ESTIMATION OF A LINEAR IS CURVE FOR ROMANIA

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Abstract

The fiscal-budgetary policy is included in the economic policy of a country, addressing the set of public measures and institutions aimed to ensure a macroeconomic equilibrium of the real economy.

The paper specifies, estimates, and analyses, from a qualitative as well as a quantitative point of view, a linear equation of the fiscal-budgetary policy in Romania, of the type IS (investment-saving), econometrically built, for the period 1995-2016, using official statistical data at the macroeconomic level. Data series that are analyzed using an econometric model are final consumption of households (private consumption) and gross fixed capital formation of non - financial corporations (private investment).

Keywords: IS curve, fiscal-budgetary policy, real economy

JEL classification: C51, H30, E62

Introduction

Analyzing the evolution of GDP components, there has been an increase in expenditure for final consumption of households in our country and in the economies of the EU member states. Concerning the investment developments, the vast majority of investments were made in the private sector. In order to understand the fiscal - budgetary measures that are imposed at the level of the national economy, the present paper models the mathematical, statistical and econometrical the data series of two very important indicators in the analysis of GDP evolution. The Romanian economists' concerns related to the analysis of these indicators are found in the specialized literature, materialized in scientific papers containing observations for the analyzed periods. The fiscal variables analyzed in this paper will be able to formulate a few theoretical conclusions on GDP developments.

Description of the Problem

In achieving its macroeconomic and social objectives, the state establishes its own economic policy that includes adjustment policies adopted to ensure the necessary budgetary revenues. One of the most common adjustment policies is the fiscal policy one. Having macroeconomic objectives at the Government disposal, fiscal policy can also be considered in the public policies category by means of which the state ensures the society members' welfare.

The fiscal policy concept can be defined as a kind of adjustment public policy which included the set of rules, institutions and procedures that are designed to manage, from the public authority perspective, the macroeconomic equilibrium in the real economy by controlling the tax rates trajectory and government expenditures [1].

The main fiscal policy characteristics are presented in the figure 1.

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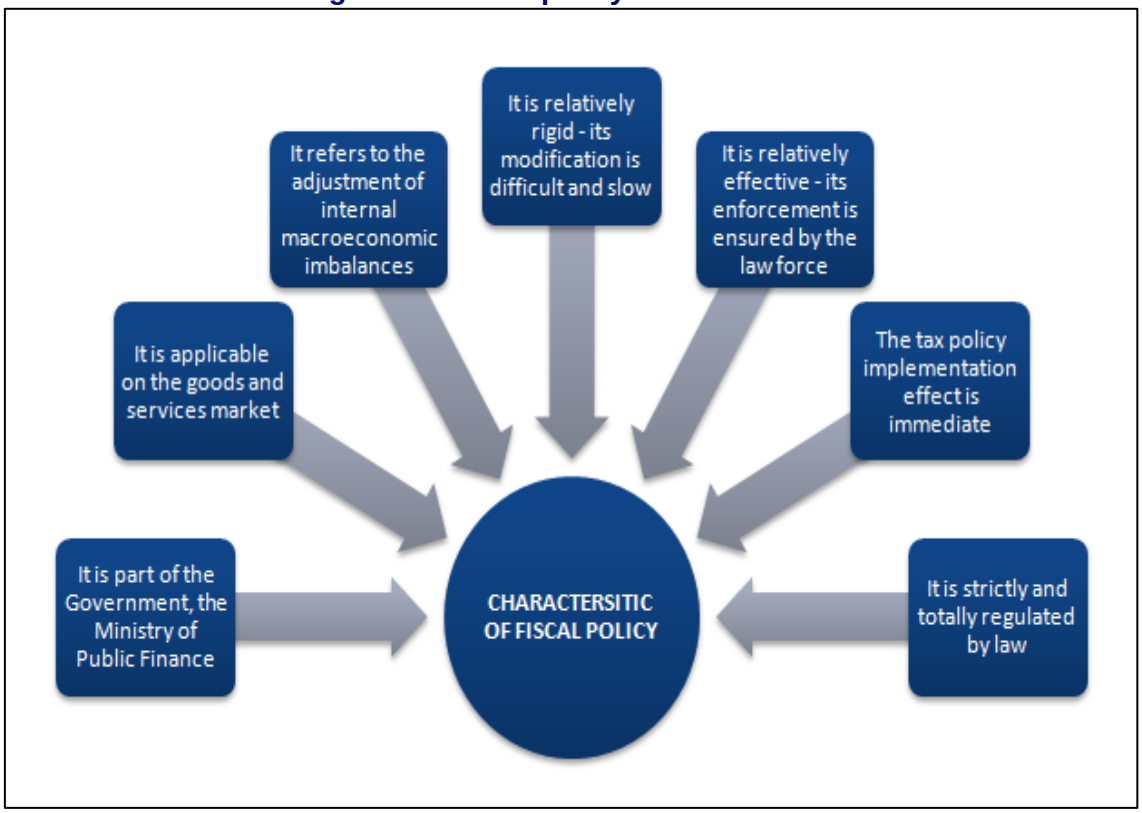
Figure 1 – Fiscal policy characteristics



Source: author's work

Financial resources for achieving macroeconomic objectives assumed by the state, are ensured through the four tools of fiscal policy: taxes, payments for public services, other mandatory levies, and government expenditures.

One of the fiscal policy objectives is also to ensure and maintain the macroeconomic balance on the goods and services market. According to the equilibrium macroeconomic equation the aggregate supply on the goods and services market must be equal to the aggregate demand for goods and services on this market (the case of a closed economy).

Macroeconomic equilibrium equation (case of a closed economy):

$Y = C(Y_d) + I(r)$, where $0 < C'(Y_d) = \alpha < 1$, $I_r^{'} < 0$ (1)

where $Y_d = Y - t(Y)$, and t(Y) – direct tax

Then,

$Y = C[Y - t(Y)] + I(r)$, where $0 < t'(Y) < 1$ (2)

Applying an elementary (differential) calculation of the previous relationship we obtain:

$dY = C'(Y) \cdot [1 - t'(Y)]dY + I'_r\, dr$ (3)

$dY \cdot \left[1 - \alpha \cdot \left(1 - t'(Y)\right)\right] = I'_r\, dr$ (4)

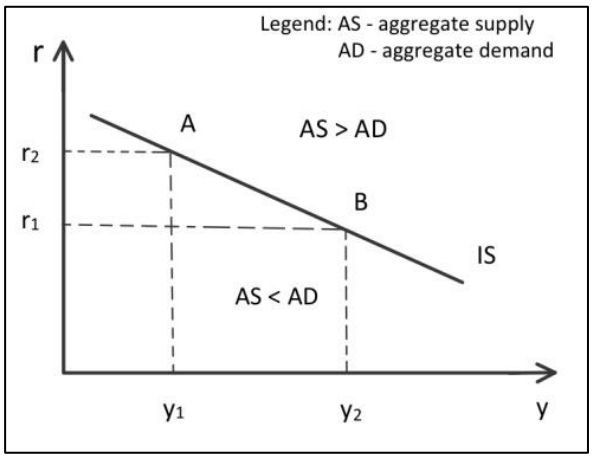
$\frac{dY}{dr} = \frac{I'_r}{1-\alpha\cdot[1-t'(Y)]} < 0$ (5)

$dY\ /\ dr$ is the slope of the line $Y = y(r)$ is called as: IS (investment saving).

The IS function indicates the equality of savings and investments on the goods and services market: $I = S$.

The IS graphic representation is shown in the figure 2.

Figure 2 – Representation of IS graph



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Based on an econometrical model, this paper presents a quantitative analysis of two series of final consumption indicator data for households and gross fixed capital formation of non-financial corporations, indicators that have contributed significantly to last year's economic growth in Romania.

Methodology and Data Sources

From indicator analysis, which determines the change over GDP, households final consumption and gross fixed capital formation of non-financial corporations were selected. The first indicator analyzed is an important component of GDP and is a constant concern of the welfare economy, the second indicator is geared towards long-term growth in private consumption. The mathematical modeling of the two indicators was done using the IS equation, as shown below:

$$Y = \alpha \cdot C_{pr} + \beta \cdot I_{pr} \quad (6)$$

where:

Y – total income (Nominal GDP)

C_{pr} – final consumption of the population (private consumption)

I_{pr} – gross fixed capital formation of non-financial corporations (private investment)

α, β – parameters of the equation

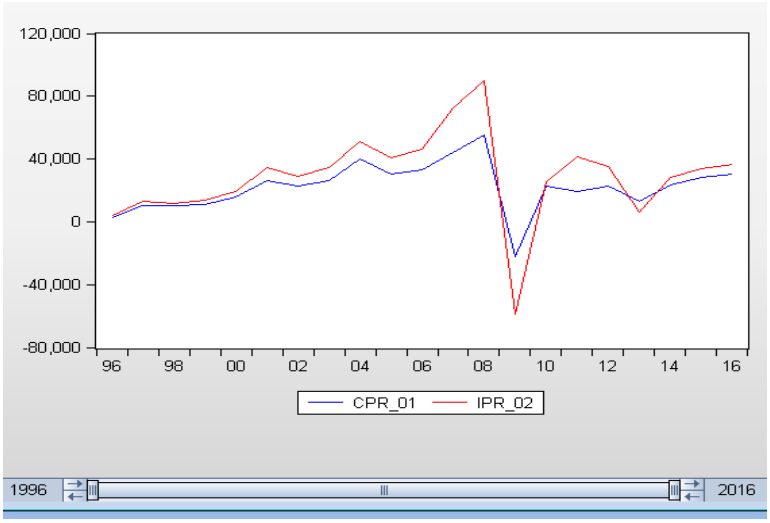
The statistical and econometrical analysis was done using a one-factor linear regression model. The correlations between the two variables of the econometrical model were studied: the independent variable X – final consumption of households (private consumption) - C_{pr} and the dependent variable Y – gross fixed capital formation of non-financial corporations (final investments) - I_{pr}, concerning Romania in 1995-2016 period. Statistical information available in the Romanian Statistical Yearbook and on the EUROSTAT website was used.

Analysis of recorded data series: the independent variable X – final consumption of households (private consumption) and the dependent variable Y – gross fixed capital formation of non-financial corporations (private investment), from the annual values evolution point of view, as shown in figure 3, shows the evolution of the two variables over the analyzed. The direct relationship between consumer price dynamics and revenue dynamics influences the final consumption of households structure.

As can be seen from 1995 to 2008 there was an increasing trend in the evolution of the two variables studied which is justified on the basiss of the economic growth recorded in that period in Romania, and also on the increase of incomes of both employees and pensioners, and other social categories. Between 2008 and 2010, there is a sharp fall in both private consumption and private investment due to decrease in the growth rate of the population's incomes having as cause the

deepening of the economic crisis and the adoption of measures for restoring the budget balance, which reduced the salary rights for the budgetary personnel by 25%. For the 2010 – 2016 period, the concomitant evolution of the two variables shows an socillating tendency in the first part of the interval and a growth trend towards the end of the analyzed period.

Figure 3 – The common kinematics of the two variables for the analyzed period



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The stationarity analysis of the independent variable X, final consumption of households, for recorded values (level values), was done using the correlation and the Dickey-Fuller test. From the correlogram graph (which is, at the same time, decreasing but also oscillating depending on the number of lags taken into account), as seen in figure 4a, it is shown that the series of the independent variable X at the recorded values (level values) is non-stationary. In order to check rigorously the stationary or non-stationary character of the series, the unit root test was done. As seen in figure 4b, the calculated vale of the test, i.e. 0.689 is greater than the tabulated values for all three levels of significance (1%: - 3.78; 5% - 3.01; 10%: - 2.64). Consequently, the time series of the independent variable X for the recorded values (level values) is non-stationary (the null hypothesis is accepted).

Figure 4 – The correlogram (a) the Dickey – Fuller test
(b) for the independent variable X – registered values

Series: CPR Workfile: WF-1::Untitled\

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Correlogram of CPR

Date: 10/22/17 Time: 22:01
Sample: 1995 2016
Included observations: 22

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.882	0.882	19.553	0.000
		2	0.760	-0.081	34.791	0.000
		3	0.636	-0.075	46.046	0.000
		4	0.510	-0.090	53.667	0.000
		5	0.375	-0.122	58.026	0.000
		6	0.242	-0.086	59.961	0.000
		7	0.115	-0.082	60.425	0.000
		8	-0.006	-0.083	60.427	0.000
		9	-0.141	-0.190	61.234	0.000
		10	-0.245	-0.006	63.884	0.000
		11	-0.327	-0.032	69.001	0.000
		12	-0.387	-0.033	76.913	0.000

a)

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Augmented Dickey-Fuller Unit Root Test on CPR

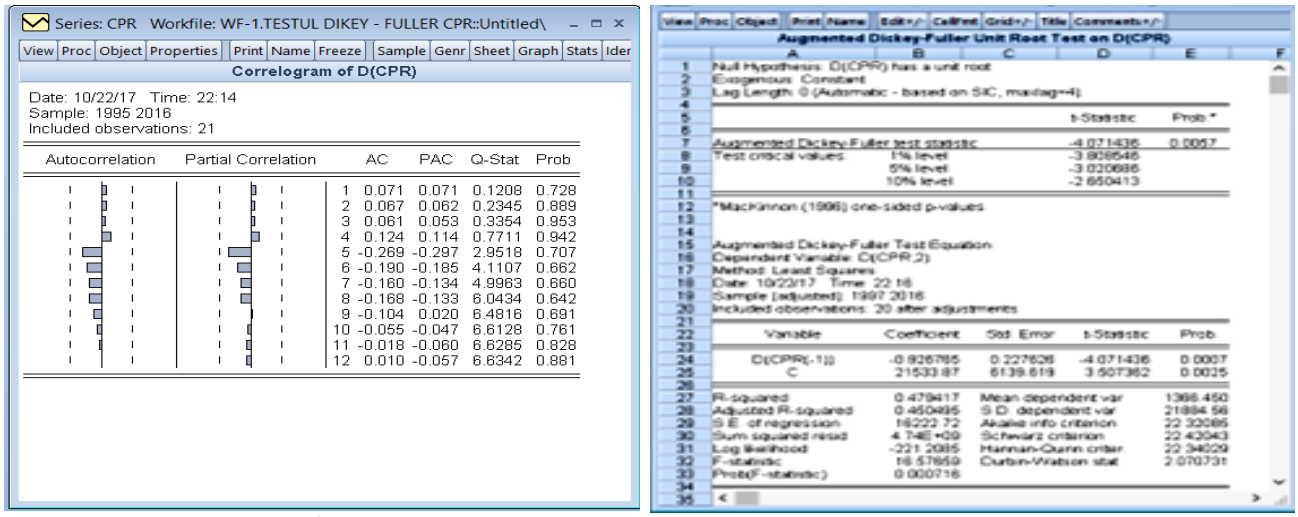
	A	B	C	D	E
1	Null Hypothesis: CPR has a unit root				
2	Exogenous: Constant				
3	Lag Length: 0 (Automatic - based on SIC, maxlag=4)				
4					
5				t-Statistic	Prob.*
6					
7	Augmented Dickey-Fuller test statistic			0.689885	0.9888
8	Test critical values:	1% level		-3.788030	
9		5% level		-3.012363	
10		10% level		-2.646119	
11					
12	*MacKinnon (1996) one-sided p-values.				
13					
14					
15	Augmented Dickey-Fuller Test Equation				
16	Dependent Variable: D(CPR)				
17	Method: Least Squares				
18	Date: 10/22/17 Time: 22:10				
19	Sample (adjusted): 1996 2016				
20	Included observations: 21 after adjustments				
21					
22	Variable	Coefficient	Std. Error	t-Statistic	Prob.
23					
24	CPR(-1)	0.016532	0.023963	0.689885	0.4986
25	C	18779.71	6061.424	3.098234	0.0059
26					
27	R-squared	0.024437	Mean dependent var		22170.00
28	Adjusted R-squared	-0.026908	S.D. dependent var		16046.06
29	S.E. of regression	16260.51	Akaike info criterion		22.32126
30	Sum squared resid	5.02E+09	Schwarz criterion		22.42074
31	Log likelihood	-232.3732	Hannan-Quinn criter.		22.34285
32	F-statistic	0.475941	Durbin-Watson stat		1.846664
33	Prob(F-statistic)	0.498607			
34					

b)

Source: author's work

For values calculated as first-order differences of the independent variable X, from the correlogram graph (which is relatively constant depending on the number of lags taken into account), shows that the series of the independent variable X which is noted as D(X), for the level values calculated as first-order differences, is stationary, as seen in figure 5a. In order to check rigorously the stationary or non-stationary character of the series, the unit root test was done. As observed in figure 5b, the calculated value of the test, i.e. -4.071 is lower than the tabulated values for all three levels of significance: 1%: - 3.80, 5%: -3.02, 10%: -2.65. Consequently, the time series of the independent variable X for the values calculated as first-order differences is stationary (the null hypothesis is rejected) for any of the levels of tabulated significance.

Figure 5 – The correlogram (a) and Dickey – Fuller test (b) for the independent variable D(X) – first-order differences

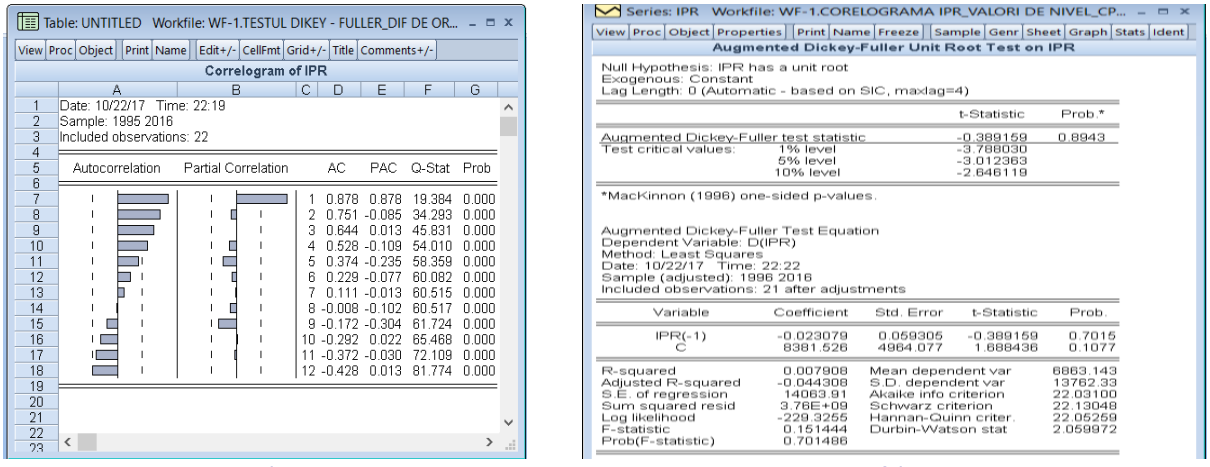


a) b)

Source: author's work

The stationarity analysis for the dependent variable Y, the gross fixed capital formation of non-financial corporations (level values), as seen in figure 6a and, as it can observed from the correlogram graph (decreasing but also oscillating depending on the number of lags taken into account) shows that the series of dependent variable Y at the level of recorded values (level values) is non-stationary. The Dickey – Fuller test verifies the stationary or non-stationary character of the series, and as seen in figure 6b, the calculated values of the test, i.e. 0.389 is greater than the tabulated values for all three levels of significance (1%: -3.78; 5%: -3.01; 10%: -2.64). Consequently, the time series of the independent variable X for the recorded values (level values) is non-stationary (the null hypothesis is accepted).

Figure 6 – The correlogram (a) and the Dickey – Fuller test (b) for the dependent variable Y – recorded values

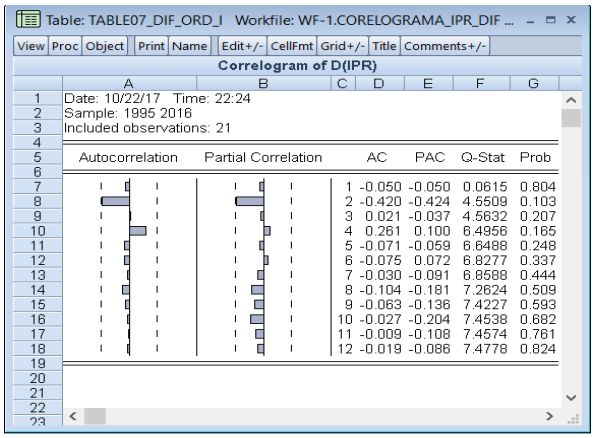


a) b)

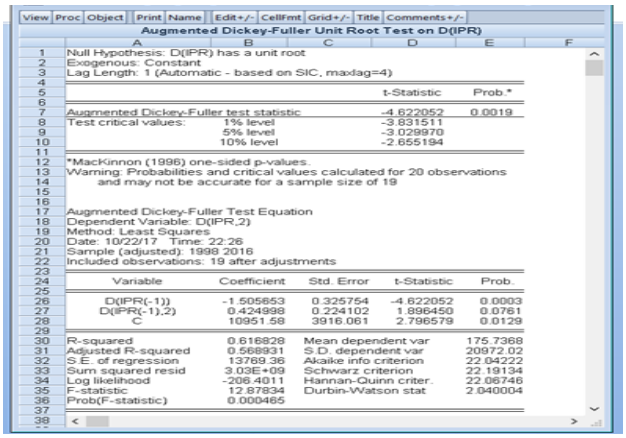
Source: author's work

The stationarity of the dependent variable Y, which is noted D(Y), at the level values calculated as first-order differences, is shown in the correlogram graph (which is relatively constant depending on the number of lags taken into account) from the figure 7a, and it shows that the variable series D(Y) is stationary. The results of the Dickey – Fuller test (which verifies the stationary or non-stationary character of the series) shows that the calculated value of the test, i.e. -4.622 is lower than the tabulated values for all three levels of significance 1%: - 3.83; 5%: - 3.02; 10%: - 2.65. Consequently, the time series of the variable D(Y) for the values calculated as first-order differences is stationary (the null hypothesis is rejected) for any of the levels of tabulated significance (figure 7b).

Figure 7 – The correlogram (a) and the Dickey – Fuller test (b) for the dependent variable D(Y) – first-order differences



a)

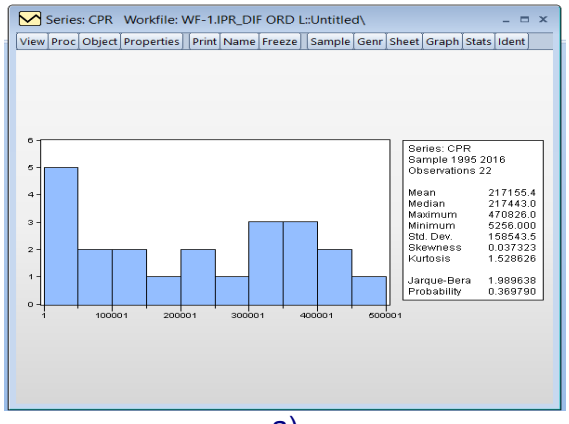


b)

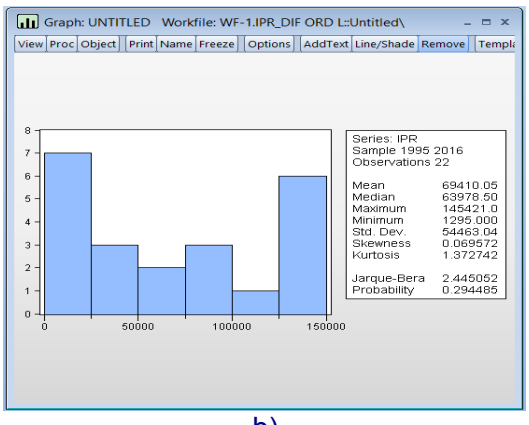
Source: author's work

The histograms of the two variables analyzed, for values calculated as first-order differences, as seen in figure 8, show that for the variable D(X), in terms of statistical distribution of the series, from the value of the Skewness indicator, thus the coefficient of asymmetry (0.04), there is a relatively close distribution of the normal distribution. As for the value of the indicator showing the flattening of the distribution, i.e. Kurtosis: 1.52 the value less than 3 shows a platykurtic distribution. The value of the Jarque – Bera test: 1.98 (which indicates, by comparing the difference between the coefficient of asymmetry and the flattening coefficient against the normal distribution, the degree of normality of the distribution) has a null probability associated, so the hypothesis of the normal distribution of the time series of the variable D(X) is rejected. The histogram of the variable D(Y) shown in figure 8b shows a distribution close to the normal distribution, the coefficient of asymmetry (Skewness) is 0.006, the Kurtosis indicator has a value less than 3, which shows us that the analyzed series has a platykurtic distribution, the value of the Jarque – Bera test of 2.44 is associated with a probability of zero, therefore, the hypothesis of the normality of the distribution of variable D(Y) time series.

Figure 8 – The histograms of the two variables – first-order differences



a)



b)

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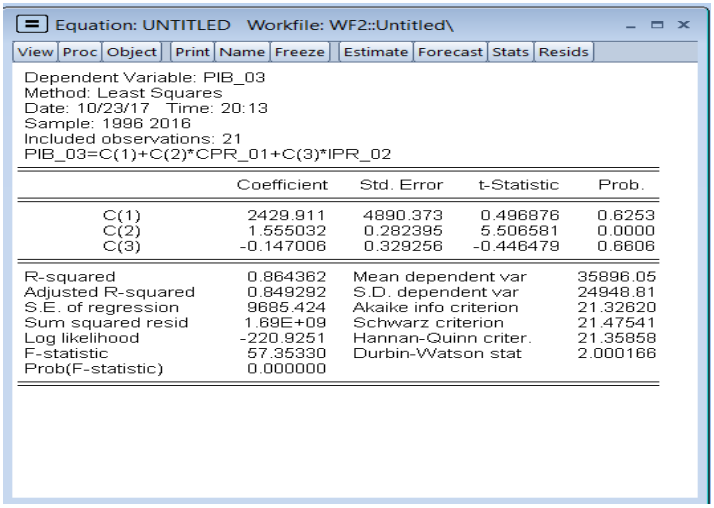
The parameters of the single-factor regression equation as seen in figure 9 were estimated.

Figure 9 – The estimation of regression equation parameters



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Dependent Variable: PIB_03
Method: Least Squares
Date: 10/23/17 Time: 20:13
Sample: 1996 2016
Included observations: 21
PIB_03=C(1)+C(2)*CPR_01+C(3)*IPR_02

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	2429.911	4890.373	0.496876	0.6253
C(2)	1.555032	0.282395	5.506581	0.0000
C(3)	-0.147006	0.329256	-0.446479	0.6606

R-squared	0.864362	Mean dependent var	35896.05
Adjusted R-squared	0.849292	S.D. dependent var	24948.81
S.E. of regression	9685.424	Akaike info criterion	21.32620
Sum squared resid	1.69E+09	Schwarz criterion	21.47541
Log likelihood	-220.9251	Hannan-Quinn criter.	21.35858
F-statistic	57.35330	Durbin-Watson stat	2.000166
Prob(F-statistic)	0.000000		

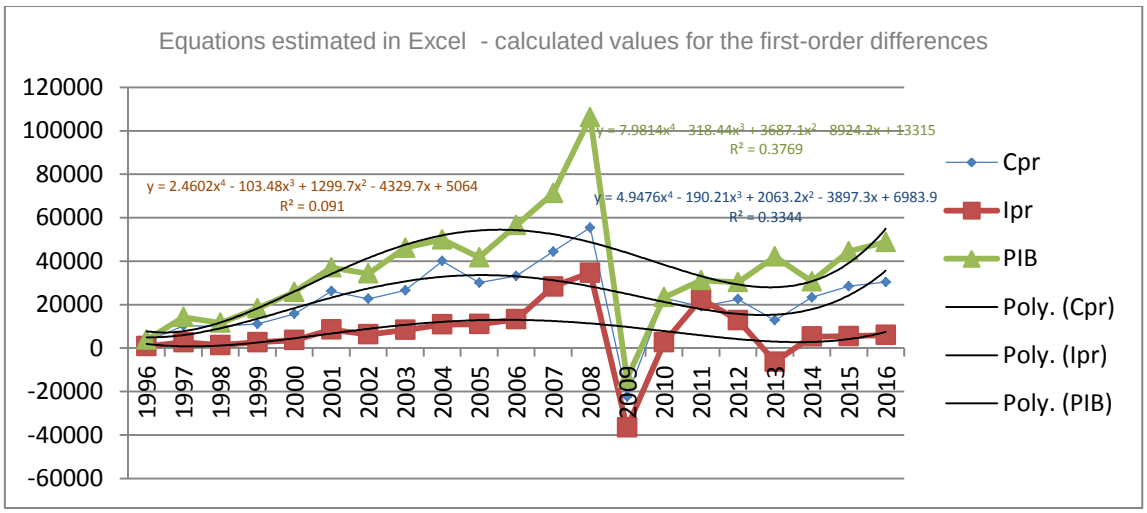
Source: author's work

The linear relation between the two variables analyzed has the expression:

$$dY = 2429.9 + 1.56 \cdot dCpr - 0.15 \cdot dIpr \quad (7)$$

Figure 10 shows the evolution of the variables for the analyzed period, processed using Excel.

Figure 10 – The estimation of regression equation for values calculated as first-order differences



Source: author's work

Results Obtained

The GDP variation is directly proportional to the variation of the variable C_{pr} – final consumption of households (private consumption) and inversely proportional to variation of the variable I_{pr} – gross fixed capital formation of non-financial corporations (private investment).

The equation requires an interpretation inconsistent with the economic theory that says gross domestic product, or its variation adds the variation of private consumption to the variation of private investment.

Since the variable of private investment is negative, we can assume that private investment in the current year is equivalent to a cash extraction from consumption, as the investment effect will manifest itself in the future.

Conclusions

Following the econometrical modeling of the two series of data, the free term of the estimated equation is very high, thus 2429.9, does not depend on either the independent variable X or the dependent variable Y, which means that the first-order difference over GDP has a high degree of independence from the independent variables taken into account. This means that there are other casual factors on the absolute GDP dynamics and that in GDP dynamics a certain autonomous inertia must be accepted, due to the fact that the GDP is monetarily equal to its distribution. In fact, this result was expected because in the analysis only the fiscal variables (as the IS curve shapes the fiscal policy) were taken as independent variables.

The dependence of absolute GDP variation on final private consumption variation is positive and over-unitary, thus 1.56. This means (from the perspective of the partial output of private final consumption in relation to GDP) a marginal propensity towards over-consumption, which can only be explained by the fact that income affected to consumption also comes from sources other than labor income or capital gains (example: could come from consumer credit).

The dependence of absolute GDP variation on the absolute variation of private investment is negative and sub unitary, thus -0.15. This means that the withdrawal of the money supply from the available private investment has a short-term contraction effect on GDP, with the compensatory effect of investments appearing with a certain lag (in this study, but this effect was not taken into account).

Future Directions to Be Approached

In this context, we propose that, in a research development, we should examine by econometrical means the existence of lags in the impact of private invesment on GDP.

A study will also be developed on a possible indifference curve for the absolute GDP change in which the independent variables in this study will be included in a marginal substitution rate. Thus, by calculating the total differential of the equation (7) it can be obtained (be noted):

$$d(dY) = \alpha \cdot dC_{pr} + \beta \cdot dI_{pr} = 0 \quad (8)$$

where:

$\alpha = 1.56, \beta = -0.15$

From the relation (8), it can be obtained:

$$\alpha \cdot dC_{pr} = -\beta \cdot dI_{pr} \quad (9)$$

$$R_{ms} = \frac{dC_{pr}}{dI_{pr}} = -\frac{\beta}{\alpha} \quad (10)$$

where:

R_{ms} – the marginal substitution rate

An important economic indicator for adopting consumer decisions, the marginal substitution rate, is also an important tool for analyzing the variation of the two independent variables studied in this paper.

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