

The Relationship between Exchange Rate and Key Macroeconomic Indicators. Case Study: Romania

Anca Elena Nucu ¹

The purpose of this article is to examine the influence of the following key macroeconomic indicators: GDP, inflation rate, money supply, interest rate and balance of payments on exchange rate of the Romanian leu against the most important currencies (EUR, USD) during 2000-2010 period. The main findings of our study are: it is an inverse relationship between exchange rate EUR/RON, Gross Domestic Product, respectively money supply and a direct relationship between exchange rate EUR/RON, inflation and interest rate. We can not validate the correlation between exchange rate and Balance of payment, because the test statistic is not significant.

Key words: exchange rate, GDP, money supply, inflation, balance of payment, econometric analysis

JEL Classification: E31, C5, F31

1. Introduction

The reasons underlying this theme are related to timeliness and importance of the problem through the solutions needed to be implemented by domestic monetary policy, given the interdependence of global financial systems. The topicality is revealed through the

¹ Anca Elena NUCU, PhD, "Alexandru Ioan Cuza" University of Iași, nucu.anca@yahoo.com

following issues: first, the exchange rate is a macroeconomic indicator with remarkable effects on the stability of the banking system, because currency depreciation has negative repercussions on the quality of loan portfolio, and secondly, is one of the nominal convergence indicators required by the accession to the euro area (two years before examination, national currency must have been part of ERM II).

The exchange rate is a dynamic variable, whose mobility is determined by a wide range of economic, financial, political and social factors (Voinea, 2004, p.134), the most important being the following GDP, inflation rate, money supply, interest rate and balance of payments.

Our article is structured in the following way: section two entitled “The evolution of key macroeconomic indicators in Romania between 2000 and 2010” presents a short numerical and descriptive evolution of the following indicators in Romania: GDP, money supply, inflation rate, reference interest rate and balance of payment, during 2000-2010 period. In section three “Econometric analysis. Results” we examined, using SPSS software, the influence of these indicators on exchange rate of the Romanian leu against the most important currencies (EUR, USD). The research goal was identifying a connection, setting the intensity of the relationship through Pearson correlation coefficient, determining the parameters of the regression equation and testing the validity of the model. The study ends with some conclusions.

The multitude of factors that, directly or indirectly, influence the exchange rate make difficult to modeling this variable so complex and dynamic (Cerna, 2005, p.95). The evolution of exchange rate, on short, medium or long term, has an influence on general economic equilibrium, given the links between foreign exchange market, money market and capital markets. Based on these considerations, at present, it shows that the optimality of monetary policy requires deviations from price stability, requiring stabilization of the exchange rate (Faia and Iliopoulos, 2010). The comparison between different regimes of monetary policy highlights the reversal of impossible trinity: a greater

degree of financial globalization, by inducing persistent current account deficits, calls stabilizing the exchange rate.

2. The evolution of key macroeconomic indicators in Romania between 2000 and 2010

In order to realize the analysis, we used a combination of techniques and qualitative and quantitative tools, mixes considered in research methodology through triangulation (Zaiț and Spalanzani, 2006, p.197). In the stage debut, abduction is the method which offers techniques and tools for searching the connections between variables considered. The reality is perceived, understood and, then, explicated. In order to conceive the econometric model, searching the available data is an important stage, which is based on techniques of mediated collection, and we used official statistics (monthly bulletins, annual reports National Bank of Romania). For Consumer Price Index and money supply, we considered monthly data series for the period 2000-2010, and for Gross Domestic Product and reference interest rate, we took into consideration annual data series, because of unavailability of data. For a systematic presentation of the results, we used, as instruments, tables and charts made in Excel and SPSS, the software thus becoming research tools.

This section presents the data used in correlation and regression analysis, being, therefore, a numerical and descriptive analysis of the key macroeconomic indicators in Romania during 2000-2010 period.

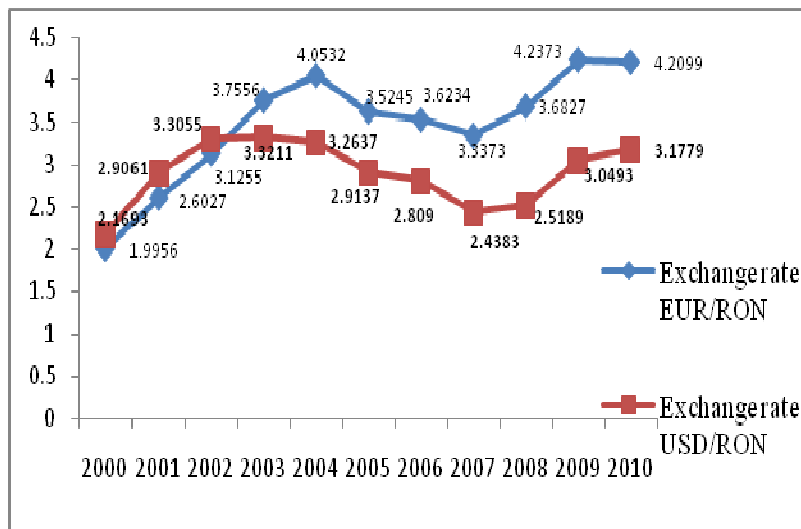
Exchange rate

The evolution of exchange rate EUR/RON and USD/ RON was not stable and linear, being marked by a series of major fluctuations. Thus, since 2000 to 2004, EUR rose continuously against RON with more than 100%, the trend began to reverse in time, the average during the

first nine months of 2008, being over 10 percent lower than the rate recorded in the first days of 2004.

Figure 1

The evolution of the exchange rate in Romania 2000-2010



Source: National Bank of Romania, www.bnro.ro, accessed on July 2011

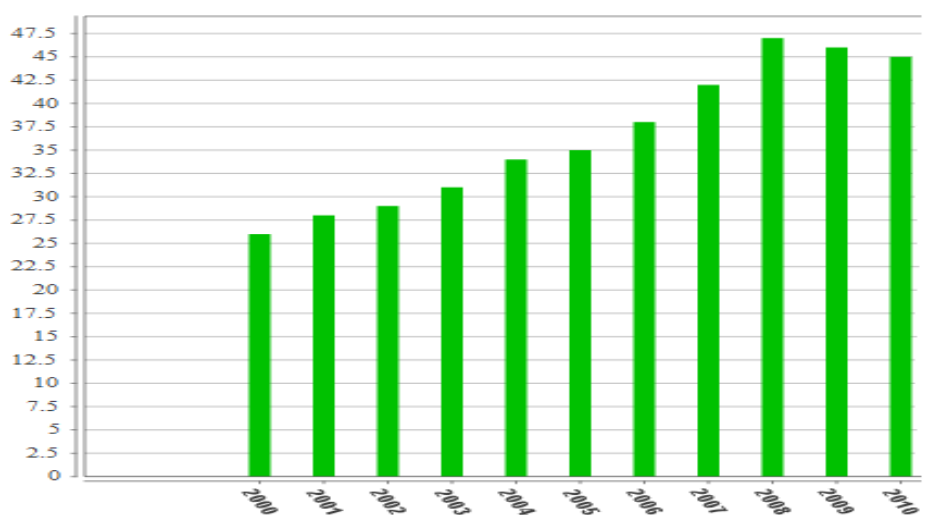
A somewhat similar trend, but in a narrower range, registered and USD/RON, which started at an average rate of 2.164 RON in 2000 reaching an annual average rate 3.2637 RON / USD in 2002, then depreciated steadily until 2008. The deterioration of confidence in the components of financial market, following the financial crisis effects has putted pressure on the exchange rate. Since 2009 under the impact of international crisis, domestic currency continued to depreciate more pronounced against the euro and the U.S. dollar. By the end of March 2009, the RON depreciated with 25% against the euro from mid-2007 despite the increase of interest rates. The trend of depreciation of the exchange rate was maintained during 2010.

Gross Domestic Product

In terms of GDP growth, the period 2000-2010 was one of the most glorious periods in all history of the Romanian economy.

Figure 2

The evolution of GDP per capita in PPS in Romania (in Purchasing Power Standards) 2000-2010



Source: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsieb010>, accessed on July 2011

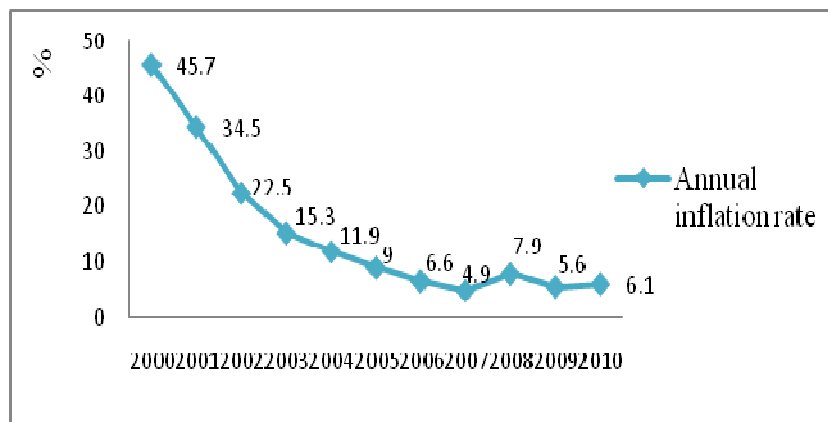
During 2000-2006, GDP growth was robust, being on average 5.6 percent per year, which led to doubling GDP per capita. However, at the end of 2007 the level of this indicator (expressed in purchasing power parity) stood for Romania only at 40.3 percent of the EU27 average. During 2007-2008 GDP increased massively due to accession of our country to EU and due to strong growth of private capital inflows. Romanian economy went into recession in the third quarter of 2008, when GDP decreased by 0.1%. In 2009, the economy has declined over 7% and for 2010 fell by a further 1%. In 2009 Romania stood on penultimate place of the European Union after the value of

Gross Domestic Product (GDP) per capita, with 45% from the EU average, followed only by Bulgaria.

Inflation rate

Regarding inflation, Romania registered a positive trend during 2000-2007. During 2000-2005, Romania has experienced a strong disinflation, reaching single digits. After 2005 the inflationary trend has registered slowing slightly. The lowest level of inflation was 4.9%, value recorded in 2007. In 2008 Romania ranked 5 in the European Union (EU), the indicator recorded, in our country, a level of 6.4%, according to Eurostat. Average monthly inflation stood at 0.5%, as in 2007, while annual inflation average rose to 7.9%, three points above the 2007 level. The inflation rate in 2010 stood 0.5 percentage points above the average of 2009, reaching 6.1%. The increase occurred due to increasing the standard VAT rate by 5 percentage points, from 19% to 24%.

Figure 3
The evolution of inflation rate in Romania 2000-2010 (%)



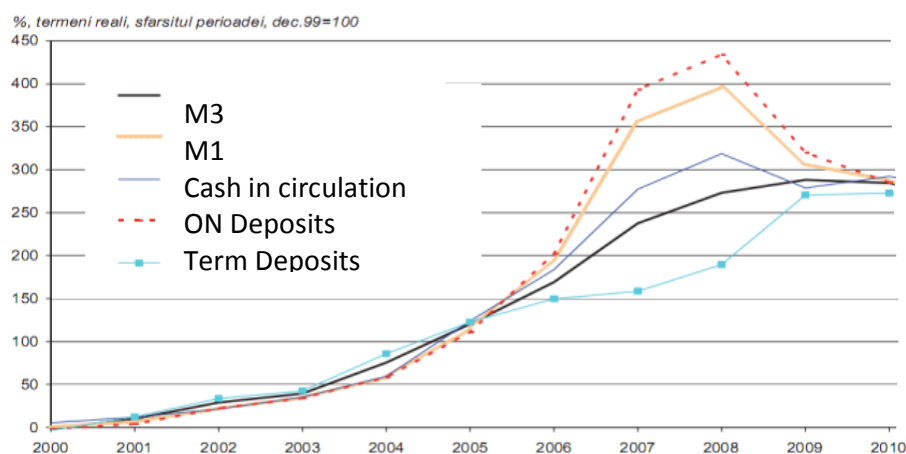
Source: National Bank of Romania, www.bnro.ro, accessed on July 2011

Money supply

The evolution of monetary indicators in the period 2000-2010 is characterized by an upward trend. Thus all monetary aggregates have had a positive development, the Romanian economy experienced a very dynamic re-monetization process, the average annual growth of broad money (M2) being almost three times exceeding the average GDP growth rate (15.83 percent 5.5 percent).

Figure 4

The evolution of money supply in Romania 2000-2010 (%)



Source: National Bank of Romania, www.bnro.ro, accessed on July 2011

Annual growth trajectory of the broader monetary aggregate was not uniform during the interval. Thus, after having been negative in 2000, annual growth rate of money supply gradually increased, reaching consistently in 2005 (except December) to record levels. This trend was maintained in the period 2007-2010 which led to a doubling of money supply. The evolution of M2 dynamics and changes in the structure of money supply reflect the impact of the action of many factors. On the one hand, the period under review was marked by a consolidation of disinflation, and a robust economic growth, both

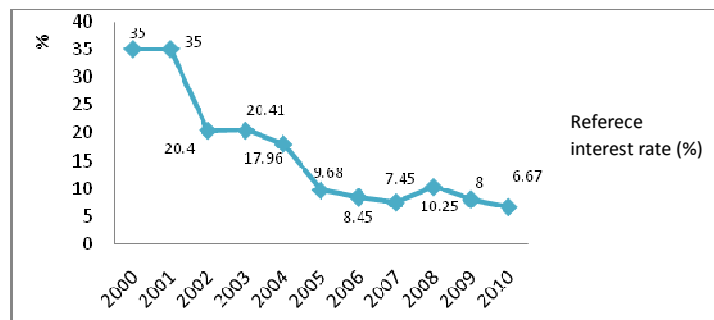
processes are likely to support an improvement in demand for money. On the other hand, in this period was felt the strong influence of a set of structural and institutional changes. In addition to strengthening economic activity (increase in money demand for transactions) and relative reduction in the opportunity cost of holding money as cash and demand deposits in lei, M1 has also contributed to the increase, especially in the last two years and diversification of banking products. In these circumstances, the current accounts of people were the most dynamic structural element of M1.

Interest rate

The interest rate practiced by the NBR in the period 2000-2007 showed a downward trend, the most significant leap being recorded in 2002 when it reached 20.4%. The reference interest is back on an upward trend in 2008 when its level was 10.25%, then continued downward trend in coming years. The financial crisis has brought to the fore the importance of the interest rate in economic recovery process. Under these conditions, the National Bank of Romania dropped the reference interest rate to historic levels in order to stimulate economic growth.

Figure 5

The evolution of reference interest rate in Romania 2000-2010 (%)



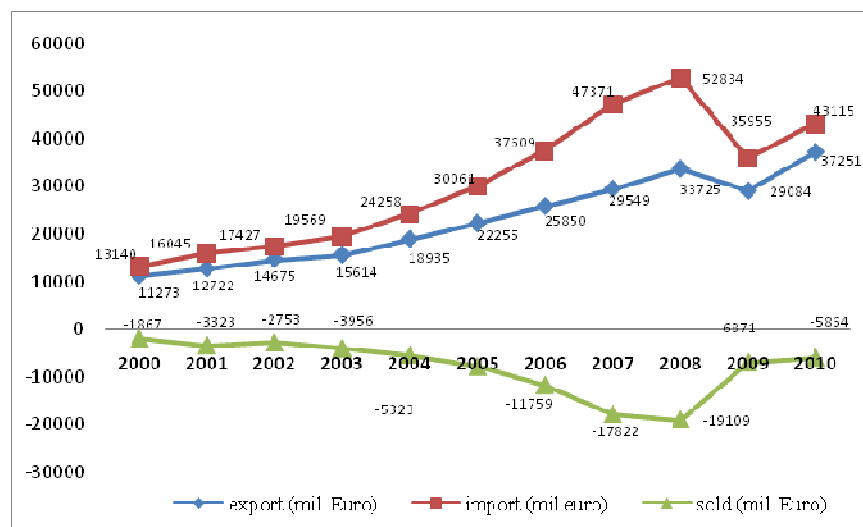
Source: National Bank of Romania, www.bnro.ro, accessed on July 2011

Balance of payments

The trade policy in Romania has been characterized, in recent years, by restriction of the possibilities to boost exports. Shares weak authorities, which sought to stimulate imports (considerably cheaper) to have time for economic recovery, led to worsening external imbalance. The trade balance recorded the largest deficits in 2007-2008 given the expansion of imports from the EU and exports decline.

Figure 6

The evolution of balance of payments in Romania 2000-2010 (mil. euro)



Source: National Bank of Romania, www.bnro.ro, accessed on July 2011

3. Econometric analysis. Results

Case 1: The variables considered are:

- the value of Gross Domestic Product (noted by PIB)- independent numerical variable (X)
- the exchange rate EUR/RON (noted by CV)- dependent numerical variable (Y).

Pearson correlation coefficient $\rho=0.729$ which shows that the correlation between GDP and CV, in Romania, is direct and strong. For testing the significance of the correlation coefficient, we use the T test (Jaba and Grama, 2004, p.122). The properly Sig. value is (Sig = 0.011) < ($\alpha = 0.05$) highlights that we obtained a significant correlation coefficient to a threshold of 0.011, so are less than 5% chance of error if we say that between the two variables it is a significant correlation.

The estimated regression equation is $CV=2.531+3.066* PIB$.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		
	B	Std. Error	Beta			Lower Bound	Upper Bound	
1	(Constant)	2.531	.329		7.689	.000	1.787	3.276
	PIB (mil lei)	3.07E-006	.000	.729	3.191	.011	.000	.000

a. Dependent Variable: cursul de schimb RONEUR

Coefficient $b=3.066$ correspond to a direct (positive) link between the variables considered.

A growth of GDP with a unit determines an increase of exchange rate, on average, with 3.066 units, in Romania, so, a depreciation of RON against the single currency. If Gross Domestic Product (Y), in a country, increases in greater proportion than the Gross Domestic Product in a foreign country (Y^*), so $Y > Y^*$, because of increased imports, the current balance account is poor, and the currency depreciates.

For testing the parameters of the regression model, we use the T test. Value (Sig = 0.011) < ($\alpha = 0.05$) shows that β (slope) corresponds to a

significant link between the two variables. F test has a high value ($F = 10.184$) and the Sig. value properly F statistics is low: ($\text{sig} = 0.011$) $<$ ($\alpha = 0.05$) which means that the independent variable – GDP explains the variation of dependent variable- the EUR/RON exchange rate, during the period analyzed.

The coefficient of determination $R^2 = 0.531$ (R Square Model Summary table) shows that 53.1 % of EUR/RON exchange rate variation can be explained by GDP value obtained in Romania during 2000-2010.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.729 ^a	.531	.479	.4945476

a. Predictors: (Constant), PIB (mil lei)

b. Dependent Variable: cursul de schimb RON/EUR

In the case of the exchange rate USD/RON and GDP, the test statistic is not significant. Hence the exchange rate USD/RON is not related to GDP, it has a connection with the other determinants not listed in the study.

Case 2: The variables considered are:

- the value of Consumer Price Index (noted by IPC)- independent numerical variable (X)
- the exchange rate EUR/RON (noted by CV) - dependent numerical variable (Y).

Pearson correlation coefficient $\rho = -0.875$ shows an inverse and strong correlation between variables, the coefficient is very close to -1 (which corresponds to a perfect correlation) (Jaba and Grama, 2004, p.102). The properly Sig. value is ($\text{Sig} = 0.000$) $<$ ($\alpha = 0.01$) highlights that we obtained a significant correlation coefficient to a threshold of 0.000, so are less than 1% chance of error if we say that between the two variables it is a significant correlation.

The estimated regression equation is $CV=8.532-0.044* IPC$. Coefficient $b= -0.044$ correspond to an inverse (negative) link between the variables considered. A growth of IPC with a unit determines a decrease of exchange rate on average with 0.044 units in Romania.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	8.532	.247		34.494	.000	8.043	9.021
	IPC (%)	-.044	.002	-.875	-20.607	.000	-.048	-.040

a. Dependent Variable: curs valutar RON/EUR

Value ($\text{Sig} = 0.000$) $<$ ($\alpha = 0.05$) shows that β (slope) corresponds to a significant link between the two variables. The Sig. value properly F statistics is ($\text{sig} = 0.000$) $<$ ($\alpha = 0.05$), which means that the independent variable – IPC explains the variation of dependent variable- exchange rate EUR/RON.

The coefficient of determination $R^2 = 0.766$, shows that 76.6% of the variance in the dependent variable (exchange rate) can be explained by changes in the independent variable (Consumer Price Index).

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.875 ^a	.766	.764	.3235419

a. Predictors: (Constant), IPC (%)

b. Dependent Variable: curs valutar RON/EUR

In the case of exchange rate USD/RON, Pearson correlation coefficient $\rho = -0.389$ shows an inverse correlation, but of less intensity compared with the previous case. For testing the significance of the correlation coefficient, we use the Z test. The properly Sig. value is ($\text{Sig} = 0.000$) $<$ ($\alpha = 0.01$) highlights that we obtained a significant correlation coefficient to a threshold of 0.000, so are less than 1% chance of error if we say that between the two variables it is a significant correlation.

The estimated regression equation is $CV = 4.246 - 0.012 * IPC$.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	4.246	.285		14.881	.000	3.682	4.811
	IPC (%)	-.012	.002	-.389	-4.813	.000	-.017	-.007

a. Dependent Variable: curs valutar RON/USD

Coefficient $b = -0.012$ correspond to an inverse (negative) link between the variables considered. A growth of IPC with a unit determines a decrease of exchange rate on average with 0.012 units in Romania. Value ($\text{Sig} = 0.031$) $<$ ($\alpha = 0.05$) shows that β (slope) corresponds to a significant link between the two variables. The Sig. value properly F statistics is ($\text{sig} = 0.000$) $<$ ($\alpha = 0.05$), which means that the independent variable– IPC explains the variation of dependent variable- exchange rate EUR/RON.

The coefficient of determination $R^2 = 0.151$, shows that 15.1% of the variance in the dependent variable (exchange rate) can be explained by changes in the independent variable (Consumer Price Index).

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.389 ^a	.151	.145	.3732554

a. Predictors: (Constant), IPC (%)

b. Dependent Variable: curs valutar RON/USD

Case 3: The variables considered are:

- the value of money supply (noted by M_m)- independent numerical variable (X)
- the exchange rate EUR/RON (noted by CV)- dependent numerical variable (Y).

Pearson correlation coefficient $\rho = 0.685$ which shows a direct correlation between the variables. The properly Sig. value is ($\text{Sig} =$

0.000) < ($\alpha = 0.01$) highlights that we obtained a significant correlation coefficient to a threshold of 0.000, so are less than 1% chance of error if we say that between the two variables it is a significant correlation.

The estimated regression equation is $CV = 2.821 + 7.29 * Mm$.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2.821	.074		38.217	.000	2.675	2.967
	masa_monetara	7.29E-006	.000	.685	10.714	.000	.000	.000

a. Dependent Variable: curs valutar RON/EUR

Coefficient $b=7.29$ correspond to a direct (positive) link between the variables considered. A growth of money supply with a unit determines an increase of exchange rate on average with 7.29 units, in Romania, hence, a depreciation of the domestic currency against the single currency. The increasing of money supply, while maintaining constant the other factors, leads to domestic currency depreciation. For testing the parameters of the regression model, we use the T test. Value (Sig = 0.011) < ($\alpha = 0.05$) shows that β (slope) corresponds to a significant link between the two variables. F test has a high value (F = 114 785) and the Sig. value properly F statistics is low: (sig = 0.000) < ($\alpha = 0.05$) which means that the independent variable – money supply explains the variation of dependent variable- exchange rate EUR/RON.

The coefficient of determination $R^2 = 0.469$ (R Square Model Summary table) shows that 46.9% of EUR/RON exchange rate variation can be explained by money supply value in Romania during 2000-2010.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.685 ^a	.469	.465	.4870232

a. Predictors: (Constant), masa_monetara

b. Dependent Variable: curs valutar RON/EUR

In the case of the exchange rate USD/RON and money supply, the test statistic is not significant. Hence the exchange rate USD/RON is not related to money supply, it has a connection with the other determinants not listed in the study.

Case 4: The variables considered are:

- the value of reference interest rate (noted by RD)- independent numerical variable (X)
- the exchange rate EUR/RON (noted by CV) - dependent numerical variable (Y).

Pearson correlation coefficient $\rho = -0.802$ shows an inverse and strong correlation between variables, the coefficient is very close to -1 (which corresponds to a perfect correlation). The properly Sig. value is (Sig = 0.003) < ($\alpha = 0.01$) highlights that we obtained a significant correlation coefficient to a threshold of 0.003, so are less than 1% chance of error if we say that between the two variables it is a significant correlation.

The estimated regression equation is $CV = 4.315 - 0.052 * RD$. Coefficient $b = -0.052$ correspond to an inverse (negative) link between the variables considered.

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		
	B	Std. Error	Beta			Lower Bound	Upper Bound	
1								
	(Constant)	4.315	.247		17.472	.000	3.756	4.874
	rata dobanzii de referinta (%)	-.052	.013	-.802	-4.033	.003	-.081	-.023

a. Dependent Variable: curs_valutarEUR_ROM

A growth of interest rate with a unit determines a decrease of exchange rate EUR/RON on average with 0.052 units in Romania, so an appreciation of RON against the single currency. Value (Sig =

$0.003) < (\alpha = 0.05)$ shows that β (slope) corresponds to a significant link between the two variables. The Sig. value properly F statistics is $(\text{sig} = 0.003) < (\alpha = 0.05)$, which means that the independent variable – RD explains the variation of dependent variable- exchange rate EUR/RON.

The coefficient of determination $R^2 = 0.644$, shows that 64.4% of the variance in the dependent variable (exchange rate) can be explained by changes in the independent variable (reference interest rate).

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.802 ^a	.644	.604	.4309080

a. Predictors: (Constant), rata dobanzii de referinta (%)

b. Dependent Variable: curs_valutarEUR_ROM

In the case of exchange rate USD/RON and reference interest rate, the test statistic is not significant. Hence the exchange rate USD/RON is not related to this indicator, it has a connection with the other determinants not listed in the study.

Case 5: In the case of correlation between exchange rate of RON vs. major currencies (EUR and USD) and balance of payment, the test statistic is not significant. Statistical analysis presents a case atypical, poor balance of payments position, mainly due to the negative balance of trade, leads to a continuous appreciation of the Romanian leu. The consequence was the positioning of the leu / euro on a steep downward slope, a similar recording and against U.S. dollar. This situation can be explained by the balance of capital movements, which by capital inflows from current transfers and direct investment countered the effects it has on the exchange rate the deficit of the current account balance.

4. Conclusions

The exchange rate is a dynamic variable, the main factors influencing its formation being the following: GDP, inflation rate, money supply, interest rate and balance of payments. In Romania, the foreign exchange policy was an important lever in the framework of macroeconomic stabilization. In practice, analysis of the factors influencing the exchange rate must take into account their interdependence, the connection between them, which ultimately leads to currency appreciation or depreciation.

The results of the analysis can be summarized in the following table:

Table 1

The correlation and regression analysis results of the main macroeconomic indicators and the exchange rate EUR / RON

Factors influencing the exchange rate EUR/RON (CV)	Direct relationship	Inverse relationship	The form of the relationship
Gross Domestic Product (PIB)	$\rho = 0.729$ [0.011]		$CV = 2.531 + 3.066 * PIB$
Inflation rate (IPC)		$\rho = -0.875$ [0.000]	$CV = 8.532 - 0.044 * IPC$
Money supply (Mm)	$\rho = 0.685$ [0.000]		$CV = 2.821 + 7.29 * Mm$
Interest rate (RD)		$\rho = -0.802$ [0.003]	$CV = 4.315 - 0.052 * RD$
Balance of payment	the test statistic is not significant.		

In the case of exchange rate USD/RON and the following indicators: reference interest rate, money supply and GDP, the test statistic is not

significant. Between the exchange rate USD/RON and Consumer Price Index, Pearson correlation coefficient $\rho = -0.389$ shows an inverse correlation, but of less intensity compared with the case of exchange rate EUR/RON.

In Romania, during the period analyzed, the monetary policy regarding interest rate, inflation and other factors determined the overall appreciation of the Romanian leu against euro. The study demonstrates an unusual position of balance of payments deficit, mainly due to the negative balance of trade (imports greater than exports), which leads to a continuous appreciation of the Romanian leu.

In this context, the NBR should create a balance between ensuring the continuation of disinflation by targeting a real appreciation of the currency and external competitiveness that could affect the confidence of foreign investors.

Acknowledgements

This work was supported by the the European Social Fund in Romania, under the responsibility of the Managing Authority for the Sectoral Operational Programme for Human Resources Development 2007-2013 [grant POSDRU/CPP 107/DMI 1.5/S/78342].

References

- Cerna, S. (2005), *Economie monetară și financiară internațională*, Editura Universității de Vest, Timișoara
- Faia, E. and Iliopoulos, E. (2010), *Financial Globalization, Financial Frictions and Optimal Monetary Policy*, Kiel Institute for the World Economy Kiel Working Paper No. 1639, ideas.repec.org/p/fip/feddgw/52.html

Jaba E. and Grama, A. (2004), *Analiza statistică cu SPSS sub Windows*, Editura Polirom, București

Voinea, G. (2004), *Mecanisme și tehnici valutare și financiare internaționale*, Editura Sedcom Libris, Iași

Zaiț, D. and Spalanzani, A. (2006), *Cercetarea în economie și management*, Editura Economică, București,

***Annual Report and Monthly Bulletin National Bank of Romania, 2000-2010, www.bnro.ro, accessed on July 2011

www.eurostat.ec.europa.eu

www.insse.ro