An Analysis on the Money Demand Dependence Relative to GDP and the Interest Rate for Romania during 2001-2011

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Abstract: In this paper, we have investigated the dependence of money demand based on GDP and the real interest rate in Romania during 2001-2011. After determining the regression equation, an apparently surprising conclusion is that the most influential factor in the demand for money is the level of GDP and not the real interest rate.

Keywords: money demand; GDP; interest rate; regression

JEL Classification: R12

1 Introduction

The purpose of this paper is to statistically analyze the dependence of money demand based on GDP and the real interest rate in Romania during 2001-2011.

For accuracy and adequacy of calculations, we have reduced the existing data (GDP, the money demand) using GDP deflator at the level of year 2000. We also determined the real interest rate taking into account the consumer price indices in the mentioned period.

2 The Money Demand Dependence Relative to GDP and the Interest Rate

In this section we shall investigate the dependence of money demand to GDP and the interest rate. For data consistency calculations we will report all computations to the level of year 2000.

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Considering the GDP deflator for year n: $GDP_{deflator,n}=\frac{nominal\,GDP_n}{real\,GDP_n}$ we first compute the cumulative deflator for the year n relative to 2000:

$$GDP_{cumulative\ deflator,n}=\frac{GDP_{cumulativedeflator,n-1}}{GDP_{deflator,n}}=\frac{1}{\prod_{k=1}^{n}GDP_{deflator,n}}$$

where $GDP_{deflator,2000}=1$.

Table 1

Year	**Deflator GDP-Romania ($GDP_{deflator,n}$)**	**Cumulative Deflator-Romania ($GDP_{cumulative\ deflator,n}$)**
2000	1.443	1
2001	1.374	0.727802038
2002	1.234	0.589790954
2003	1.24	0.475637867
2004	1.15	0.413598145
2005	1.123	0.368297547
2006	1.108	0.332398508
2007	1.13	0.294157971
2008	1.116	0.263582412
2009	1.065	0.247495222
2010	1.036	0.238895002
2011	1.071	0.223057892

Source: The World Bank

Also let the consumer price index (IPC) for the year n: IPC_n and π_n - the inflation.

Table 2

Year	**$IPC_n=1+\pi_n$**
2001	1.345
2002	1.225
2003	1.153
2004	1.119
2005	1.09
2006	1.065
2007	1.0484
2008	1.0785
2009	1.0559
2010	1.0609
2011	1.0579

Source: Romanian National Institute of Statistics

Considering the nominal interest rate rd, we first calculate the real interest rate (without inflation): $r=\frac{rd-\pi_n}{1+\pi_n}$.

Table 3.

Year	The nominal interest rate (rd)	The real interest rate (r)
2001	0.3880	0.03197
2002	0.2847	0.04873
2003	0.1884	0.03070
2004	0.2027	0.07480
2005	0.0959	0.00541
2006	0.0844	0.01822
2007	0.0746	0.02499
2008	0.0946	0.01493
2009	0.0933	0.03542
2010	0.0667	0.00547
2011	0.0625	0.00435

Source: Romanian National Institute of Statistics

Let now consider GDP for the period 2001-2011:

Table 4.

Year	GDP (current mil. lei) Y
2001	117945.8
2002	152017.0
2003	197427.6
2004	247368.0
2005	288954.6
2006	344650.6
2007	416006.8
2008	514700.0
2009	501139.4
2010	522561.1
2011	578551.9

Source: Romanian National Institute of Statistics

Considering the cumulative deflator, we get:

Table 5

Year	GDP (mil. 2000-lei) Y
2001	85841.2
2002	89658.3
2003	93904.0
2004	102310.9
2005	106421.3
2006	114561.3
2007	122371.7
2008	135665.9
2009	124029.6
2010	124837.2
2011	129050.6

Also, let the money demand for the period 2001-2011:

Table 6

Year	The money demand – average daily (current mil. lei) MD
2001	5719.50
2002	7302.50
2003	9325.00
2004	12403.70
2005	17342.20
2006	25071.10
2007	35213.30
2008	46771.20
2009	45800.20
2010	46667.20
2011	52018.10

Source: Romanian National Institute of Statistics

At the level of 2000-currency, the situation is as follows:

Table 7

Year	The money demand – average daily (mil. 2000-lei) MD
2001	4162.7
2002	4306.9
2003	4435.3
2004	5130.1
2005	6387.1
2006	8333.6
2007	10358.3
2008	12328.1
2009	11335.3
2010	11148.6
2011	11603.0

The research question consists to search the dependence of money demand from GDP and the level of real interest rate in comparable prices for the year 2000.

Let therefore the regression equation:

$$MD=m_Y Y+m_r r+M_0,\ m_Y>0,\ m_r<0,\ M_0 \in \mathbf{R}$$

where:

- MD – the money demand in the economy;
- Y – GDP;
- r – the interest rate;
- m_Y – the rate of money demand in the economy;
- m_r – a factor of influencing the demand for currency from the interest rate, $m_r<0$;
- M_0 – additive constant (*representing the demand for money in the absence of added value and financial mechanisms*)

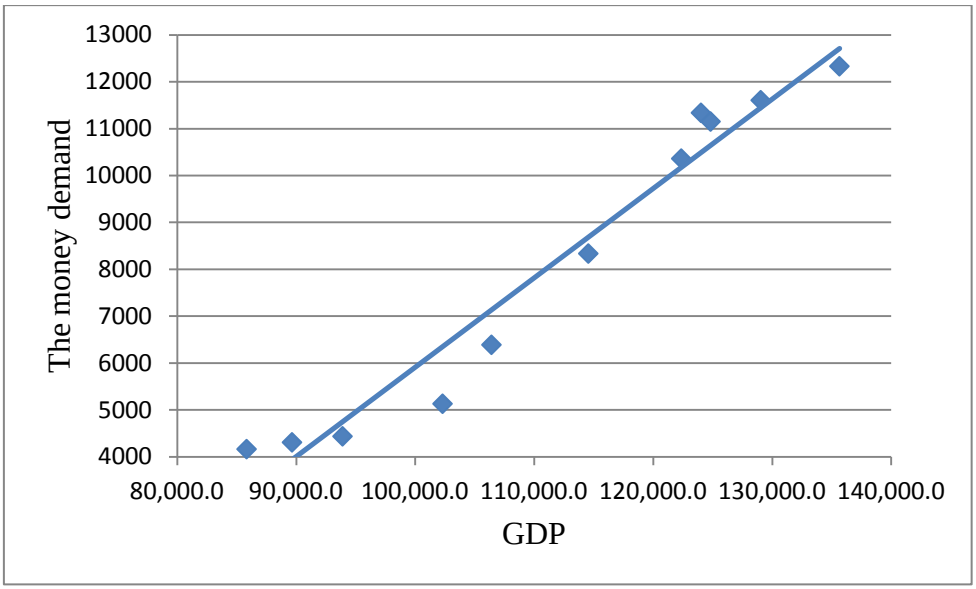

Figure 1. The dependence of the money demand from GDP

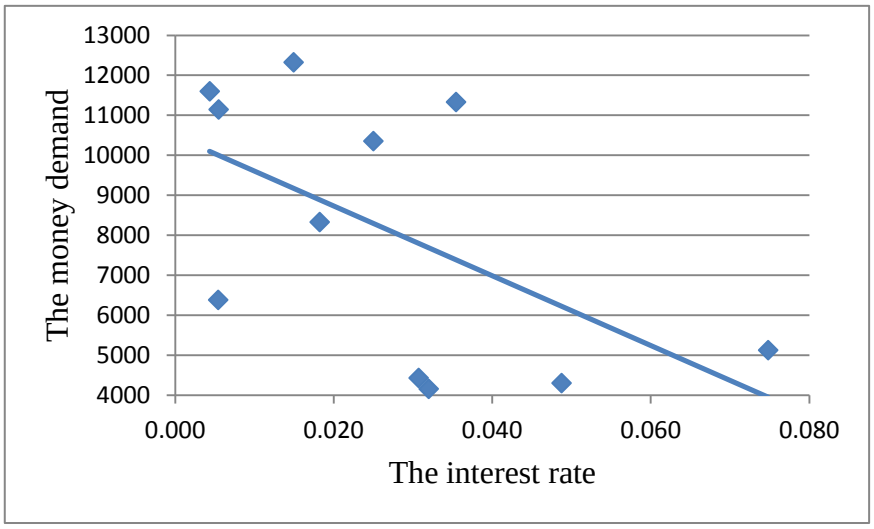

Figure 2. The dependence of the money demand from the interest rate

The regression analysis provides the following results:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.980778278
R Square	0.96192603
Adjusted R Square	0.952407537
Standard Error	723.9406769
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	105927679.1	52963839.56	101.0586523	2.10142E-06
Residual	8	4192720.829	524090.1037		
Total	10	110120399.9			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept (M_0)	-12203.49939	1977.00423	-6.172722954	0.000267267	-16762.47932	-7644.519462
X Variable 1 (Y)	0.184376252	0.015798811	11.67026123	2.65027E-06	0.147944129	0.220808376

X Variable 2 (r)	-9379.055266	12653.01207	-0.741250796	0.479732307	-38556.95342	19798.84289

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*Standard Residuals*
1	3323.727344	838.9364112	1.295630225
2	3870.267631	436.6808137	0.674397789
3	4822.215452	-386.8923464	-0.597505855
4	5958.66611	-828.5188016	-1.279541556
5	7367.288226	-980.1985136	-1.513791515
6	8748.043571	-414.4473437	-0.640061032
7	10124.55215	233.7207439	0.360951862
8	12670.05294	-341.9872421	-0.528155652
9	10332.40843	1002.922248	1.548885423
10	10762.24635	386.3144932	0.596613435
11	11549.57819	53.46953681	0.082576876

The regression analysis revealed the following:

- For the number of data N=11 and the number of degrees of freedom k=1 (the number of independent variables), the Durbin-Watson test provides the values (Savin, White & Kenneth, 1977, pp. 1989-1996): dl=0.93 and du=1.32, and the Durbin-Watson value statistic: $d=\frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2}$ (where e_i are residues derived from regression) is d=1.056. Because $d \in (du, 4-du)$ follows that the errors are uncorrelated.

- The empirical correlation coefficient ρ (multiple R) is 0.981, while the critical value of the correlation coefficient for N=11 and a significance threshold of 95% is $r_c=0.602$. Because $\rho > r_c$ follows that a linear dependence between variables may exist.

- Significance $F=2.1 \cdot 10^{-6}$ (*which means the probability that the regression equation can not explain the evolution of the endogenous variable – the phenomenon having links purely random*) is much smaller than $\alpha=0.05$. From the econometric theory it is known that if Significance $F<\alpha$ then the null hypothesis

H0 is rejected with probability 1-α=0.95, so it is possible that at least one regression coefficient to be different from 0. In this case, we can consider this requirement met.

- The values P-value are an essential indicator for the revealing the variables which significantly influencing the process if they are less than α=0.05. Thus, for the coefficient of the independent variable Y we have P-value=$2.65 \cdot 10^{-6}$<0.05 and for the coefficient of the independent variable r we have P-value=0.479>0.05. For the remainder we have P-value= 0.0003<0.05.

- The intervals [Lower 95%,Upper 95%] representing the confidence intervals where are the coefficients, are for the independent variable Y: [0.1479;0.2208], for the independent variable r:[-38556.9534;19798.8429] and for the remainder: [-16762.4793;-7644.5195]. Because 0 not belonging at the appropriate intervals for Y and remainder, implies that for a higher probability of 0.95 their coefficient belong to their respective ranges. A further analysis confirms that the coefficient of r belongs in the interval [-18752.2063, -5.9043] with a probability greater than 0.52.

- The regression equation is thus:

$$MD=0.1844Y-9379.05527r-12203.4994$$

From these data, it appears that an increase in GDP of 1 billion lei, the money demand increases by 184.4 million lei. Also, an increase in the real interest rate by 1% leads to a decrease in average daily money demand to 93.79 million in the 2000-currency.

It also should be noted that R Square=$\frac{SPE}{SPT}$=0.9619 shows that the demand for money is explained at the rate of 96.19% of GDP development and the real interest rate.

3 Conclusions

The above analysis shows that for Romania there is a greater dependence of money demand from the evolution of GDP in relation to the real interest rate.

This slightly paradoxical, can be explained also through the fact that people and businesses do not have sufficient information or those officials does not have a high confidence concerning the expected rate of inflation and therefore no real interest rates can be expected.

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