

EMPIRICAL EVIDENCE ON THE REAL MONEY DEMAND DETERMINANTS AND ITS STABILITY IN NORTH MACEDONIA

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Abstract

The aim of this study is to empirically examine the determinants that have influence on the real money demand and its stability in case of North Macedonia. The used data are analyzed quarterly, over the period 1997 (q1) to 2020 (q4). The research method consists of time series econometric techniques, using Cointegration analysis (Trace and the Maximum Eigenvalue statistics) for checking long and short - term and Vector Error Correction Method (VECM). The estimation results show that there is one Cointegration equations among the five variables. The ECTt-1 carries a negative sign which confirms the long-run relationship in the Cointegration analysis. The long-run coefficient indicate that all the selected variables have an impact on the real money demand. Specifically, interest rate on deposit in denar and exchange rate have a negative impact on the real money demand, while real industrial production and the increased consumer price index have a positive impact on the real money demand. The short-run results of our VECM model shows that the second lagged of real money demand, the second and the third lagged of real industrial production, the second and the third lagged of consumer price index had a significant impact on the current real money demand. Moreover, the results also show that the real money demand function had remained persistent stable throughout the analyzed period in case of North Macedonia, but again we must be cautious that the time series data used in our study is not that long.

Keywords: Real Money Demand, Cointegration analysis, Vector Error Correction Model, Determinants, Stability, North Macedonia.

JEL E41 Demand for Money

I. INTRODUCTION

North Macedonia economy faced challenges in the last year's due to economic growth and maintenance of macroeconomic balances. Additionally, negative developments in the global area are reflected in added uncertainties in the North Macedonian economy. Moreover, higher food, fuel and primary commodity prices are translated into stronger foreign inflationary pressures, expansion of trade deficit and potentially weaker domestic demand as a result of negative effects on North Macedonian households' financial balances.

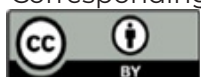
Therefore, starting from this point monetary policy makers should be careful in implementing the current regimen of monetary targeting. The demand for money is one of the topical issues that have attracted the most attention in the literature, both in developed and developing countries. Sustainability of money demand is one of the essential factors on which it is based the choice of monetary regimen. The Central Bank's monetary policy and goals are often depending on its thoughtful and stability of money demand, a stable demand function of 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).

However, when the demand for money is not stable (real and nominal interest rates will change) there will be economic fluctuations. North Macedonia as a small but yet open economy, has a relatively high degree of

euroization and in transition with partial euroization, the theory suggests that the real money demand is determined by: output, reflecting economic activity; the interest rate, as the opportunity cost of holding money; and the expected change of exchange rate, as the opportunity cost of holding domestic currency (Handa 2000), and hence it influences the euroization. Therefore, many empirical studies are dedicated to investigate what are the crucial determinants of the money demand function, and to observe if it is stable in long and short run. Most studies use gross domestic product, gross national disposable income, consumption expenditure and industrial production, as a proxy for output to measure the economic activity, and consumer prices as a conventional measure of prices in the economy, opportunity costs of holding money and many other variables.

Our empirical literature review focuses on Central and Southeast Europe (including Republic of North Macedonia as well) based on the reason, that it would be more useful in background of our research. More of these studies are country specific studies not panel studies. According to Skrabic and Plazibat (2009), real money demand function is analyzed within multivariate time-series framework, empirical results provide the evidence that real industrial production and exchange rate explains the most variations of money demand in the long-run, while interest rate is significant only in short-run. Golinelli and Rovelli

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(2002) analyzed the effect of interest rate used as the transmission mechanism tool on the inflation and money demand in the Czech Republic, Poland and Hungary, and measured the effect of interest rates in the real money demand and prices in the domestic market for the period 1991- 2000. The result provides that interest rates and exchange rate were found to be significant and the stability tests showed that the early stage of transition had been marked by the instable money demand while its stability would be achieved at a later stage.

Maravić and Palić (2005) analyze the long and short-term money demand in Serbia for the period January 1996 to March 2005, 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) proved 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 analyzed period is unstable. Kjosevski (2013) analyze the long and short-run determinants, and stability of money demand in case of the Republic of Macedonia using monthly data from January 2005 to October 2012. Empirical results provide the evidence that exchange rate and interest rate had impact on money demand in the long-run, while interest rate is significant only in short-run and the result also shows that money demand is stable.

III. EMPIRICAL RESULTS

Empirical results of the tests are presented in this section. Before proceeding to Cointegration analysis, as first we need to check the order of integration of the variables. In order to determine the order of integration, the Augmented Dickey-Fuller (ADF) is applied to the levels and the first differences. According to the results of Augmented Dickey-Fuller (ADF) test presented in

II. DATA AND METHODOLOGY APPROACH

In order to investigate the macro-determinants of money demand relationship in North Macedonia, we based on the model of Skrabic and Tomic - Plazibat (2009), and selected variables as following:

- ✓ Real money demand ($RM1 = M1/CPI$);
- ✓ Real industrial production adjusted with producer price index, as a proxy of real output (RIP);
- ✓ interest rate on deposits in denar (IRD);
- ✓ exchange rate of denar per euro (ER);
- ✓ consumer price index (CPI).

We used quarterly data from q1-1997 to q4-2020 according to the official reports of the National Bank of the Republic of North Macedonia. All the data are transformed into natural logarithms (denoted Ln), except the interest rate, which is defined as $[(1 + \text{interest rate}/100) * 100]^1$. The VECM approach provides a framework for the empirical investigation determinants that have influence on the real money demand and its stability. Namely, it enables an investigation of short- and long-run effects. The methodology proceeds through the following stages:

- first, testing each variable in the model for stationarity;
- second, specifying the VECM, which means determining the lag order of the underlying VAR, testing for Cointegration and the Cointegrating rank, and imposing restrictions on the Cointegrating vector(s) and short-run parameters in the model;
- third, checking the model by diagnostic tests;
- four, interpreting results from the estimated model.

Table 1, all the variables are non-stationary at levels but stationary in the first difference since the t-statistics are greater than the critical value of t-statistic at 5% level of signification at levels but the t-statistics are less than the critical value of t-statistic at 5% level of signification in the first difference.

Table 1. Augment Dickey-Fuller Unit Root Test results

Variables		at Level		at First Difference		Conclusion Order of integration
		t-statistic	t-statistic at 5%	t-statistic	t-statistic at 5%	
LnRM1	Constant	0.242	-2.899	-4.021	-2.900	I(1)
	Constant and trend	-2.234	-3.461	-4.013	-3.462	I(1)
IRD	Constant	-1.078	-2.902	-5.476	-2.903	I(1)
	Constant and trend	-1.778	-3.465	-5.412	-3.466	I(1)
LnRIP	Constant	-1.509	-2.908	-3.519	-2.909	I(1)
	Constant and trend	-2.862	-3.473	-3.961	-3.473	I(1)
LnER	Constant	-1.092	-2.899	-6.580	-2.900	I(1)
	Constant and trend	-2.739	-3.461	-6.542	-3.462	I(1)
LnCPI	Constant	-1.168	-2.899	-4.102	-2.900	I(1)
	Constant and trend	-2.423	-3.461	-4.245	-3.462	I(1)

Source: Researcher's calculation

¹ Hence, parameters on the logged levels measure constant elasticities and the parameters on the interest rate will show percentage changes of the dependent variable in response to a percentage point change in interest rates.

After assuring that all the variables are stationary in the first difference, I (1) we performed a VAR Lag order selection process. Table 2 reports the lag order selection criteria's statistics. The lag length of the model is selected based on modified LR test statistics (LR), Final Prediction Error criteria (FPE), Akaike's

information criteria (AIC), the Hannan and Quinn information criteria (HQIC) and the Swartz-Bayesian information criteria (SBIC). According to the three out of five criteria, specifically LR, FPE and AIC suggest to set the lag length at 4, so for our model the lag length is chosen to be 4.

Table 2: Lag Order Selection Criteria's

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	403.016				2.5e-11	-10.2055	-10.1451	-10.0545
1	816.047	826.06	25	0.000	1.2e-15	-20.1551	-19.7922	-19.2486*
2	857.232	82.369	25	0.000	8.1e-11	-20.57	-19.9048	-18.9083
3	903.93	93.397	25	0.000	4.7e-16	-21.1264	-20.1588*	-18.7093
4	940.02	72.179*	25	0.000	3.7e-16*	-21.4108*	-20.1408	-18.2383

Source: Researcher's calculation

Before we estimate the VECM, preliminary we should test for the existence of Cointegration among the real money demand (RM1), real industrial production (RIP), exchange rate of denar per euro (ER), interest rate on deposit in denar (IRD) and consumer price index (CPI) or in other words we should test the Cointegration rank using the methodology by Johansen (1988).

The results of the Johansen Cointegration rank tests are presented in Table 3. The Cointegration rank is

tested using the Trace and the Maximum Eigenvalue statistics. According to the results both Trace statistic and Maximum Eigenvalue statistics suggest that there is one Cointegration equation (vector) among the five variables at 5% level of significance. This also implies that a long run relation can be found among real money demand (RM1), real industrial production (RIP), exchange rate of denar per euro (ER), interest rate on deposit in denar (IRD) and consumer price index (CPI).

Table 3: Johansen Cointegration tests

Maximum Rank	Trace statistic	0.05 Critical Value	Max-Eigen statistic	0.05 Critical Value
None	81.7998*	68.52	41.8890*	33.46
At most 1	39.9108	47.21	21.9973	27.07
At most 2	17.9135	29.68	12.9117	20.07
At most 3	5.0018	15.41	4.9796	14.07
At most 4	0.0222	3.76	0.0222	3.76

Source: Researcher's calculation

Further on, based on the results of the lag selection criteria's statistics and the Johansen Cointegration test we chose one rank and four lags to obtain the estimation of Cointegrating relationships through a Vector Error Correction model (VECM). To estimate the long-run coefficients of real money demand and its

determinants, we must normalize one variable in the Cointegrating vector. Even from the above results we discovered that we have one Cointegration equations (vector), it is a common practice to normalize the variable of interest, which in this case is LnRM1.

Table 4: Cointegration analysis with normalization

Variables	Coefficient	Standard Error	t- statistic	p-value
LnRM1	1	-	-	-
IRD	0.1096907	0.0207785	5.28	0.000
LnRIP	-2.249412	0.5132956	-4.38	0.000
LnER	83.89734	23.26541	3.61	0.000
LnCPI	-4.122975	0.7826426	-5.27	0.000
C	-322.3076	-	-	-

Source: Researcher's calculation

Note: * indicates the rejection of the null hypothesis at 5% level. Trace statistic and Max-eigenvalue test indicates one cointegrating vectors

The long-run coefficient indicate that all the selected variables have an impact on the real money demand. Specifically, interest rate on deposit in denar and exchange rate have a negative impact on the real money demand, while real industrial production and consumer price index have a positive impact on the real money demand.

If the interest rate on deposit in denar increases by 1%, the population will be encouraged to save more and reduce the real money demand by 10.96%.² If real industrial production increases by 1%, the real money demand will get increased by 2.25%. If exchange rates increase by 1% the real money demand will decrease by 83.89%. If consumer price index increases by 1%, the real money demand will increase by 4.13%.

In Table 5 are presented the results of short-run coefficients of the Vector Error Correction (VECM)

Estimates. The short run results of our VECM model shows that the second lagged of real money demand, the second and the third lagged of real industrial production, the second and the third lagged of consumer price index had a significant impact on the current real money demand at 5% and 10% level.

If the previous real money demand increased by 1% the current real money demand will decrease by 0.23%. If the second lagged of real industrial production increases by 1% the current real money demand will decrease by 0.004%. If the third lagged of real industrial production increases by 1% the current real money demand will decrease by 0.14%. If the second lagged of consumer price index increases by 1% the current real money demand will increase by 1.09%. And if the third lagged of consumer price index increases by 1% the current real money demand will decrease by 1.42%.

Table 5: Vector Error Correction Model Estimates

Variables	Coefficient	Standard Error	z- statistic	p-value
D(LnRM1(-1))	-0.1989641	0.125658	-1.58	0.113
D(LnRM1(-2))	-0.2281812	0.123332	-1.85	0.064
D(LnRM1(-3))	0.0230211	0.1311419	0.18	0.861
D(IRD(-1))	0.0000776	0.0098039	0.01	0.994
D(IRD(-2))	-0.0042569	0.0120563	-0.35	0.724
D(IRD(-3))	0.0063833	0.0077756	0.82	0.412
D(LnRIP(-1))	-0.1558477	0.1022186	-1.52	0.127
D(LnRIP(-2))	-0.1453425	0.0834447	-1.74	0.082
D(LnRIP(-3))	-0.1414294	0.068506	-2.06	0.039
D(LnER(-1))	-6.522527	5.698192	-1.14	0.252
D(LnER(-2))	6.891624	5.797569	1.19	0.235
D(LnER(-3))	4.8255715	5.583161	0.86	0.387
D(LnCPI(-1))	-0.177888	0.6288702	-0.28	0.777
D(LnCPI(-2))	1.092087	0.6135316	1.78	0.075
D(LnCPI(-3))	-1.417346	0.621959	-2.28	0.023
ECT(-1)	-0.0623992	0.0361132	-1.73	0.084
C	0.0396639	0.0094869	4.18	0.000
R ² = 0.5691				

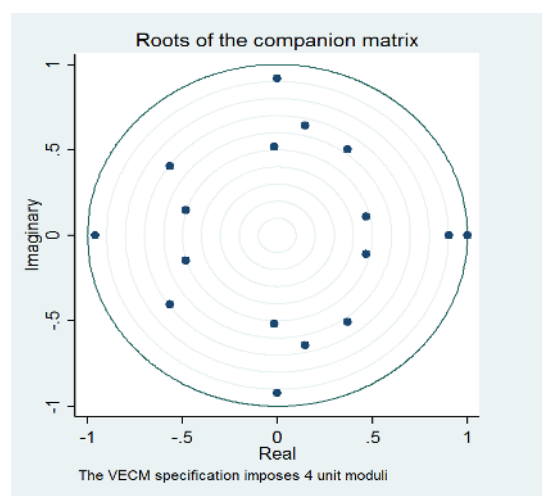
Source: Researcher's calculation

As expected, the ECT_{t-1} carries a negative sign and is significant at 10% level which confirms the long-run relationship in the Cointegration analysis. The value of the ECT_{t-1} indicates the speed of adjustment to the long-run equilibrium. From the results obtained in Table 5, the speed of adjustment in our case is about 6.24%, which means that approximately 6.24% of the disequilibrium from the previous year's shocks converge back to the long-run equilibrium and is corrected in the current year.

Our VECM has a R-Squared of 0.569, meaning that the natural logarithm of real industrial production, interest rate on deposit in denar, the natural logarithm of exchange rate of denar per euro and natural logarithm of inflation can explain up to 56.91% movement of the natural logarithm of the real money demand.

In order to fully ascertain the stability of the long-run real money demand function, the Eigenvalue stability condition is performed. The results showed that the real money demand had persisted stable since all the roots lie inside the unite circle.

Figure 1. Stability graph for VECM



Source: Author's illustration

² For this variable (IRD) we are dealing with a form of the log-linear model, so $100 \times \square (100 \times 0.1096)$ is the expected percent age change in Y for a unit increase in X.

The model is also checked for serial correlation and normality. To accomplish this, we used the LM test for autocorrelation and the Jarque-Bera test for normality. The results are presented in Table 6 and Table 7.

According to the LM test results presented in Table 6, the p-value of all the variables is greater than 0.05, so the null hypotheses in not rejected at 5% significant level of confidence, meaning that there is no serial correlation in our model.

Table 6: LM test results

lag	Chi squared	df	Prob. > Chi squared
1	32.3148	25	0.14910
2	36.1953	25	0.06869
3	16.6733	25	0.89330
4	24.7055	25	0.47897

Source: Researcher's calculation

Further on, according to the results of the Jarque-Bera test results in Table 7 the p-value of the residuals of our depended variable (LnRM1) is greater than 0.05, so the

null hypotheses in not rejected at 5% significant level of confidence, meaning that our model is normally distributed.

Table 7: Jarque-Bera test results

	Chi squared	df	Prob. > Chi squared
D(LnRM1)	0.567	2	0.75323

Source: Author's calculation

IV. SUMMARY WITH CONCLUSIONS

North Macedonia economy faced challenges in the last year's regards economic growth and maintenance of macroeconomic balances. Additionally, negative developments in the global area are reflected in added uncertainties in the North Macedonian economy. Moreover, higher food, fuel and primary commodity prices are translated into stronger foreign inflationary pressures, expansion of trade deficit and, potentially, weaker domestic demand as a result of negative effects a North Macedonian households' financial balances. Therefore, starting from this point monetary policy makers should be careful in implementing the current regime of monetary targeting. Sustainability of money demand is one of the essential factors on which it is based the choice of monetary regime.

Results provide that in the case of North Macedonia the real money demand had persisted stable throughout the analyzed period (1997-2020), we have estimated both short-and long-run money demand function, and results provide the evidence that the long-run coefficient show that all the selected variables have an impact on the real money demand. Specifically, interest rate on deposit in denar and exchange rate have a negative impact on the real money demand, while real industrial production and consumer price index increases have a positive impact on the real money demand.

The short run results of our VECM model shows that the second lagged of real money demand, the second and the third lagged of real industrial production, the second and the third lagged of consumer price index had a significant impact on the current real money demand at 5% and 10% level.

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