Analysis of the Correlation between GDP and the Final Consumption

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Abstract. *This paper presents the results of the researches performed by the author regarding the evolution of Gross Domestic Product. One of the main aspects of GDP analysis is the correlation with the final consumption, an important macroeconomic indicator. The evolution of the Gross Domestic Product is highly influenced by the evolution of the final consumption. To analyze the correlation, the paper proposes the use of the linear regression model, as one of the most appropriate instruments for such scientific approach. The regression model described in the article uses the GDP as resultant variable and the final consumption as factorial variable.*

Keywords: consumption; model; evolution; variable; economy.

The Gross Domestic Product, seen as one of the main macro-economical aggregates, specific to the National Accounts System, represents the synthetic expression of the results of economic activity produced within the economic territory during a time interval, regardless the contribution of the internal or foreign subjects.

In the analysis made on the factors that determine the variation of the GDP, we have started from the methodological elements specific to the method of final production use (expenses method), considering that it is a significant source of information on the main correlations that influence the evolution of the main macro-economic aggregate.

So, according to the previously mentioned calculation method, the Gross Domestic Product can be determined by summarizing the elements that express the use of goods and services that form the final production, respectively: private (personal) consumption - CP, public consumption – CPL, gross investments – IB or the gross capital formation – FBCF and the net export – EXN, determined as difference between the value of exports and the value of imports.

$$PIB_{pp} = CP + CPL + IB + EXN$$

or

$$PIB = CF + FBCF + VS + (E – I)$$

where:

CF = final consumption;
FBCF = gross formation of fixed capital;
VS = variation of inventories;
E = value of exports;
I = values of imports.

Starting from the previously mentioned elements, we wished to identify the relationship existing in our country between the evolution of the final consumption (regarded as a sum of the two fundamental components – the private consumption and the public consumption) and the variation of GDP. We have used, for analysis, the linear uni-factorial regression method.

To build a linear regression model, we have defined the final consumption as independent variable, while the value of GDP was considered a dependant (resultant) variable. Thus, the regression model can be written under the following mathematical expression:

$$GDP = a + b \cdot CF$$

From the econometric point of view, the considered model must include the residual component too, seen as a representation of the differences that occur between the theoretically determined values and those measured in the real economy.

GDP = a + b · CF + u

where:

GDP = Gross Domestic Product → dependant variable;

CF = Final Consumption → independent variable;

a, b → parameters of the regression model;

u → the residual variable.

To determine the parameters of this model we have considered a dataset regarding the evolution of the two macroeconomic result indicators during the period 1990 – 2009. This information is synthesized in table 1:

Table 1

Evolution of GDP and final consumption in Romania between 1990 and 2009

Year	GDP (million lei)	Final consumption (million lei)
1990	85,70	67,90
1991	220,40	167,20
1992	602,90	464,30
1993	2.003,60	1.523,60
1994	4.977,30	3.845,20
1995	7.213,50	5.866,20
1996	10.891,90	8.993,90
1997	25.292,60	21.861,90
1998	37.379,80	33.746,90
1999	54.573,00	48.436,20
2000	80.377,30	69.253,30
2001	116.768,70	99.473,70
2002	152.017,00	127.118,80
2003	197.427,60	168.818,70
2004	247.368,00	211.057,60
2005	288.954,60	251.038,10
2006	344.650,60	294.867,60
2007	416.006,80	344.937,00
2008	514.654,00	420.872,20
2009	491.273,70	397.273,50

To make a pertinent analysis of the correlation between the two macroeconomic indicators from Table 1, it is necessary to establish in the first step to identify a series of particular characteristics related to the evolution of
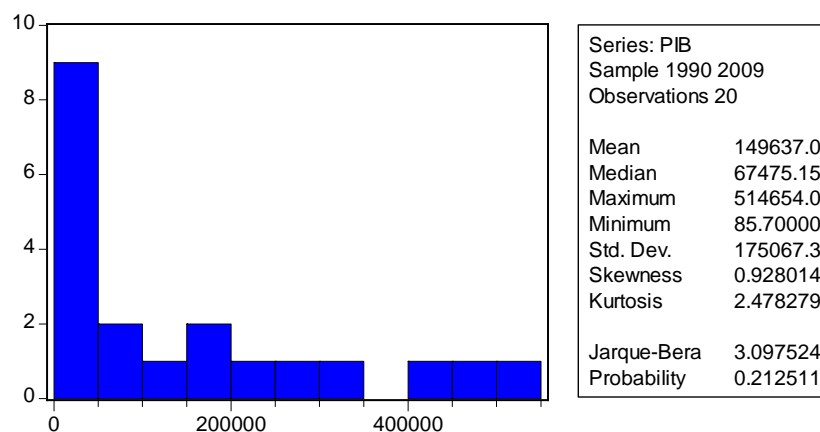
each measure, during the analyzed interval. Therefore, we have studied, with the help of Eviews 5.1., the individual evolution of each of the two indicators.

So, the study of the evolution of Romanian GDP between 1990 and 2009, has allowed the achievement of the following significant information and graphical representations:
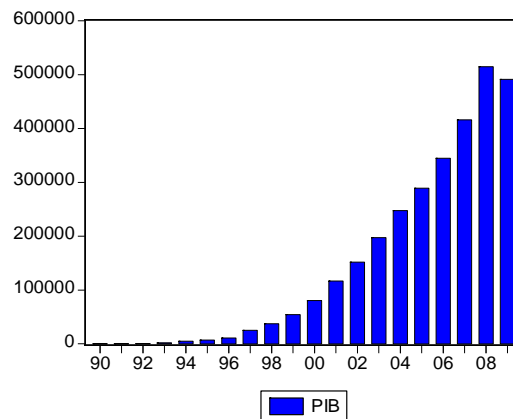
Figure 1. *Evolution of Romania's GDP (PIB) between 1990 and 2009*

As it can be seen both from the analysis of the research data and from the figure 1, during the considered interval, our country's GDP has recorded a constant year-to-year increase, the exception being the very last year of the interval. So, it can be observed that, on the background of the economic-financial crisis that has affected the entire world starting with the second half of 2008, the value of Romania's GDP for 2009 presents a decrease if approximately 4% against the immediately previous time interval.


Series: PIB	
Sample 1990 2009	
Observations 20	
Mean	149637.0
Median	67475.15
Maximum	514654.0
Minimum	85.70000
Std. Dev.	175067.3
Skewness	0.928014
Kurtosis	2.478279
Jarque-Bera	3.097524
Probability	0.212511

Figure 2. *The main statistical tests made on the value of Romania's GDP between 1990 and 2009*

With the help of Eviews 5.1. we have performed a series of statistical tests meant to ensure a more accurate image on the evolution of the GDP of our country during the considered interval. So, we can observe that the average value of this indicator for the interval between 1990 and 2009 is 149.637 millions lei, with a variation between a minimum value of 85,7 millions lei (at the end of 1990) and a maximum value of 514.654 millions lei (at the end of 2009).
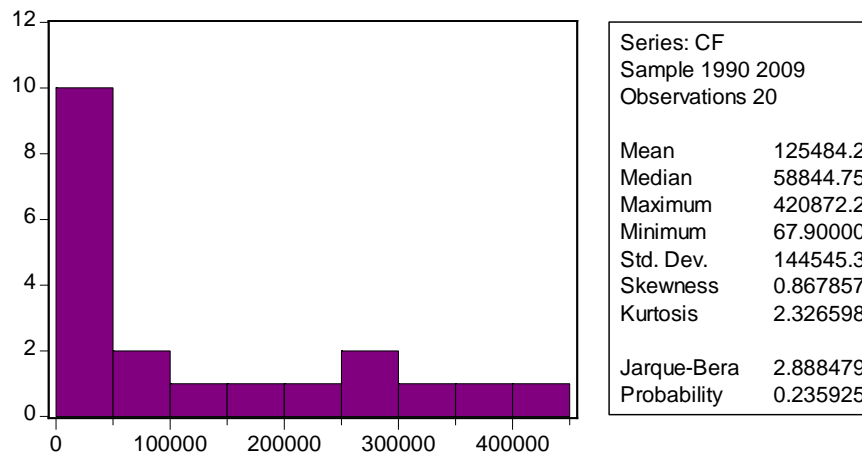
The values of the statistical tests allow us to state that the distribution of the values of GDP for the considered interval is not perfectly symmetrical (the value of the skewness is not zero), the distribution being more likely flat (kurtosis < 3). Also, it can be ascertained that, inside the considered data series, the values between the minimum and the average of the series are far more numerous than those included in the second half of the variation interval for the researched indicator.

A similar analysis can be made regarding the evolution of the final consumption (public and private) during the time interval between 1990 and 2009. The main elements achieved following the analysis with Eviews 5.1. are presented in Figure 3:
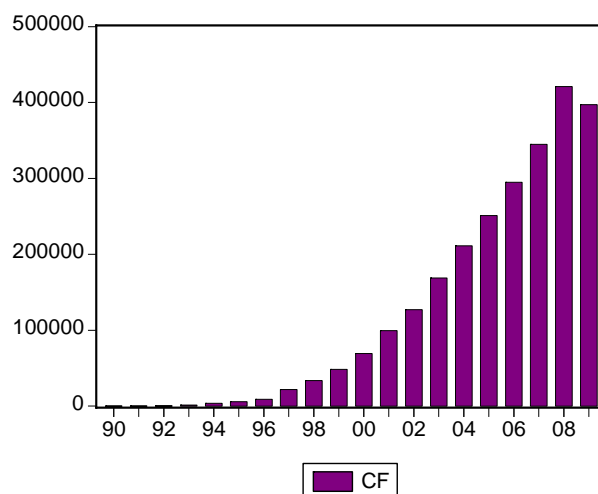
Figure 3. *Evolution of the final consumption in Romania between 1990 and 2009*

The graphic in Figure 3 allows us to conclude that, during the research interval, the consumption had an accentuate evolution, with significant increases, from one period to another. Similar to those ascertained for the evolution of GDP, it can be seen that the year 2009 presents an anomaly versus the general rule of evolution for the final consumption in our country. So, we observe that it is the single interval in which the value of the indicator decreases comparatively to the previous time period.

Series: CF
Sample 1990 2009
Observations 20

Mean	125484.2
Median	58844.75
Maximum	420872.2
Minimum	67.90000
Std. Dev.	144545.3
Skewness	0.867857
Kurtosis	2.326598
Jarque-Bera	2.888479
Probability	0.235925

Figura 4. *Statistical tests made on the Romanian final consumption between 1990 and 2009*

In Eviews, we have determined the variation interval of the research interval, establishing that the value of the final consumption is enclosed between 67.9 millions lei, in 1990 and 420,872 millions lei, at the end of 2008. Also, we were able to state that the average value of this indicator for the period between 1990 and 2009 is 58,844.75 millions lei.

As it can be seen, the values for the Skewness and Kurtosis tests allow us to affirm that the distribution is not symmetrical, being predominant the values between the minimum and the average of the data series.

From the previous analyses, we extracted a very important conclusion regarding the modality of analysis for the correlation between the two indicators. It is observed that the evolution of the indicators is very similar; with accelerate increases for the interval between 1990 and 2008 and a decrease of approximately 4- 5% in the final year of the research interval. Also, it can be observed that the statistical tests performed upon the data series for the indicators are almost identical. Based on these ascertainments, we can state that between the value of the GDP and the value of the final consumption there is a strong interdependence.

To confirm this statement, and to identify the typology of the regression function, we have represented the pairs of points that reflect the correspondent values of GDP and final consumption (Figure 5).
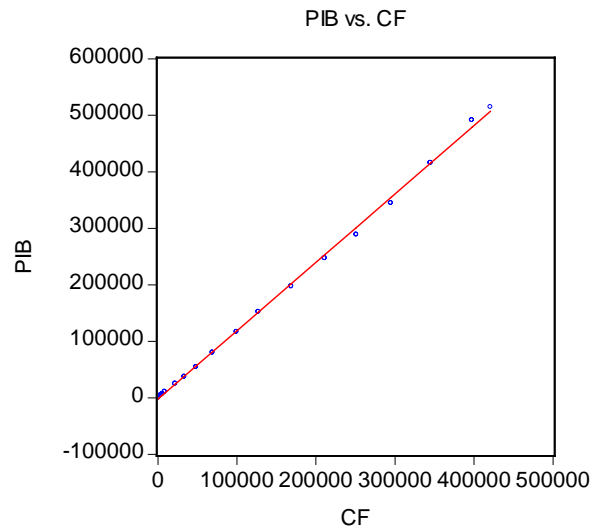
Figura 5. *Correlation GDP – final consumption*

As it can be seen from Figure 5, the pairs of pints GDP –final consumption describe almost perfectly the trajectory of a line, allowing us to state that the uni-factorial linear regression model can describe with good results the relation between the two indicators.

The main model of each regression model is the determination of the parameters, operation that can be made by using the least squares method. In this approach, we start from the equation of the simple linear regression model

y = a + bx + u
t =1,n

where:

$\hat{y}_t$ = the theoretical values of the y variable obtained only depending on the values of the essential factor x and the values of the estimators for the parameters a and b, respectively $\hat{a}$ and $\hat{b}$;

$u_t = y_t - \hat{y}_t = (a - \hat{a}) + (b - \hat{b})x_t \rightarrow$ estimations of the values of the residual variable.

The least squares method assumes the minimization of the following function:

$$F(\hat{a},\hat{b}) = \min\sum_{t=1}^{10}(y_t - \hat{y}_t)^2 = \min\sum_{t=1}^{10}(y_t - \hat{a} - \hat{b}x_t)^2$$

The minimum condition of the function results from:

$$F'(\hat{a}) = 0 \Rightarrow n\hat{a} + \hat{b}\sum x_t = \sum y_t$$

$$F'(\hat{b}) = 0 \Rightarrow \hat{a}\sum x_t + \hat{b}\sum x_t^2 = \sum x_t y_t$$

To estimate the parameters of this regression model, we have used Eviews 5.1., defining the equation that has as resultant variable the Gross Domestic Product, and as factorial variable the value of the final consumption. Also, we have considered that this model will include a free term, c. The estimation method set in the program is the least squares.

The Eviews 5.1 processing provided the following results:

Dependent Variable: PIB				
Method: Least Squares				
Date: 10/11/10 Time: 04:56				
Sample: 1990 2009				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2268.559	1701.196	-1.333509	0.1990
CF	1.210555	0.009017	134.2531	0.0000
R-squared	0.999002	Mean dependent var		149637.0
Adjusted R-squared	0.998947	S.D. dependent var		175067.3
S.E. of regression	5681.209	Akaike info criterion		20.22236
Sum squared resid	5.81E+08	Schwarz criterion		20.32193
Log likelihood	-200.2236	F-statistic		18023.91
Durbin-Watson stat	0.479777	Prob(F-statistic)		0.000000

To interpret the results obtained from the linear regression model, it is necessary to establish, since the beginning, if this can be considered as correct, and if the results it offers can be used in real macroeconomic analyses.

The probability that the model is correct is very high – approximately 99.9%, this conclusion being drawn from the results provided by Eviews for the tests: R – squared (0.9990) and Adjusted R – squared (0.9989).

Also, the viability of this regression model is confirmed by the values of the F – statistic test (18023.91 – far above the table level considered to be a mark in viability analysis for econometric models), and also by the null degree of risk (given by the value of the Prob F – statistic test).

Based on the previous elements, we can consider that the regression model that describes the correlation between the value of GDP and the final consumption is correct, accurately reflecting the real evolution of the two macroeconomic indicators. So, it is possible to write the linear regression models as:

PIB = - 2268,5 + 1,21 CF

The regression model allows us to establish a set of aspects regarding the relationship existing between the two considered variables. It can be seen that a significant relationship exists between the evolution of the GDP value and the value of final consumption, in Romania, between 1990 and 2009. So, an increase by one monetary unit of the final consumption will lead to an increase by 1.21 monetary units of the GDP value.

The above presented situation can be considered as normal when knowing that, in our country, the economic growth in the last years was based exclusively on a policy of consumption stimulation, especially for its private component.

Also, we can conclude that, to surpass the present economical – social crisis moment, in Romania shall be limited the measures that directly and negatively affect consumption (i.e. the major salary decreases in the late period or the firings of personnel from public administration).

The analysis of the regression model cannot be complete without mentioning that the free term indicates the fact that the factors not included in the model have a high influence on the value of GDP. The negative value of the free term reveals that the variables not included in the model have, as a whole, a negative effect on the GDP evolution.

Based on the elements presented, we can draw the conclusion that Romania's GDP is influenced, mainly, by the evolution of the public and private consumption.

References

Andrei, T., Bourbonais, R. (2008). *Econometrie,* Editura Economică, Bucureşti

Anghelache, C., Mitruţ. C, Bugudui, E., Deatcu, C. (2010). *Econometrie*, Editura Artifex, Bucureşti

Anghelache, C., Mitruţ C., Voineagu V. (2010). Sistemul *Conturilor Naţionale. Sinteze şi studii de caz,* Editura Economică, Bucureşti

Anghelache, C., "The Gross Domestic Product evolution", *Revista Română de Statistică,* nr. 3/2010-supliment

Anghelache C., Bugudui E., Deatcu C. (2010). *Statistică generală şi economică,* Editura Artifex, Bucureşti

Anghelache C., Anghelache G.V., „Metode econometrice de prognozare a utilizării finale a PIB", *Revista Română de Statistică*, nr. 12/2010-supliment

Anghelache C., „Macroeconomic indicators used in international comparability", *57th Conference „Statistics – past, present and future"*, Durban, 2009

Goodwin, N.R., "Macroeconomics for the Twenty-First Century", *Tufts University, series GDAE Working Papers,* no. 03-02, 2008

Institutul Naţional de Statistică, „Anuarul Statistic al României"