the economy of the country that were ignored in the study, like the conflict of 2001, the debt crisis of 2012, the political crisis of 2015, even in the VECM model were not included

the dummies for global crisis of 2008 and the health crisis of Covid-19. They were only accounted in the multiple regression estimated using OLS. Thus, this may be encountered as the main limitation of this research.

Figure 2. Stability test based on CUSUM and CUSUM squared



Source: Author's calculations

5. CONCLUSION

In this study were investigated the determinants of money demand function for the case of North Macedonia. It has been performed a cointegration analysis and a VECM model for the time 1998q1-2021q4. The long-run estimation results show that real GDP, deposit interest rate, inflation and exchange rate are significant determinants of money

demand function. Specifically, the results show that increased GDP increases the demand for real money balances, whereas increased deposit interest rate and inflation decreases the demand for real money balances, whereas a possible depreciation of the exchange rate will decrease the demand for denars, which will reduce the demand for money. It was also found that the real GDP, interest rate and inflation are significant determinants even in the short run, whereas the exchange rate not. However, based on the CUSUM stability test, we observed that plots cross the 5 percent critical boundaries, implying that the coefficients in the model are not stable and the money demand function cannot be used for forecasting and predicting future performances.

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