EFFECT OF EXCHANGE RATE CHANGES ON IMPORTANT ECONOMIC INDICATORS ON THE EXAMPLE OF ROMANIA

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1) Introduction and Formulation of the problem

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 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.

The exchange rate is a dynamic variable, whose mobility is determined by a wide range of economic, financial, political and social factors ,the most important being the following GDP, inflation rate, balance of payments and interest rates.

This paper is structured in the following way: section two entitled "The description and evolution of key macroeconomic indicators in Romania between 2000 and 2011" presents a short numerical and descriptive evolution of the following indicators in Romania: GDP, inflation rate, reference interest rate and balance of payment, during 2000-2011 period. In section three "Econometric Model. Results" we examined, using MS Word, the influence of these indicators on exchange rate of the Romanian leu against the most important currency (EUR). The research goal was identifying a connection, setting the intensity of the relationship among there indicators, determining the parameters of the regression equation and testing the validity of the model. The study ends with some conclusions.

Exchange rate variable is not a constant variable, so it always fluctuates due to some economic, political and social factors, and these fluctuations influence on several macroeconomic indicators. They are:

- **Gross Domestic Product**
- **Inflation rate**
- **Balance of Payments**
- **Interest rate**

Determination of variables (in general case).

Exchange rate.

Y-exchange rate (Dependent variable)

In finance, an exchange rate (also known as the foreign-exchange rate, forex rate or FX rate) between two currencies is the rate at which one currency will be exchanged for another. It is also regarded as the value of one country's currency in terms of another currency.

The evolution of exchange rate EUR/RON and USD/ RON was not stable and linear, being marked by a series of major fluctuations.

Gross Domestic Product

X1-Gross Domestic Product (Explanatory or Independent Variables)

Gross domestic product (GDP) is the market value of all officially recognized final goods and services produced within a country in a given period. GDP per capita is often considered an indicator of a country's standard of living.

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

Inflation Rate

X2-Inflation Rate (Explanatory or Independent Variables)

In economics, the inflation rate is a measure of inflation, or the rate of increase of a price index such as the consumer price index. It is the percentage rate of change in price level over time, usually one year.

Regarding inflation, Romania registered a positive trend during 2000-2007. During 2000-2005, Romania has experienced a strong disinflation, reaching single digits.

Balance of Payment

X3-Balance of payment (Explanatory or Independent Variables)

Balance of payments (BoP) accounts are an accounting record of all monetary transactions between a country and the rest of the world. These transactions include payments for the country's exports and imports of goods, services, financial capital, and financial transfers. The BoP accounts summarize international transactions for a specific period, usually a year, and are prepared in a single currency, typically the domestic currency for the country concerned.

Interest rate

X4-Interest rate (Explanatory or Independent Variables)

An interest rate is the rate at which interest is paid by a borrower for the use of money that they borrow from a lender.

2) Explanation of all economic indicators in case of Romania (2000-2011)

In order to realize the analysis, we used a combination of techniques and qualitative and quantitative tools. 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 have used official statistics (monthly bulletins, annual reports from different sources, for example we have used official site of National Bank of Romania). For a systematic presentation of the results, we used, as instruments, tables and charts made in Excel, 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 2000-2011 period.

Exchange rate (Y)

The evolution of exchange rate EUR/RON was not stable and linear, being marked by a series of major fluctuations (see table 1 in appendix). 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. 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. 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 per capita at PPS (Purchasing Power Parity) EURO/Capita (X1)

In terms of GDP growth, the period 2000-2010 was one of the most glorious periods in all history of the Romanian economy(see table 2 in appendix). During 2000-2006, GDP growth was robust, being on average 7728, 5 (average calculated using initial table) per year. However, at the end of 2007 the level of this indicator (expressed in purchasing power parity) stood for Romania only at 10400 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 in 2009 from 12000 to 11000 in 2009. In 2010 the situation began to improve and in 2010 GDP began to increase reached 11700 in 2011.

Inflation rate in % (X2)

Regarding inflation, Romania registered a positive trend during 2000- 2007(see table 3 in appendix), because inflation rate gradually declined during that time. 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%. And in 2011 annual average inflation rate decreased slightly and stood at 5, 8%.

Balance of Payment (X3)(Trade of goods only)

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, leaded 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.(see table 4 in appendix)

Interest rate in % (X4)

The interest rate practiced by the NBR (National Bank of Romania) in the period 2000-2007 showed a downward trend(see table 5 in appendix), the most significant leap being recorded in 2002 when it reached 27,3%. The reference interest is back on an upward trend in 2008 when its level was 12,3%, 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.

3) Econometric model

After analyzing these economic indicators, Initial Table was constructed

Year	Y	X1	X2	X3	X4
2000	1,9956	6,5	45,7	-1,867	50,7
2001	2,6027	7	34,5	-3,323	41,3
2002	3,1255	7,4	22,5	-2,752	27,3
2003	3,7556	7,6	15,3	-3,955	17,1
2004	4,0532	7,9	11,9	-5,323	19,1
2005	3,6234	8,6	9,1	-7,806	8,4
2006	3,5245	9,1	6,6	-11,659	8,1
2007	3,3373	10,4	4,9	-17,822	7,2
2008	3,6827	12	7,9	-19,109	12,3
2009	4,2373	11	5,6	-6,871	11,3
2010	4,2099	11,2	6,1	-5,864	6,5
2011	4,2379	11,7	5,8	-5,549	6,25

Mathematically, the model should be as following:

Y=Exchange rate (ROL/EUR)

X1=Gross Domestic Product per capita at PPS (Purchasing Power Parity) EURO/Capita (divided by 1000)

X2=Inflation rate (in %)

X3=Trade Balance (in billions Euros)

X4=Interest rate (in %)

$$\begin{cases} Yt = a0 + a1x1t + a2x2t + a3x3t + a4x4t + \varepsilon t \\ \varepsilon(\varepsilon t) = 0 \\ \sigma(\varepsilon t) = const \end{cases}$$ a0...a4 </>0

where,

E is expectation of residual/disturbance term. Residual is, basically a difference between real and theoretical points.

Et – is a disturbance term, showing random factors which can occur at any point in time and still influence the endogenous variable.

σ - is a standard deviation

Identification of dependency between exchange rate(Y) and external factors influencing on it (X1,…X4)

In order to find dependency between Y and X1,X2,X3,X4 we can construct matrix of pair correlations and scatter diagrams.

Let's start with correlation matrix. In order to see, whether there is any correlation between all chosen variable, a correlation matrix should be constructed in Excel . Correlation matrix represents whether there occur a linear relationship between each exogenous variable and the explained variable. The bigger the correlation coefficient, the more linearly dependent is Y on a specific X. Correlation coefficient lies somewhere in between 0 and 1. So, if it is equal to 0, the variable are independent, while if it is equal to 1, the variable are perfectly dependent.

	Y	*X1*	*X2*	*X3*	*X4*
Y	1				
X1	0,695990413	1			
X2	-0,889215046	-0,776182495	1		
X3	-0,216987267	-0,621168675	0,571604296	1	
X4	-0,861630365	-0,765367818	0,987258247	0,548032024	1

A few words should be also said about the sign of each correlation coefficient in the given matrix. If the sign is positive, it indicates that there is a positive linear dependence. Conversely, if there is a "-" sign in front of the correlation coefficient, it represents a negative linear relationship between a particular causal variable and the Y.

Correlation matrix is a very useful tool, because not only can it tell the relationship between exogenous and endogenous variable, but it shows the dependence between each variable in response to all other presented in the matrix.

Using constructed correlation matrix we can see, that

If X1=0, 695990413 it has nearly strong positive linear relationship between X1 and Y;

If X2=0, 889215046 ~ 1 it has strong positive linear relationship between X2 and Y;

If X3=0, 216987267 it has weak positive linear relationship between X3 and Y;

If X4=0, 861630365 ~ 1 it has strong positive relationship between X4 and Y

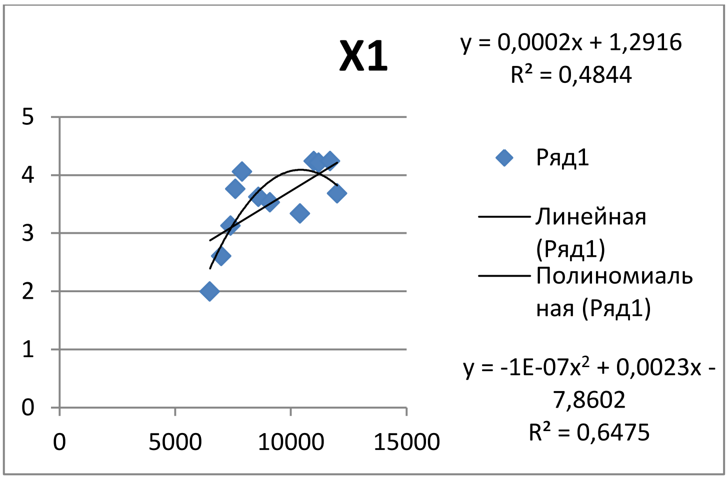
Scatter diagrams

A scatter diagram is a tool for analyzing relationships between two variables. One variable is plotted on the horizontal axis and the other is plotted on the vertical axis. The pattern of their intersecting points can graphically show relationship patterns. Most often a scatter diagram is used to prove or disprove cause-and-effect relationships. While the diagram shows relationships, it does not by itself prove that one variable *causes* the other. In addition to showing possible cause and- effect relationships, a scatter diagram can show that two variables are from a common cause that is unknown or that one variable can be used as a surrogate for the other.

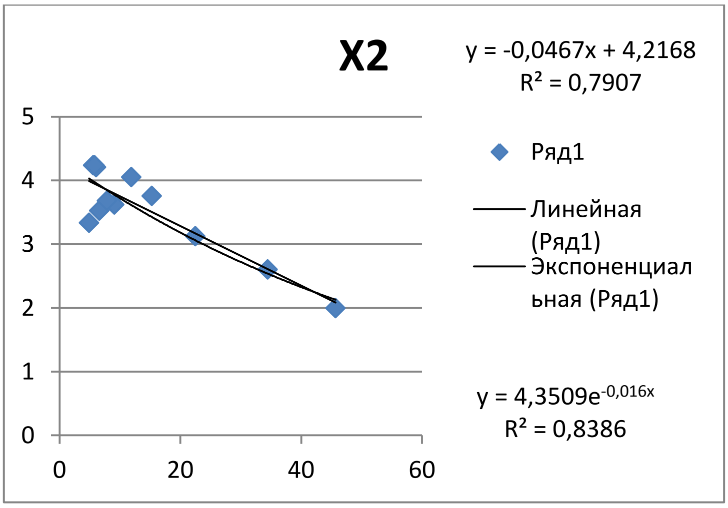
The dependence of the endogenous variable on each of the remaining exogenous variables was investigated using scatter diagrams.

It is useful to create scatter diagrams to graphically show, how the statistics for each variable are scattered through a trend line, representing the dependence of effect variable.

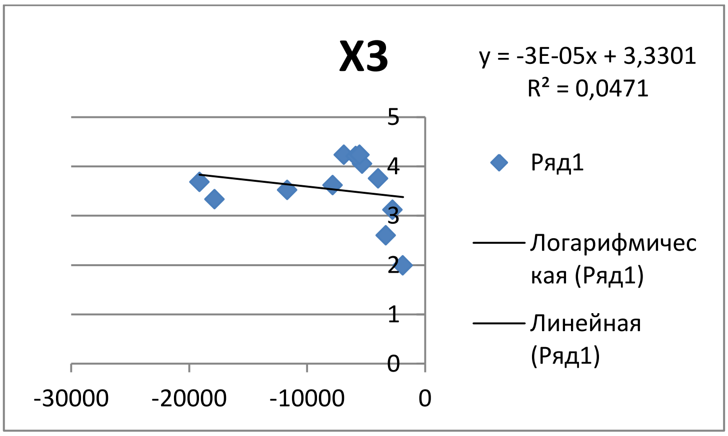
Here given 4 diagrams, representing 4 explanatory variables and Y response to each of them.



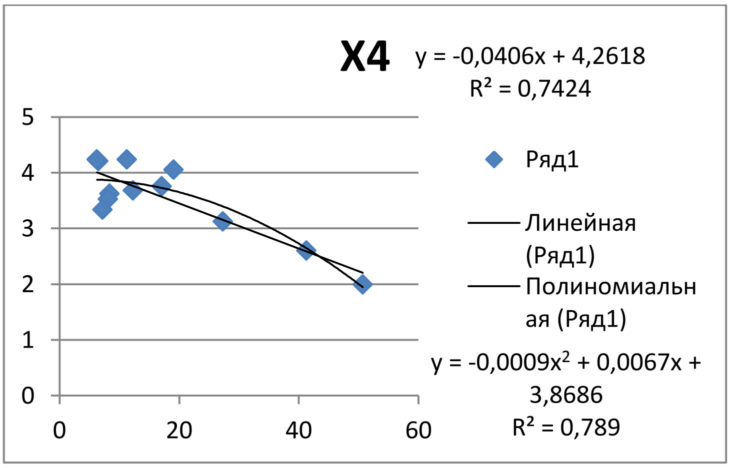
This graph shows that exogenous variable X_1 has a strong moderate linear dependence with the endogenous variable.



This graph shows that exogenous variable X_2 has a strong negative linear dependence with the endogenous variable.



This graph shows that exogenous variable X_3 has a moderate negative linear dependence with the endogenous variable.



This graph shows that exogenous variable X_4 has a strong negative linear dependence with the endogenous variable.

General form of econometric model

General form of econometric model looks like

$$\begin{cases} Yt = a0 + a1x1t + a2x2t + a3x3t + a4x4t + \varepsilon t \\ \varepsilon(\varepsilon t) = 0 \\ \sigma(\varepsilon t) = const \end{cases}$$

a0...a4 </>0

where,

E is expectation of residual/disturbance term. Residual is, basically a difference between real and theoretical points.

Et – is a disturbance term, showing random factors which can occur at any point in time and still influence the endogenous variable.

σ - is a standard deviation

Estimated econometric model

$$\begin{cases} yt = 3{,}89 + 0{,}09X1t - 0{,}10X2t + 0{,}06X3t + 0{,}04X4t + \varepsilon t \\ (0{,}55)\ (0{,}06)\ (0{,}03)\ (0{,}01)\ (0{,}03)\ (0{,}87) \\ R^2 = 0{,}92\ \ F = 31{,}77 \end{cases}$$

The value of adjusted R^2 is 0.92. In other words, the model correctly explains 92% of all observations. Adjusted R^2 is close to 1, so R-test confirmed good quality of the model.

In order to confirm the significance of the model, we should check it by **F-test**(see table 6 in appendix)

Using formula FРАСПОБР, F critical=4, 53367695

As F calculated > F critical (31, 77005749 > 4, 53367695), it means that $\mathcal{R}^2$ is not randomly chosen, so we have good quality of specification)

In order to find significance of the coefficients, we should check it by **T-test**(see table 6 in appendix)

Using formula СТЬЮДРАСПОБР, T critical=1, 943180281

If absolute value of T statistical is higher than T critical, these coefficients are significant ($|Tstat|$>Tcrit)

In model case,

a_0 is significant, because 7,070485701 > 1, 943180281

a_1 is not significant because 1,541938578 < 1, 943180281

a_2 is significant, because absolute value of -3,47009807 > 1, 943180281

a_3 is significant, because 4,309761028 > 1, 943180281

a_4 is not significant, because 1,759139925 < 1, 943180281

So, coefficients a_1 and a_4 are not significant, it means that change in Y(exchange rate) don't effect on X1(Gross Domestic Product) and on X4 (Interest rate)

Model without X1

Then we need to create the second model without X1,

Year	Y	X1	X2	X3
2000	1,9956	45,7	-1,867	50,7
2001	2,6027	34,5	-3,323	41,3
2002	3,1255	22,5	-2,752	27,3
2003	3,7556	15,3	-3,955	17,1
2004	4,0532	11,9	-5,323	19,1
2005	3,6234	9,1	-7,806	8,4
2006	3,5245	6,6	-11,659	8,1
2007	3,3373	4,9	-17,822	7,2
2008	3,6827	7,9	-19,109	12,3
2009	4,2373	5,6	-6,871	11,3
2010	4,2099	6,1	-5,864	6,5
2011	4,2379	5,8	-5,549	6,25

where

Y=Exchange rate (ROL/EUR)

X1=Inflation rate (in %)

X2=Trade Balance (in billions Euros)

X3=Interest rate (in %)

As in previous case we have made regression analyses and made F-test and T-test

In this case coefficients a_0, a_1,a_2 are significant, because ($|Tstat|$>Tcrit) , but coefficient a_3 is not significant, , it means that change in Y(exchange rate) don't effect on X3(Interest rate) (see table 7 in appendix)

I order not to remove this coefficient, we have tried to change time period and use X_{3t-1} and again made regression analyses, F-test and T-test

But this technique hasn't changed anything, so we have decided to remove this variable and find new one, that will be significant for my model.

Final Model

Model with new variable

From the Trade balance of Romania, we can see that number of imports always higher than number of exports, it means that Romania is import-oriented country.

And we want to introduce a new variable X3- Imports of services (current US$) in millions. From the analysis of the structure of Romania's services imports, we can note the following:

- their sectorial distribution is similar at both levels: world and European;

- whereas, at world level, the weight of transport services is rising, this same weight is declining in the relation with EU-25;
- tourism imports from EU-25 are increasing at a slower pace than world-originating imports, which indicates a preference for European tourist destinations.

So using Excel we have constructed **Final Model**

Year	Y	X1	X2	X3
2000	1,9956	45,7	-1,867	14,043
2001	2,6027	34,5	-3,323	16,502
2002	3,1255	22,5	-2,752	18,825
2003	3,7556	15,3	-3,955	25,113
2004	4,0532	11,9	-5,323	33,996
2005	3,6234	9,1	-7,806	42,812
2006	3,5245	6,6	-11,659	47,381
2007	3,3373	4,9	-17,822	72,541
2008	3,6827	7,9	-19,109	87,575
2009	4,2373	5,6	-6,871	64,838
2010	4,2099	6,1	-5,864	48,096
2011	4,2379	5,8	-5,549	52,246

Where,

Y=Exchange rate (ROL/EUR)

X1=Inflation rate (in %)(Decrease in the value of domestic currency will lead to increase in inflation rate, so there is inverse relationship)

X2=Trade Balance of goods(in billions Euros) (If the country is import-oriented one, there is constant increase of the value of foreign currency inside domestic country. If import increases Trade Balance of goods decreased and this lead to depreciation of domestic currency, so there is direct relationship)

X3=Imports of services (current US dollars) in billions(Romania refers to countries with developing economy, that’s why in order to increase its economy, Romania should import foreign technology, intellectual property and other services. This translated to negative trade balance in service sphere and leads to depreciation of domestic currency, so it is direct relationship)

Exchange rate regression model looks like

$$\{\mathrm{Y} = 4{,}37 - 0{,}05 \times \mathcal{X}_{1t} + 0{,}09 \times \mathcal{X}_{2t} + 0{,}01 \times \mathcal{X}_{3t} + \mathcal{E}_t\}$$

(0,29) (0,007) (0,02) (0,00073) (0,201)

$\mathcal{R}^2 = 0{,}91$ $\mathcal{F} = 36{,}42$ $\mathcal{F}_{critical} = 4{,}347$

Tests: R²-Test, F-Test, T-Test, GQ-Test, DW-Test,R-test

We can see that as F calculated > F critical (36, 42436 > 4, 346831), it means that $\mathcal{R}^2$ is not randomly chosen, so we have good quality of specification)

$\mathcal{R}^2 = 0{,}91$ is close to one, it means that Var(X1) describes Var(X2) by approximately 91%.

And as ($|Tstat|$>Tcrit) in all four cases is right, it means that all coefficients are significant in this model.(see table 8 in appendix)

Let's carry out Goldfeld-Quandt test to check the estimated model for homoscedasticity. To do the test, a new variable z was introduced, such that:

$$z_t = x_{1_t} + x_{2_t} + x_{3_t}$$

Then dataset was sorted (in descending order) according to the values of z. After the sorting, residual sum of squares (RSS) was found separately for two samples, consisting of upper and lower observations (the results of these calculations are given in table 9 in appendix). Based on these numbers, let's find the GQ number by dividing the bigger RSS by the smaller one.

$$GQ = \frac{RSS_1}{RSS_2} = \frac{0{,}282262}{0{,}257753} = 1{,}095087$$

To complete the test, the GQ number has to be compared with the critical value of F-statistic, which equals 9,27 at 5% level of significance. The GQ number calculated above is less than the critical value of F-statistic.

Thus, the hypothesis of homoscedasticity of residuals in the final estimated model is confirmed at 10% level of significance, according to GQ-test. So, GQ-test is passed successfully – the model can be estimated through least square method.

Let's carry out Durbin-Watson test to check the residuals of the model for autocorrelation. To do the test, estimated values of Y were calculated for each year, using the coefficients obtained in regression analysis .Then, the residual value for each year was found as the difference between actual and estimated values of Y. Finally, for each year except the first one, the difference between the residual for current and previous year was calculated.(see table 10 in appendix)

On the basis of these calculations, the following results were obtained:

$$\sum (\varepsilon_i - \varepsilon_{i-1})^2 = 0{,}69$$

$$\sum \varepsilon_i^{\ 2} = 0{,}28$$

Thus, the value of the Durbin-Watson statistic for the final estimated model is:

$$DW = \frac{\sum(\varepsilon_i - \varepsilon_{i-1})^2}{\sum \varepsilon_i^{\ 2}} = 2{,}5$$

The observed value of Durbin-Watson (calculated on the basis of sample data) is compared with the critical value of Durbin-Watson, which is determined on a special table.

The critical value of Durbin-Watson is determined depending on the values of the upper and lower d1 d2 border criterion on special tables. These boundaries are defined, depending on the volume of sample n and the number of degrees of freedom (h-1), where h - number of evaluated sample parameters.

If the observed value of the Durbin-Watson is less than the critical value of the lower boundary, d <d1, then the fundamental hypothesis of no autocorrelation between the residuals of the regression model is rejected.

If the observed value of the Durbin-Watson more critical of its upper boundary, d> d2, then the fundamental hypothesis of no first order autocorrelation between the residuals of the regression model is adopted.

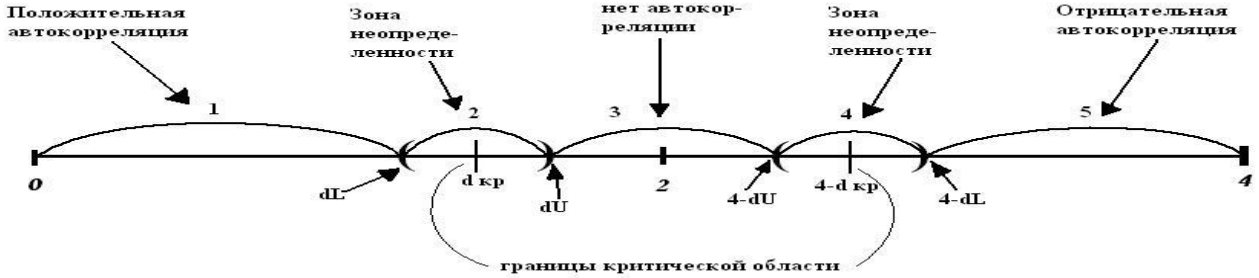
If the observed value of the Durbin-Watson is between the upper and lower critical limits, that is, d1 <d<d2, adequate justification for making no single solution, further research is needed.

If the observed value of the Durbin-Watson more critical level 4 - d1, d> 4 - d1, then the fundamental hypothesis of no first order autocorrelation between the residuals of the regression model is again rejected.

If the observed value of the Durbin-Watson is less than the critical value 4 - d2, d<4 - d2, then the fundamental hypothesis of no first order autocorrelation between the residuals of the regression model is once again adopted.

If the observed value of the Durbin-Watson is in the critical interval between the values of 4 - d1 and 4 - d2, is a sufficient basis for making the right decision is not only more research is needed.

This value was compared with upper and lower limits of DW-statistic



$d_l = 0{,}60$

$d_u = 1{,}93$

$4\text{-}d_l = 3{,}4$

$4\text{-}d_u = 2{,}07$

2,07< 2,49 < 3,4

Confidence intervals

In order to find out whether the estimated model is good for forecasting, let's construct the confidence interval and check whether the real value of Y in 2011 (the last observation), which equals 4,23 belongs to this interval.

The lower and upper boundaries of the confidence interval are calculated by the following formulas:

$$y^{-} = \hat{y} - t_{crit} \cdot s$$

$$y^{+} = \hat{y} + t_{crit} \cdot s$$

Where $\hat{y}_t = a_0 + a_1 \cdot x_{1_t} + a_2 \cdot x_{2_t} + \dots + a_n \cdot x_{n_t}$

Substituting real values of explanatory variables for 2011 and the coefficients of the estimated model (see table…….) into this formula, get:

$\hat{y}_{2011} = 4{,}38 - 0{,}05 \cdot x_{1_{2011}} + 0{,}09 \cdot x_{2_{2011}} + 0{,}01 \cdot x_{3_{2011}} = 4{,}38 - 0{,}05 \cdot 5{,}8 + 0{,}09 \cdot (-5{,}55) + 0{,}01 \cdot 52{,}25 = 4{,}30$(see table 10 in appendix)

The value of s (standard error of the model) and critical value of t-statistic have been calculated earlier in the regression statistics (see table …)

They are:

$s = 0{,}2$

$t_{crit} = 1{,}89$

Thus, the boundaries of the confidence interval are:

$\hat{y}^{+}_{2011} = 4{,}68$

$\hat{y}^{-}_{2011} = 3{,}92$

One can easily check that 4, 30∈[3,92; 4,68]

It follows that the real value of Y in 2011 belongs to the confidence interval, so the model is adequate and may be used for forecasting.

Forecasting

It has already been calculated that the model predicts the value of Y in 2011 to be equal to 4,30 , while its real value was 4,24. In order to find out whether this forecast is good, let's calculate the percentage deviation of the forecast from the real value.

$$\frac{|4{,}30 - 4{,}24|}{4{,}24} \times 100\% = 1{,}41\%$$

The deviation of the forecast from the real value is less than 2%, thus, this forecast may be considered a good one, and the high quality of the model for making forecasts is confirmed once again. This means, that in 98,59% cases the model would give an exact right result.

4) Conclusion

The exchange rate is a dynamic variable, the main factors influencing its formation being the following: , inflation rate, balance of trade in goods and import of services. 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 multitude of factors that, directly or indirectly, influence the exchange rate make difficult to modeling this variable so complex and dynamic .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 .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. Thus, the aim of creating a model for describing the long-term relationship of exchange rate and different economic indicators has been achieved. The quality of the model was confirmed by several econometric tests.

As far as the forecasts are concerned, the model allows making high-quality assessments of the future development of the Romanian exchange rate economic development.

Appendix

Table 1

Exchange rate

Year	Y
2000	1,9956
2001	2,6027
2002	3,1255
2003	3,7556
2004	4,0532
2005	3,6234
2006	3,5245

2007	3,3373
2008	3,6827
2009	4,2373
2010	4,2099
2011	4,2379

Table 2

Gross Domestic Product per capita at PPS (Purchasing Power Parity) EURO/Capita (X1)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
GDP	6500	7000	7400	7600	7900	8600	9100	10400	12000	11000	11200	11700

Table 3

Inflation rate in %

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Annual average inflation rates	45,7	34,5	22,5	15,3	11,9	9,1	6,6	4,9	7,9	5.6	6.1	5.8

Table 4

Balance of Payment (X3)(Trade of goods only)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Export	11273	12722	14675	15614	18935	22255	25850	29549	33725	29084	37251	41237
Import	13140	16045	17427	19569	24258	30061	37509	47371	52834	35955	43115	46786
Trade balance	-1867	-3323	-2752	-3955	-5323	-7806	-11659	-17822	-19109	-6871	-5864	-5549

All numbers are given in millions Euro

Table 5

Interest rate in %

Year	Interest rate
2000	50,7
2001	41,3
2002	27,3
2003	17,1
2004	19,1

2005	8,4
2006	8,1
2007	7,2
2008	12,3
2009	11,3
2010	6,5
2011	6,25

Table 6

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,97719722
R Square	0,95491442
Adjusted R Square	0,92485736
Standard Error	0,18776714
Observations	11

ANOVA			Fcritical	4,53367695	
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	4,480403988	1,120100997	31,77005749	0,000354188
Residual	6	0,211538993	0,035256499		
Total	10	4,691942982			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	3,88763264	0,549839545	7,070485701	0,000401057	2,542223741
X1	8,9337E-05	5,7938E-05	1,541938578	0,174026738	-5,2432E-05
X2	-0,1015863	0,029274755	-3,47009807	0,013302209	-0,17321902
X3	6,4114E-05	1,48765E-05	4,309761028	0,005038733	2,77127E-05
X4	0,04482723	0,025482471	1,759139925	0,129048676	-0,01752613
		Tcritical	1,943180281		

Table 7

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,968013

R Square	0,937049
Adjusted R Square	0,91007
Standard Error	0,205414
Observations	11

ANOVA			Fcritical	4,346831	
	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	4,396579	1,465526	34,73235	0,000142
Residual	7	0,295364	0,042195		
Total	10	4,691943			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	4,686962	0,200508	23,37548	6,66E-08	4,212837
X1	-0,11323	0,030943	-3,65917	0,008079	-0,18639
X2	5,23E-05	1,39E-05	3,749496	0,007173	1,93E-05
X3	0,049528	0,027677	1,789472	0,116668	-0,01592
		Tcritical	1,894579		

Table 8

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,969431227
R Square	0,939796905
Adjusted R Square	0,913995578
Standard Error	0,200880025
Observations	11

ANOVA			Fcritical	4,346831	
	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	4,40947	1,469824	36,42436	0,000121694
Residual	7	0,28247	0,040353		
Total	10	4,69194			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	4,370053073	0,28599	15,28017	1,24E-06	3,693782393
X1	-0,050770019	0,00735	-6,9073	0,00023	-0,06815046
X2	0,091313467	0,02503	3,648443	0,008195	0,032131495
X3	0,013987276	0,0073	1,915184	0,097015	-0,00328242
		Tcritical	1,894579		

Table 9

Year	Y	X1	X2	X3	Z
2000	1,9956	45,7	-1867	14043	15955,7
2001	2,6027	34,5	-3323	16502	19859,5
2002	3,1255	22,5	-2752	18825	21599,5
2003	3,7556	15,3	-3955	25113	29083,3
2004	4,0532	11,9	-5323	33996	39330,9
2005	3,6234	9,1	-7806	42812	50627,1
2006	3,5245	6,6	-11659	47381	59046,6
2007	3,3373	4,9	-17822	72541	90367,9
2008	3,6827	7,9	-19109	87575	106691,9
2009	4,2373	5,6	-6871	64838	71714,6
2010	4,2099	6,1	-5864	48096	53966,1
2011	4,2379	5,8	-5549	52246	57800,8

GQ test

GQ	1,095087
1/GQ	0,913169

Table 10

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*ei-1*	*(ei-ei-1)^2*	*ei^2*
1	2,075804277	-0,0802			
2	2,545870792	0,05683	-0,0802	0,018778	0,003229559
3	3,239743449	-0,11424	0,056829	0,029266	0,013051566
4	3,583389473	0,17221	-0,11424	0,082056	0,029656466
5	3,755339683	0,29786	0,172211	0,015788	0,088720768
6	3,794076219	-0,17068	0,29786	0,219526	0,029130372

7	3,63307834	-0,10858	-0,17068	0,003856	0,011789256
8	3,508542328	-0,17124	-0,10858	0,003927	0,029323935
9	3,44899654	0,2337	-0,17124	0,163981	0,054617307
10	4,365233107	-0,12793	0,233703	0,130781	0,01636688
11	4,197625792	0,01227	-0,12793	0,019658	0,000150656
Theoretical	4,299667733		0,012274		
Y+	4,68025073		CYMM	0,687617	0,276036764
Y-	3,919084736				
			DW	2,491035	