# THE ISSUES FOR EVALUATION AND PREDICTION OF CURRENCY RATE

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***Abstract***

*The article has been dedicated to the issues of modeling the currency rate of manat-dollar. In the article, the issues such as consideration of external factors in the econometric model which allows to evaluate and predict the change dynamics of exchange rate in currency market of Azerbaijan on the basis of statistical analysis methods, as well as analysis of model quality indicators.*

***Keywords:*** *national exchange rate, price of oil, multidimensional regression model, Durbin-Watson criterion, expanded Dickey–Fuller test, cause and effect tests*

In recent decades, rapid growth of global capital and financial services market is observed. So this further enhances the effect on the general macroeconomic situation of changing the exchange rates of national economies in world. Especially, this is referred to the states without more great open economy experience, it means that domestic money-credit, currency policies are referred to the countries that are unable to influence the interest rates. In these circumstances, national currency rate becomes the only instrument of state "adaptation" to changing foreign conditions.

The effect of currency rate on the functioning economic system isn't appreciated unequivocally. So the changes occurring in the dynamics of currency rate are accompanied with the macroeconomic effects that characterized by both stabilizing and destabilizing effects. Therefore, the study of factors influencing the conditions for changing and formation of the national currency rate has scientific and practical significance. It is very important in terms of issues for the investment strategy development that substantiated at the state and regional levels, formation of protection measures from currency risk in the enterprises that engaged in foreign economic activity.

In the condition of the globalization of world economy, the impact of external factors on the economic development of many countries has further increased. In the years of 2007-2009 and 2014-2016, world financial and economic crisis has fully confirmed this idea. So in the period of these crises, significantly dependency of national economic systems on the uncertainties in the world financial and commodity markets showed itself vigorously.

Our analysis shows that, the researches in this direction is more fragmentary character by investigating separate issues of the exchange rates theory, it means that scientific researches that conducted the complex analysis of the factors for the formation of exchange rates and combined both the external and internal factors are less commonly encountered [1-3,5,7-11,13].

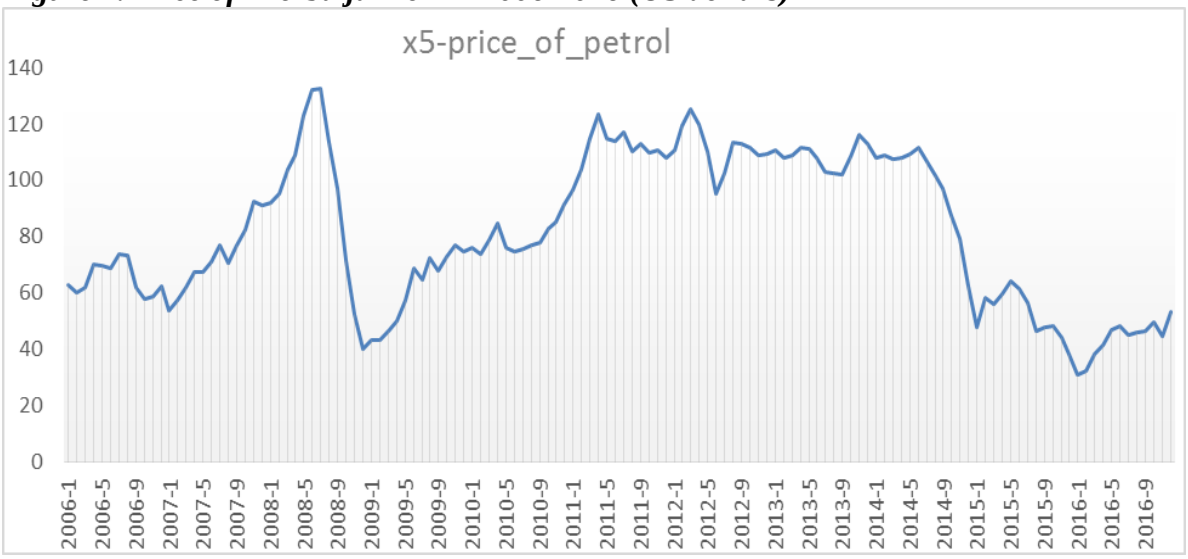
The above-mentioned necessitate the improvement of modern methods with fundamental and technical approaches for analysis of changes of exchange rates in the international currency market, as well as the development of new concepts predicting the dynamics of the exchange rate in principle.

Study of dependencies in the dynamics of exchange rate allows to set the possible development perspectives of exchange rate for getting more efficiency in the import and export of commodities and services in order to earn maximum income, as well as to be insure. By using statistical methods in analysis of exchange rate, it is possible to define the main tendencies in its formation, namely the character and degree of the dependence on the factors forming its rate, to assess quantitatively by determining whether or not there are factors and periodic, seasonal

deviations, as well as mutual dependencies on other "leading" currencies affecting randomly to the research object, to conduct comparative analysis on the basis of the creation of effective predictive models and quality indicators of models [6, 11,13].

By conducting the econometric analysis of dependence of national currency rate on the factors as inflation rate, GDP (Gross Domestic Product), trade balance, budget deficit in [4, 12,14,15] and monetary aggregates of manat for M1, M2, M3, M4 in [14] in our research works, we have obtained the indicators for strong enough and intense dependence of currency rate on these factors. We consider that it is necessary to research the effect of the factors as oil price, gold and currency reserves and monetary base of the republic on the dynamics of currency rate in order to provide more complex and systematic formulation of the research. The "heavy" impact of the oil price on the exchange rate is inevitable in the countries engaged in oil-exporting. With the falling oil prices, sharp devaluation of Azerbaijan's manat twice in 2015 - on February and December make necessary the reviewing of main provisions of the state's economic policy, re-processing, formation and development of new priority areas of the economy, the implementation of important measures in the direction of reduction and regulation of financial risks and strengthening of control. The dynamics of oil prices in world markets has been described graphically in Figure 1.

***Figure 1. Price of Azerbaijani oil in 2006-2016 (US dollars)***




*Source: author's work*

The fact for the direct impact on the manat exchange rate of falling oil prices is important for us in research. When looking at the graph, this dependence can be seen clearly. Falling oil prices pracically overlap with rising US dollar rate and correspondingly, falling Azerbaijan manat rate. For conducting quantitative assessment of this dependence of economic indicators, the necessity arises for econometric analysis.

Thus, the next research works have been carried out in order to study the effect of internal and external factors on the dynamics of national currency rate in Azerbaijan. In order to assess the impact of the price of oil in world markets expressed in US dollars, currency reserves and monetary base in the republic on *national currency rate* of Azerbaijan, wide regression analysis has been performed by including these three factors into the multidimensional regression model, adequacy of which has been shown by us in our previous researches [14,15] and which has reflected the independent factors such as *inflation rate (%)-x1, GDP (mln.manat)-x2, budget deficit (mln.manat)-x3. Money supply (mln.manat)* as *x4*, *oil price (USD dollar)* as *x5* and *currency reserves (mln. USD dollar)* as *x6* have been included in the model. Note that, the observations cover the years of 2006-2017 for months [16,17,18]. The involvement of statistical

information into research work as a sufficiently large massive is explained by the provision of maximum representativeness of the empirical basis of the research. Accuracy, representativeness of data, and a wide range of methods for scientific investigation of studied process ensure the effectiveness of the obtained results and that the theoretical results, practical suggestions become argumentative.

Regression analysis has been performed in Eviews-10 software package (Table 1).

***Table 1. Multiplicative regression analysis results for y and x1, x2, x3, x4, x5, x6***

Dependent Variable: Y_MAN_DOL__AZN_
Method: Least Squares
Date: 04/21/18 Time: 23:30
Sample: 2006M01 2017M10
Included observations: 142

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| X1_RATE_OF_INF___ | 0.010518 | 0.007832 | 1.342958 | 0.1815 |
| X2_GDP_MLN_AZN_ | -2.59E-06 | 7.04E-07 | -3.677337 | 0.0003 |
| X3_BUDGET_DEFICIT__MLN_A | 2.36E-05 | 1.81E-05 | 1.299898 | 0.1959 |
| X4_MONETAR_BASE_MLN_AZN_ | 0.000185 | 8.75E-06 | 21.15612 | 0.0000 |
| X5_PRICE_OF_PETROL__ABS_ | -0.002300 | 0.000483 | -4.764576 | 0.0000 |
| X6_FOREIGN_EXCHANGE_REZE | -0.000142 | 7.23E-06 | -19.63329 | 0.0000 |
| C | 1.001669 | 0.038059 | 26.31894 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.879110 | Mean dependent var | 0.959758 |
| Adjusted R-squared | 0.873738 | S.D. dependent var | 0.307835 |
| S.E. of regression | 0.109384 | Akaike info criterion | -1.539857 |
| Sum squared resid | 1.615269 | Schwarz criterion | -1.394147 |
| Log likelihood | 116.3299 | Hannan-Quinn criter. | -1.480647 |
| F-statistic | 163.6202 | Durbin-Watson stat | 0.438482 |
| Prob(F-statistic) | 0.000000 | | |

*Source: author's work*

According to the results of regression analysis (See: Table 1), the number of observations is *n=142; determinate coefficient* - $R^2 = 0{,}88$*; corrected determinant coefficient* - $R^2 = 0{,}87$; *Fisher criterion - F-statistics=163(p=0,000); Akaike criterion=-1,54; Schwarz criterion=-1,4; Durbin Watson coefficient DW=0,43.* Except for the value getting by *Durbin Watson coefficient*, all the results are satisfactory and it confirms the adequacy of model. Critical values for $d_l$ and $d_u$ of *DW* coefficient are defined from the specific table. According to Table, critical values are $d_l$ =1,343 və $d_u$=1,708 for number of observations - *n=150* (because it's the closest rate to 142) and number of independent factors - *k=6*. The rate of *DW=0,43* expresses positive autocorrelation for residuals in the model, it means that previous values of residuals cause an increase of subsequent values, so they have correlation between them. $H_0$ hypothesis which presumes the absence of autocorrelation is rejected. This lowers the quality of the model. There are several ways that you can apply theoretically and practically to eliminate this situation. We have used autoregressive schemes: *AR(1), AR(2), AR(3)* from several compilations and method of differences from the first and second compilations. Augmented *Dickey–Fuller test* allows to consider the mentioned terms.

In order to define the usefulness of the established model for prediction, namely to determine the stationarity of time series, augmented *Dickey–Fuller test* (*Augmented Dickey-Fuller Test – ADF*) had been conducted and the results shown in Table 2 were obtained: according to the autoregression model (*AR*) with first drawn differences, constant and trendy, maximum number of lags – 13, length of lag – 2, number of observations – 138, t= -7.972673,

p=0.0000. Estimated probability level allows the rejection of $H_0$ hypothesis about having a single root of model. The rate of t-styudent statistics due to the model is less enough than critical prices of t at the 1%, 5%, 10% significancy level. The rate of *DW=2,05* indicates that autocorrelation in the model has been eliminated. The characteristics *F-statistic=32 (p=0,000)* also is satisfactory. But $R^2 = 0{,}49$ is insufficient for the quality of the model.

That's why, we have obtained more effective results by continuing the research and making a certain change in the parameters of augmented Dickey–Fuller test (See: Table 3).

***Table 2. Advanced Dikki-Fuller test***

Null Hypothesis: D(Y_MAN_DOL__AZN_) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=13)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -7.972673 | 0.0000 |
| Test critical values: | 1% level | -4.025924 | |
| | 5% level | -3.442712 | |
| | 10% level | -3.146022 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y_MAN_DOL__AZN_,2)
Method: Least Squares
Date: 04/22/18 Time: 01:36
Sample (adjusted): 2006M05 2017M10
Included observations: 138 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(Y_MAN_DOL__AZN_(-1)) | -1.026576 | 0.128762 | -7.972673 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-1),2) | 0.157291 | 0.111638 | 1.408933 | 0.1612 |
| D(Y_MAN_DOL__AZN_(-2),2) | 0.288289 | 0.083199 | 3.465074 | 0.0007 |
| C | -0.010404 | 0.007866 | -1.322688 | 0.1882 |
| @TREND("2006M01") | 0.000225 | 9.81E-05 | 2.294237 | 0.0233 |

| | | | |
|---|---|---|---|
| R-squared | 0.494576 | Mean dependent var | 3.19E-05 |
| Adjusted R-squared | 0.479375 | S.D. dependent var | 0.060709 |
| S.E. of regression | 0.043804 | Akaike info criterion | -3.382611 |
| Sum squared resid | 0.255203 | Schwarz criterion | -3.276551 |
| Log likelihood | 238.4001 | Hannan-Quinn criter. | -3.339511 |
| F-statistic | 32.53635 | Durbin-Watson stat | 2.051677 |
| Prob(F-statistic) | 0.000000 | | |

*Source: author's work*

According to the next results of augmented Dickey–Fuller test (See: Table 3), *t=-9.272274, p=0.0000* (autoregression model (AR) with second drawn differences, constant and trendy, maximum number of lags – 13, length of lag – 8, number of observations – 131). These results reject $H_0$ hypothesis, the rate of t-styudent statistics due to the model is less enough than critical prices of t at all levels of significancy. *DW =2,1; F-statistic=73,5 (p=0,000)* characteristics are also satisfactory, it means that autoregression isn't observed at the time series, *F-statistics* (with the minimum error) is also more enough than the compared table price, $R^2$ =

0,86 for model and the results of Akaike, Schwarz criteria confirm the stationarity of the established time series for currency rate of manat on multidimensional regression model.

***Table 3. Results of the Extended Dikki-Fuller test***

Null Hypothesis: D(Y_MAN_DOL__AZN_,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 8 (Automatic - based on SIC, maxlag=13)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -9.272274 | 0.0000 |
| Test critical values: | 1% level | -4.029595 | |
| | 5% level | -3.444487 | |
| | 10% level | -3.147063 | |

*MacKinnon (1996) one-sided p-values

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Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y_MAN_DOL__AZN_,3)
Method: Least Squares
Date: 04/22/18 Time: 01:38
Sample (adjusted): 2006M12 2017M10
Included observations: 131 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(Y_MAN_DOL__AZN_(-1),2) | -6.495203 | 0.700497 | -9.272274 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-1),3) | 4.716435 | 0.653596 | 7.216133 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-2),3) | 4.157757 | 0.580394 | 7.163682 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-3),3) | 3.359120 | 0.514786 | 6.525275 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-4),3) | 2.541450 | 0.433726 | 5.859575 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-5),3) | 1.986220 | 0.331451 | 5.992501 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-6),3) | 1.420142 | 0.244031 | 5.819515 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-7),3) | 0.759021 | 0.173380 | 4.377782 | 0.0000 |
| D(Y_MAN_DOL__AZN_(-8),3) | 0.352305 | 0.087333 | 4.034048 | 0.0001 |
| C | 0.003966 | 0.008268 | 0.479604 | 0.6324 |
| @TREND("2006M01") | -5.36E-05 | 9.75E-05 | -0.549753 | 0.5835 |

| | | | |
|---|---|---|---|
| R-squared | 0.859751 | Mean dependent var | -1.98E-05 |
| Adjusted R-squared | 0.848063 | S.D. dependent var | 0.107972 |
| S.E. of regression | 0.042086 | Akaike info criterion | -3.417952 |
| Sum squared resid | 0.212552 | Schwarz criterion | -3.176523 |
| Log likelihood | 234.8759 | Hannan-Quinn criter. | -3.319849 |
| F-statistic | 73.56192 | Durbin-Watson stat | 2.107644 |
| Prob(F-statistic) | 0.000000 | | |

*Source: author's work*

One of the important issues of regression analysis is that to define the explanatory factors with the undeniable role in the formation of its dynamics by maximum impacting on the result factor in the process of establishing a useful model for prediction. As we know, Pearson coefficient which is one of the main characteristics of correlation-regression analysis defines the direction and density of the dependencies among pairs for all the factors included in the model. But with the obtained results, it can't be determined which factor is more dominant on pairs, namely playing the role of cause for another factor. These issues are investigated on the basis of *Granger* causality test. The results for F-statistics criteria obtained due to the tests are compared and evaluated with the table prices. According to the number of lags allowed by test depending on the number of observations, the results in Table 4 confirm to arrange causality for the result factor by the explanatory factors included in the model and with greater probabilities, $H_0$ hypotheses about the fact that one factor is not a reason for other factor for each pair is rejected.

Note that, the results in Table 4 have been chosen from the tests with numerous and positive ending.

***Table 4. Results of Granger Causes tests***

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| *Lags: 1* | | | |
| X3_BUDGET_DEFICIT__MLN_A does not Granger Cause Y_MAN_DOL__AZN_ | 141 | 4.44613 | 0.0368 |
| X5_PRICE_OF_PETROL__ABS_ does not Granger Cause Y_MAN_DOL__AZN_ | 141 | 5.04882 | 0.0262 |
| *Lags: 2* | | | |
| X1_RATE_OF_INF___ does not Granger Cause Y_MAN_DOL__AZN_ | 140 | 7.25168 | 0.0010 |
| X2_GDP_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 140 | 3.76436 | 0.0257 |
| X6_FOREIGN_EXCHANGE_REZE does not Granger Cause Y_MAN_DOL__AZN_ | 140 | 7.46270 | 0.0008 |
| *Lags: 3* | | | |
| X1_RATE_OF_INF___ does not Granger Cause Y_MAN_DOL__AZN_ | 139 | 6.78706 | 0.0003 |
| X2_GDP_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 139 | 3.89947 | 0.0104 |
| X6_FOREIGN_EXCHANGE_REZE does not Granger Cause Y_MAN_DOL__AZN_ | 139 | 4.42699 | 0.0053 |
| *Lags: 4* | | | |
| X1_RATE_OF_INF___ does not Granger Cause Y_MAN_DOL__AZN_ | 138 | 4.08442 | 0.0038 |
| X2_GDP_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 138 | 2.43434 | 0.0506 |
| X6_FOREIGN_EXCHANGE_REZE does not Granger Cause Y_MAN_DOL__AZN_ | 138 | 3.66293 | 0.0073 |
| *Lags: 5* | | | |
| X1_RATE_OF_INF___ does not Granger Cause Y_MAN_DOL__AZN_ | 137 | 3.49708 | 0.0054 |
| X6_FOREIGN_EXCHANGE_REZE does not Granger Cause Y_MAN_DOL__AZN_ | 137 | 3.28552 | 0.0080 |
| *Lags: 10* | | | |
| X1_RATE_OF_INF___ does not Granger Cause Y_MAN_DOL__AZN_ | 132 | 2.19336 | 0.0231 |
| X2_GDP_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 132 | 2.28064 | 0.0180 |
| X3_BUDGET_DEFICIT__MLN_A does not Granger Cause Y_MAN_DOL__AZN_ | 132 | 2.04335 | 0.0353 |
| X4_MONETAR_BASE_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 132 | 1.91003 | 0.0510 |
| X5_PRICE_OF_PETROL__ABS_ does not Granger Cause Y_MAN_DOL__AZN_ | 132 | 2.00697 | 0.0390 |
| X6_FOREIGN_EXCHANGE_REZE does not Granger Cause Y_MAN_DOL__AZN_ | 132 | 2.64115 | 0.0063 |
| *Lags: 11* | | | |
| X1_RATE_OF_INF___ does not Granger Cause Y_MAN_DOL__AZN_ | 131 | 2.94664 | 0.0019 |
| X2_GDP_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 131 | 2.06576 | 0.0289 |
| X3_BUDGET_DEFICIT__MLN_A does not Granger Cause Y_MAN_DOL__AZN_ | 131 | 2.54170 | 0.0068 |
| X4_MONETAR_BASE_MLN_AZN_ does not Granger Cause Y_MAN_DOL__AZN_ | 131 | 1.95343 | 0.0402 |
| X5_PRICE_OF_PETROL__ABS_ does not Granger Cause Y_MAN_DOL__AZN_ | 131 | 1.88983 | 0.0484 |
| X6_FOREIGN_EXCHANGE_REZE does not Granger Cause Y_MAN_DOL__AZN_ | 131 | 2.08885 | 0.0270 |

*Source: author's work*

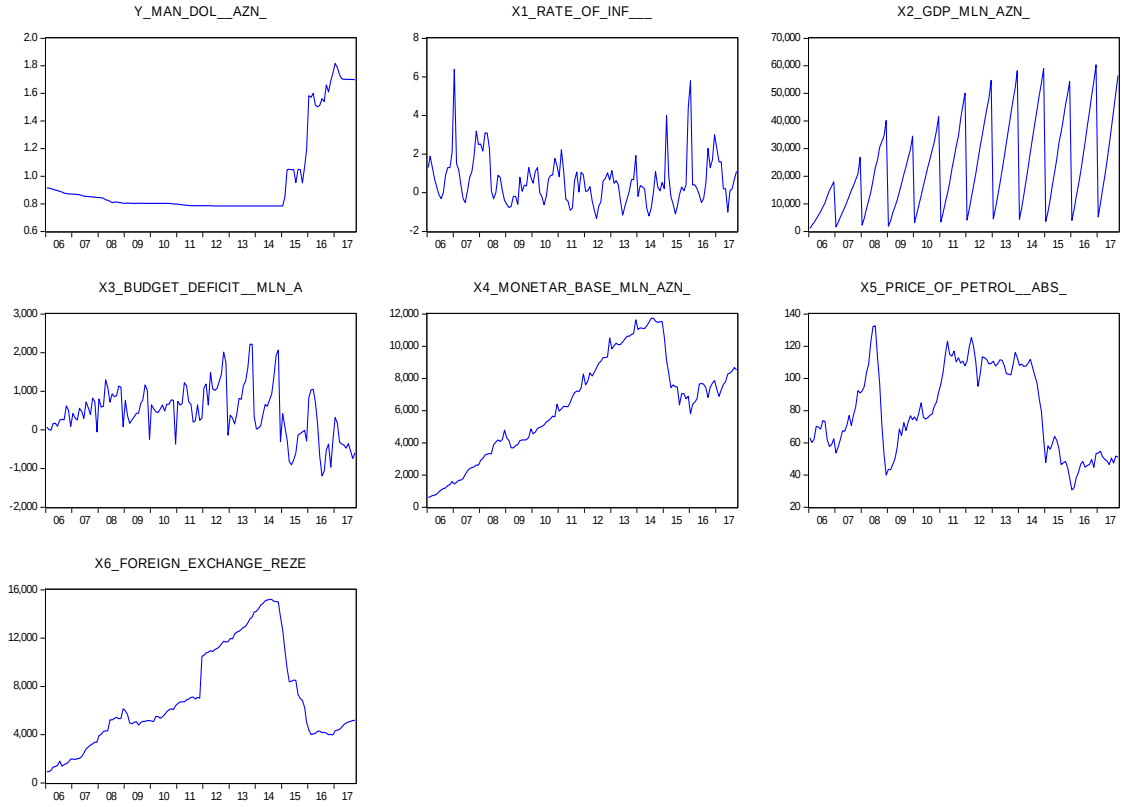
According to the obtained results, independent variables of x1, x2, x3, x4, x5, x6 generate unilateral causality for dependent variable of y.

Thus, the established multidimensional regression model is as follows:

***MAN_DOL=1+0,01INF-2,59GDP+2,36BUDGET_DEFICIT+0,001MONETAR_BASE-0,002PRICE_PETROL-0,00014FOREIGN_EXCHANGE_REZERV***

The independent dynamics of the result factors in the period of 2006-2017 which included in the model is presented graphically in Figure 2.

***Figure 2. Graphic description of dynamics of y, x1, x2, x3, x4, x5, x6 rows***




*Source: author's work*

Our research work has formed the following results:

-the factors that have more impact on the dynamics of the exchange rate in Azerbaijan and which are more important in its formation have been defined by investigating the theoretical aspects and approaches of the formation and regulation of currency rate;

- comparative analyses have been performed for the established models in order to prepare efficient proposals for the protection of stability of manat;

- wide econometric analysis has been carried out for the multidimensional regression model and the factors included in the model; the results confirming the adequacy of the model have been obtained; positive and negative moments have been analyzed;

- the stationarity of the model has been confirmed with the results of Dickey–Fuller test;

-the dependencies have been defined by conducting Granger causality test among the factors that are not dependent with the result factor;

- in research work, graphics and computing opportunities of Eviews-10 software package have been used.

We consider that, in comparison with standard models, the proposed model allows to conduct more accurate and adequate assessment of the factors affecting the exchange rate and in

its turn, it offers opportunities for its being applied as a "diagnostic tool" and significant means of model in the regulation and prediction of exchange rate.

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