REAL GROWTH OF RUSSIA'S MARKET IN TERMS OF 2005'S USD

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Introduction

Gross Domestic Product (GDP) – is an indicator of overall economic condition of a country. It provides vision of real wealth of a nation since it is strongly related to its level. GDP indicator has a very important position for economy as a whole. It is being used for characterization of results of production, level of economic development, pace of economic growth, for analyze of labor productivity and more.

Russia is the major supplier of commodities such as oil, gas and metal. Its economy was evaluated in 2.11 trillion USD in 2011, at the current USD price. Sometimes it is hard to understand the real economic situation given at different measurement instruments. Thus various systematic flaws may appear. In this work we will show the interdependence of different economic factors of the Russian Federation economy, will create an efficient econometric model to project future real Russian economy growth.

Formulation of the problem

To evaluate which factors affect Russian real GDP, its market position, consumption and total trade and show the degree of relationship between variables, find the weak points of the Russian economy, consider the methods the Russia should implements into its economic policy in order to overcome those. Create an efficient scheme to manage forecasting of Russian real economy growth.

Determination of variables

Real GDP Nominal gross domestic product is defined as the market value of all final produced in a geographical region, usually a country. That market value depends on the quantities of goods and services produced, and their respective prices (referred in lower case below). The Real GDP represents the nominal GDP adjusted to the price. This is our endogenous (dependent) variable Y.

Government consumption which buys goods and services produced in the economy and which is not a transfer payment of money collected in taxation from one group in society to another. Government consumption counts towards GDP, while transfer payments take money from some people and gives it to others. Any government expenditures and thus investments have a direct affect in GDP. This is our exogenous (independent) variable X_1.

Real GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. GDP per capita does not only grow forward as GDP grows, but also may affect increase in GDP, for example, by a sharp reduction in population. Real GDP per capita is our exogenous (independent) variable X_2.

Estimated Real Capital Stock The capital stock constitutes the equity stake of its owners. It represents the residual assets that would be due to stockholders after discharge of all senior claims such as secured and unsecured debt. Real Capital Stock is one of the most reliable and consistent factors in GDP accounting. This is our exogenous (independent) variable X_3.

Gross fixed Capital Formation Statistically it measures the value of acquisitions of new or existing fixed assets by the business sector, governments and "pure" households (excluding their unincorporated enterprises) less disposals of fixed assets. Capital formation may show the presence of foreign capitals and their effect on GDP. This is our exogenous (independent) variable X_4.

Household Consumption Is a transaction of the national account's use of income account representing consumer spending. It consists of the expenditure incurred by resident households on individual consumption goods and services, including those sold at prices that are not economically significant. It also includes various kinds of imputed expenditure of which the imputed rent for services of owner-occupied housing (imputed rents) is generally the most important one. Is minor sector of the economy that has its own fair share of effect on GDP. This is our exogenous (independent) variable X_5.

Exports GNFS Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. Export is the most direct external way of increasing the domestic GDP. This is our exogenous (independent) variable X_6.

Imports of goods and non-factor services (***GNFS***) represent the value of all goods and other market services received from the rest of the world. GDP calculation usually includes statistical adjustments, which will be shown in import effect This is our exogenous (independent) variable X_7.

Description of the statistical data related to the model.

The statistics are from official source http://databank.worldbank.org Data for model consists of 23 observations for 8 variables, of which one is endogenous and the rest of seven are exogenous.

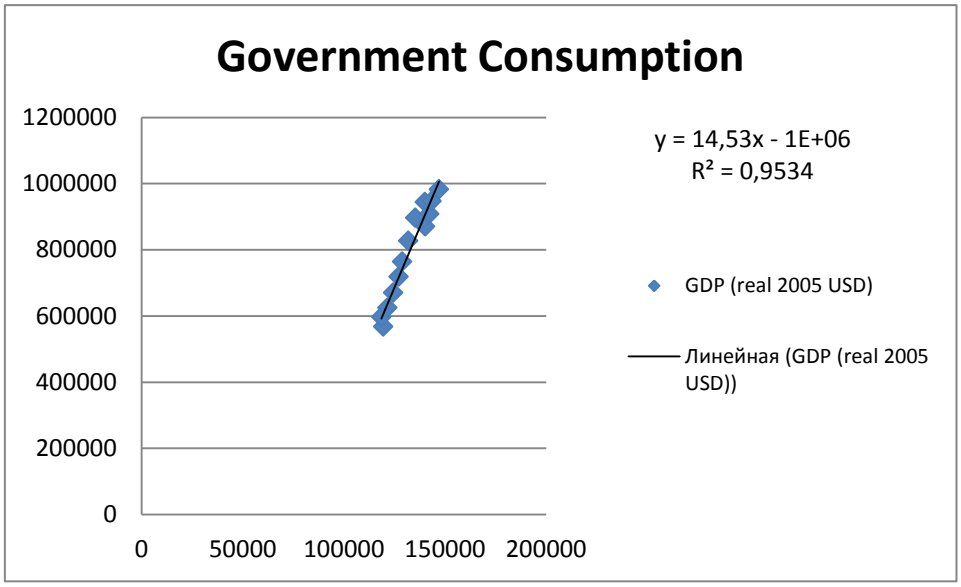
Construction of the econometric model

Correlation matrix We have a finest correlation matrix, showing that all of our exogenous variables have a very strong linear correlation with endogenous variable. Possible multicollinearity met in some of the cases, will be filtered out later on.

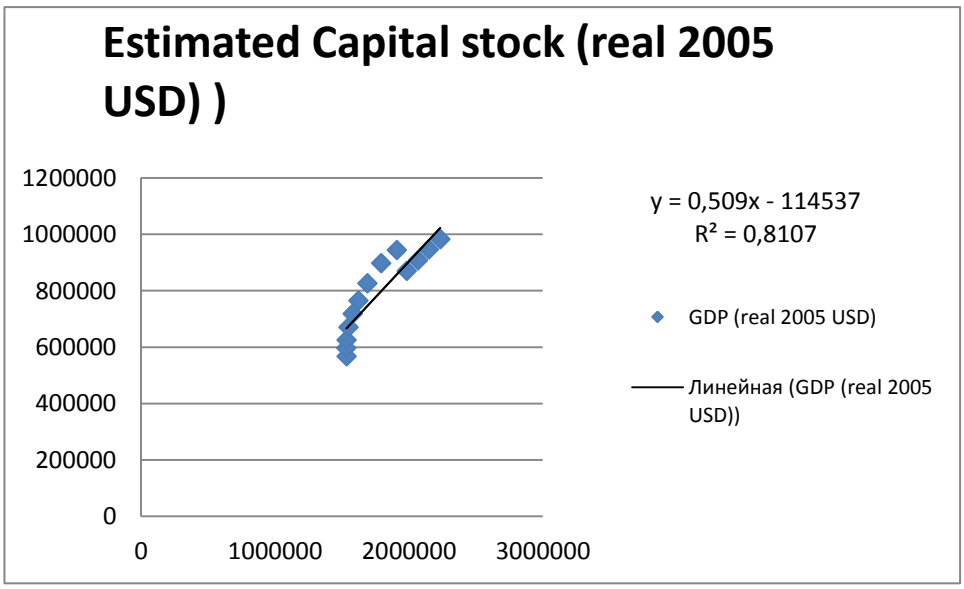
	Y	*X1*	*X2*	*X3*	*X4*	*X5*	*X6*	*X7*
Y	1.00							
X1	0.98	1.00						
X2	1.00	0.98	1.00					
X3	0.90	0.96	0.90	1.00				
X4	0.99	0.97	0.99	0.89	1.00			
X5	0.99	0.99	0.99	0.95	0.98	1.00		
X6	0.99	0.96	0.99	0.89	0.99	0.98	1.00	
X7	0.99	0.97	0.99	0.88	0.96	0.97	0.97	1.00

Scatter-diagrams

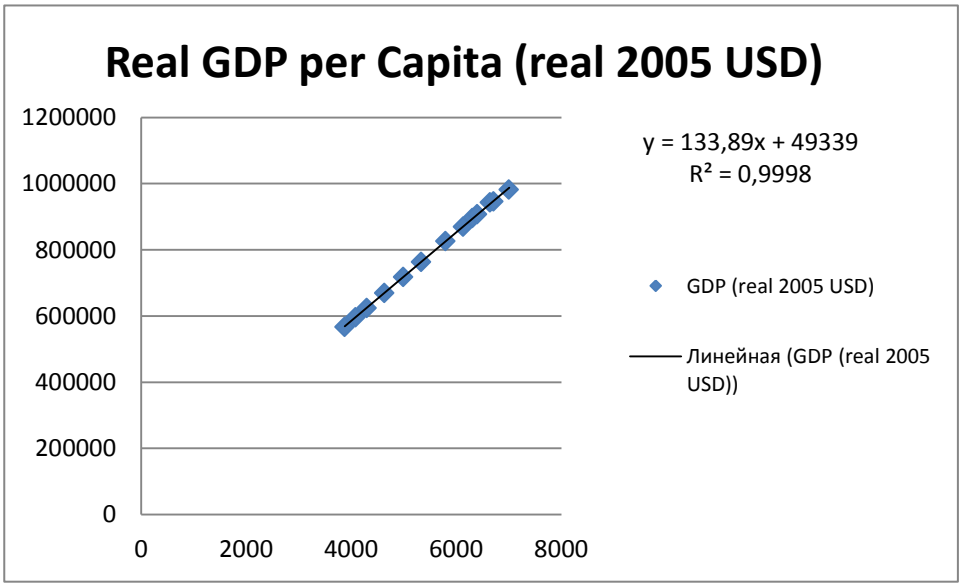
Our scatter diagrams confirm linear dependency between endogenous variable on each of the available exogenous variables. Analysis of their linear trends and coefficients of determination (R squared) are shown below for each scatter diagram:



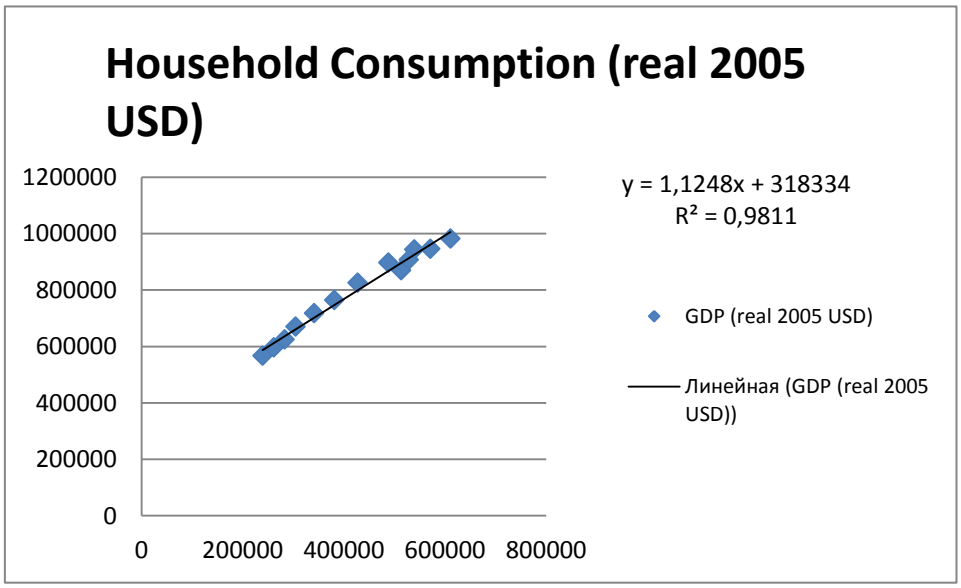
$Y = 14.53 \times X_1 - 100000$
$R^2 = 0.95$
Exogenous variable X_1 has a strong positive linear dependence with the endogenous variable (GDP).



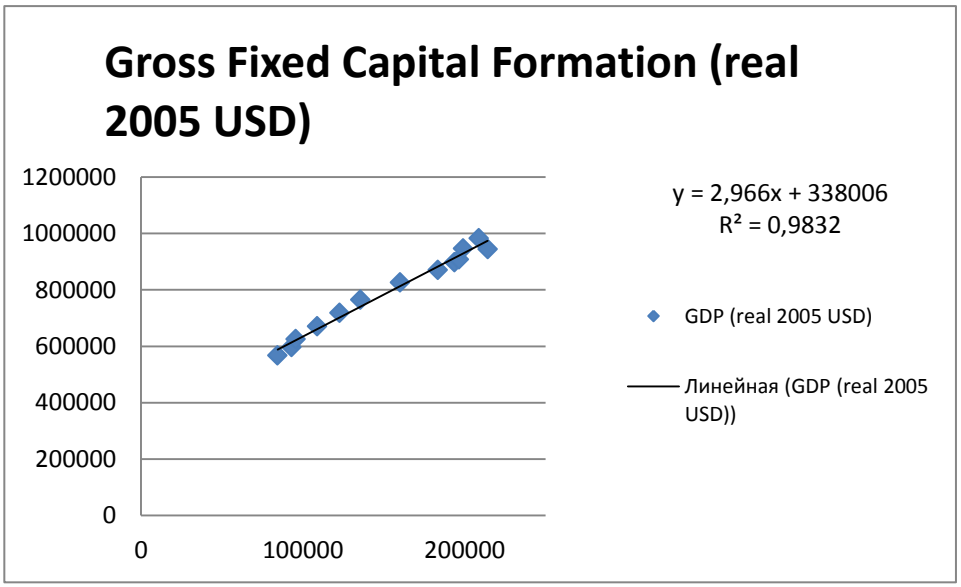
$Y = 0.51 \times X_1 - 114537$
$R^2 = 0.81$
Exogenous variable X_2 has a moderate positive linear dependence with the endogenous variable (GDP).



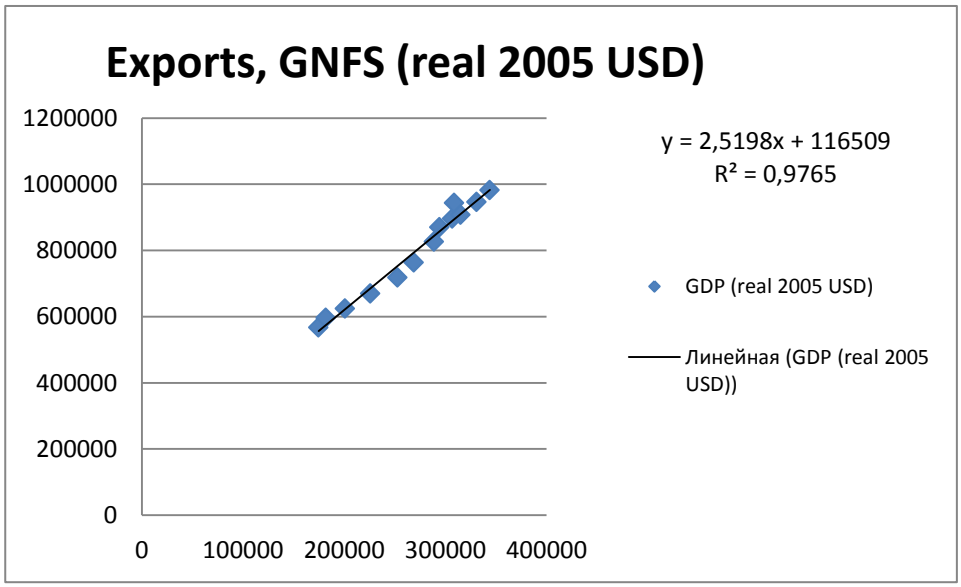
Y = 133.89x+49339
R^2 = 0.99
Exogenous variable X_3 has a strong positive linear dependence with the endogenous variable (GDP)



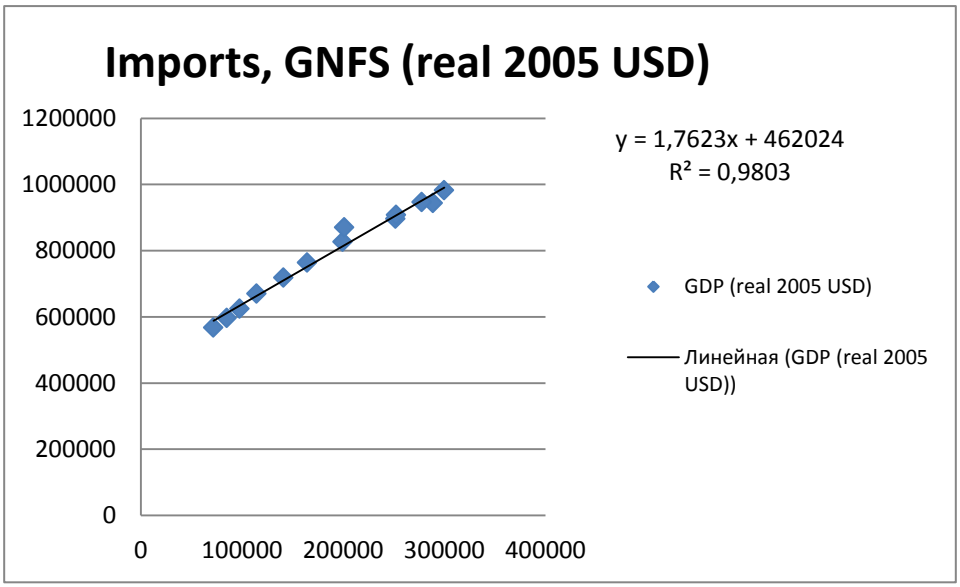
Y = 1.15x+318334
R^2 = 0.98
Exogenous variable X_4 has a strong positive linear dependence with the endogenous variable (GDP).



Y = 2.97x+338006
R^2 = 0.98
Exogenous variable X_5 has a strong positive linear dependence with the endogenous variable (GDP).



Y = 2.52x+116509
$R^2 = 0.98$
Exogenous variable X_6 has a strong positive linear dependence with the endogenous variable (GDP).



Y = 1.76x+462024
$R^2 = 0.98$
Exogenous variable X_7 has a strong positive linear dependence with the endogenous variable (GDP).

Model Specification

$$\begin{cases} y_t = a_0 + a_1 \cdot x_{1_t} + a_2 \cdot x_{2_t} + a_3 \cdot x_{3_t} + a_4 \cdot x_{4_t} + a_5 \cdot x_{5_t} + a_6 \cdot x_{6_t} + a_7 \cdot x_{7_t} + \varepsilon_t ; \\ E(\varepsilon_t) = 0 ; \\ \sigma(\varepsilon_t) = const. \end{cases}$$

In excel we should estimate the model using ordinary least square. Then we should make sure, that our exogenous and endogenous variables have a strong linear dependency. After this is settled, we should check whether the model satisfies the conditions of Gauss-Markov theorem this means that the average error is zero, the variance of errors is constant, and the residuals are have zero correlation between each other.

Initial estimated model

We make the regression analysis of the data using the "data analysis" tool of MS Excel (last row will remain untouched; we will use it later to check the adequacy of the model). Thus, the estimated model may be described as follows:

$$\begin{cases} y_t = \underset{(15110)}{33513.34} + \underset{(0.09)}{0.5 * X1t} + \underset{(5.38)}{126.4 * X2t} + \underset{(0.01)}{0.013 * X3t} + \underset{(0.03)}{0.14 * X4t} + \underset{(0.03)}{0.024 * X5t} + \underset{(0.01)}{0.048 * X6t} + \underset{(0.03)}{0.02 * X7t} + \underset{(208.65)}{\varepsilon_t} \\ R^2_{adjusted} = 0.99 \\ F = 543748.99 \qquad F_{critical} = 5.27 \end{cases}$$

R test

Value of adjusted R^2 - roughly equals to 0.99, mean that observations are correctly explained at a rate of approximately 99% by the model, adjusted R^2 is close to 1, thus it confirms the good quality of the model.

F test

To implement the F-test we should find critical value of F-statistic for 10% level of significance. Value of F-critical is 5.27. Value of F is 543748.99. Thus F>F-critical means that F is non-random and it confirms significance of R^2, thus good quality of model specification is proven.

T-test

Out first step is to find out whether this model can be improved by excluding statistically insignificant variables. This can be achieved by involvement of T-test. The critical value of t-statistic for 10% level of significance and 4 degrees of freedom is 2.13. Comparison the t-statistics of all coefficients (absolute value) with the critical value:

$|2.22| > 2.13$ => coefficient a_0 is statistically significant at 10% level of significance
$|5.52| > 2.13$ => coefficient a_1 is statistically significant at 10% level of significance
$|23.5| > 2.13$ => coefficient a_2 is statistically significant at 10% level of significance
$|-3.9| > 2.13$ => coefficient a_3 is statistically significant at 10% level of significance
$|5.36| > 2.13$ => coefficient a_4 is statistically significant at 10% level of significance
$|-0.87| < 2.13$ => coefficient a_5 is statistically insignificant at 10% level of significance
$|3.95| > 2.13$ => coefficient a_6 is statistically significant at 10% level of significance
$|-0.53| < 2.13$ => coefficient a_7 is statistically insignificant at 10% level of significance

The t-statistic of coefficients a_5 and a_7 are lower than the critical value. These coefficients are statistically insignificant thus variables x_5 and x_7 should be excluded.

Final model

$$\begin{cases} y_t = \underset{(4667.19)}{43672.32} + \underset{(0.07)}{0.5 * X1t} + \underset{(0.87)}{122.6 * X2t} + \underset{(0.01)}{0.02 * X3t} + \underset{(0.01)}{0.14 * X4t} + \underset{(0.01)}{0.06 * X6t} + \underset{(187.73)}{\varepsilon_t} \\ R^2_{adjusted} = 0.99 \\ F = 982109.32 \qquad F_{critical} = 5.05 \end{cases}$$

R test

Value of adjusted R^2 - roughly equals to 0.99, mean that observations are correctly explained at a rate of 99 % by the model, adjusted R^2 is close to 1, thus it confirms the good quality of the model.

F test

To implement the F-test we should find critical value of F-statistic for 5% level of significance. Value of F-critical = 5.05. Value of F = 982109.32. F>F-critical means that F is non-random and it confirms significance of $R^{2,}$ thus good quality of model specification is proven.

T test

Out first step is to find out whether this model can be improved by excluding statistically insignificant variables. This can be achieved by involvement of T-test. The critical value of t-statistic for 5% level of significance and 5 degrees of freedom is 2.57. Comparison the t-statistics of all coefficients (absolute value) with the critical value

$|9.36| > 2.57$ => coefficient a_0 is statistically significant at 5% level of significance
$|6.77| > 2.57$ => coefficient a_1 is statistically significant at 5% level of significance
$|140.21| > 2.57$ => coefficient a_2 is statistically significant at 5% level of significance
$|-13.23| > 2.57$ => coefficient a_3 is statistically significant at 5% level of significance
$|14.04| > 2.57$ => coefficient a_4 is statistically significant at 5% level of significance
$|8.18| > 2.57$ => coefficient a_5 is statistically significant at 5% level of significance

Goldfeld-Quandt test

Goldfeld-Quandt test is required to check the estimated model for homoscedasticity. For this test, we will introduce a new variable "z_t".

$$z_t = x_{1_t} + x_{2_t} + x_{3_t} + x_{4_t} + x_{6_t}$$

These values of z_t were required in order to sort in descending order the dataset. After the sorting was done, the residual sum of squares was separately found for both samples. Based on these calculations we may find both GQ by diving bigger RSS on smaller RSS and GQ^{-1} by vice versa method.

$$GQ = \frac{RSS_1}{RSS_2} = \frac{333374973149}{1746759052} = 1.93$$
$$GQ^{-1} = \frac{RSS_2}{RSS_1} = \frac{1746759052}{333374973149} = 0.517$$

In order to finalize the test we should compare the GQ results with the critical value of F-statistic, which equals to 3.79 at 5% level of significance, number of

observations is 7 and number of variables is 5. F-critical value is identical for each sample as they have the same size. Thus both GQ and GQ^{-1} are lower than critical value of F-statistic

This test confirmed the hypothesis of homoscedasticity of residuals in the final estimated model at 5% level of significance. According to GQ test, it is possible to apply ordinary least squares method to this model.

Durbin-Watson test

DW test allows us to check our econometric model for autocorrelation of random residuals. We will use the estimated values of Y which were calculated for each year, using the coefficients obtained in regression analysis. The difference between actual and estimated values of Y is the residual value for each year. Final step is the calculation for each year except the first one, the difference between the residual for current and previous year. These calculations provided following results:

$$\sum(\varepsilon_i - \varepsilon_{i-1})^2 = 732440549604285$$

$$\sum \varepsilon_i{}^2 = 34284520910858.4$$

$$DW = \frac{\sum(\varepsilon_i - \varepsilon_{i-1})^2}{\sum \varepsilon_i{}^2} = 2.13$$

According values of dl and du were found in the Durbin-Watson list of corresponding values:

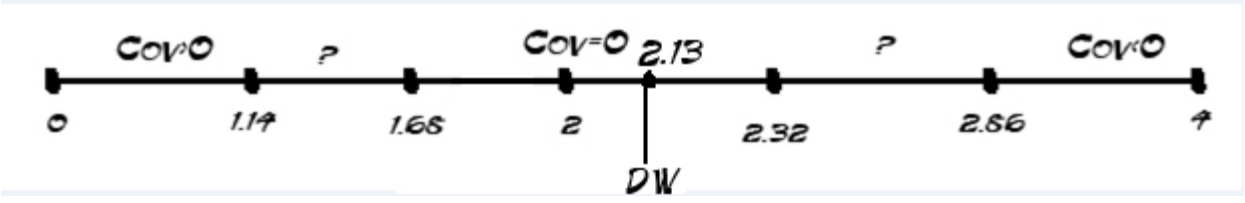
Dl=1.14

Du=1.68

4-du=2.32

4-dl=2.86

The interval for autocorrelation of the residuals is following:



Since DW is in the third interval, this means that autocorrelation of random residuals is absent.

Confidence Intervals

To check whether the estimated model is adequate and good for forecasting, we will construct the confidence interval and check whether the real value of Y in 2012, equals to 982536.03, belongs to this interval.
The lower and upper boundaries of the confidence interval are calculated by the following formulas:

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

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

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

Now we should replace real values of explanatory variables for 2012 and the coefficients of the estimated model into this formula (appendix, table 1), get:

$$\hat{y}_{2012} = 43672.31 + 0.5 * 146995.9 + 122.6 * 7006.72 - 0.02 * 2235050 + 0.15 * 208773.9 + 0.05 * 299926.9$$

$$\hat{y}_{2012} = 985515.9$$

The value of s (standard error of the model) and critical value of t-statistic were calculated earlier in the regression statistics (appendix, table 2). They are:

$$s = 183.73$$
$$t_{crit} = 2.57$$

Boundaries equal to:

$$\hat{y}^+_{2012} = 985988.08$$
$$\hat{y}^-_{2012} = 985043.71$$

Now we check if $985536 \in [985043.71; 985988.08]$. It does. Thus 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 2012 to be equal to 985515.9, while world bank predicts the value of 985536. In order to find out whether this forecast is good, we have to calculate the percentage deviation of the forecast from the real value.

$$\frac{|985536 - 985515.9|}{985536} \times 100\% = 0.002\%$$

The deviation of the forecast from the real value is less than 10%, thus, this forecast may be considered a good one, and the high quality of the model for making forecasts is confirmed one more time.

Conclusion

Our model includes a very insignificant error, compared to projection of the World Bank, while our methods differ in core and the data usage.

After the Russian Federation's output level finally exceeded the pre-crisis highs, the economy seemed to be setting on the flow of stagnated growth. Despite external resistance, Russia's economy had an outstanding performance in the first half of 2012. However, the economy will be slowing down in the second half of 2012 due inflation, weak internal demand, and unreliable external demand.

As people's purchasing power has risen and unemployment fell off, fewer people were in poor condition than at any time since the start of the economic restart in early 1990s. However, a significant share of these achievements has been bounded to high oil prices. It was boosted by supply constraints rather than powerful world demand.

The pathetic outlook means that stable, three-pronged policy move is essential to reboot the economy. First, economic decisions have to underline the stability. The recent sky grow of the interest rate was an initial step in this direction. Second, Russia has to construct buffers against the external movements. This means regenerate the reserve fund, setting up towards inflation targeting and strengthening banking control. Finally, the ruling class has to unleash the growth potential of the economy. The government also required to improve poor transaction system connectivity in line with its longer-term political and economic goals. Making accent on this agenda will ensure Russia to lift rapid growth above 4 percent and then increase it even further.

APPENDIX

Table 1. Initial data for calculating estimated value of Y_{2012}

Indicator name	GDP (real 2005 USD)	Government Consumption (real 2005 USD)	Real GDP per Capita (real 2005 USD)	Estimated Capital stock (real 2005 USD)	Gross Fixed Capital Formation (real 2005 USD)	Imports, GNFS (real 2005 USD)
2012 (expected)	985536.03	146995.91	7006.72	2235049.54	208773.88	299926.84
	Y	X1	X2	X3	X4	X6
Y	43672.32					
X1	0.50					
X2	122.60					
X3	-0.02					
X4	0.14					
X6	0.06					

Table 2 Initial data for calculating confidence interval

Регрессионная статистика				
Множественный R	1.00			
R-квадрат	1.00			
Нормированный R-квадрат	1.00			
Стандартная ошибка	183.73			
Наблюдения	11.00			
			Tcrit=	2.57
Дисперсионный анализ			Fcrit=	5.05