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Econometric Analysis Model of the Correlation between Final Consumption and Gross Disposable Income

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Abstract

This article highlights the effective possibilities for the use of linear regression model to analyze the evolution of final consumption. In this context, I consider this indicator as a dependent variable, whose variation is significantly determined by the evolution of gross disposable income as a parameter of social and economic life of a country. To emphasize the practical aspects related to the use of linear regression in macroeconomic analysis we developed a practical study in which we defined as independent variable gross disposable income in the economy of Romania, in the period 1990-2014. Data on a yearly frequency was used, and to ensure data comparability I have deflated it, taking as a basis the year 1990. The objectives of this analysis is to determine the function that best describes the relationship of the two indicators, observing the relation that is established between them and estimating an valid and statistically significant econometric model.

Keywords: Final Consumption, Gross Disposable Income, Regression, Model, Variable

Introduction

Aggregate demand and implicit of consumption in any economy is conditioned by the size of disposable income. In Romania's case, this principle is reinforced by very large share of final consumption in GDP, approximately 70%.

Final consumption consists of the value of purchases made by private households and public sector activities results that do not represent changes in the size of the material heritage sector.

Private consumption includes all purchases made by population and private organizations without lucrative character because for the private households no accumulation stands out so no goods patrimony either. The purchase of durable goods (capital) are treated as private consumption except housing construction, construction materials, processed goods in households, products used for insemination, which represents intermediary consumption.

State consumption is determined by reducing public sector production value with the collections from the sale of public services and investment in their own activities. Production value of public sector is represented by the public sector current expenditure with its

employees, depreciation of capital goods and intermediate consumption. In the public sector depreciation is calculated only for construction, equipment and machinery.

Income is an important determinant of consumption, by size and dynamic, it constitutes the main source of purchase of the economic goods.

Gross disposable income measures the income available to the nation for the performing of the final consumption and savings operations. Gross economy is part of the gross disposable income which is not subject to final consumption expenditure.

In this article, we highlighted the effective possibilities for the use of linear regression model to analyze the evolution of final consumption. In this context, I consider this indicator as a dependent variable, whose variation is significantly determined by the evolution of gross disposable income as a parameter of social and economic life of a country. To emphasize the practical aspects related to the use of linear regression in the analysis of the macroeconomic developments in general and the analysis of the final consumption, in this particular case, we have developed a practical study in which we defined as the independent the variable gross disposable income in the economy of Romania.

The choice of these indicators as benchmarks in the regression analysis was not coincidental. So, I started this research approach to finding that income is the main vector of growth for the level of the final consumption by the state.

Methodology of Research

Simple linear regression model is a relatively easy and highly effective way of determining the correlation between two economic indicators. Thus, macroeconomic research use of this method of analysis allows the determination of how a certain economic variables defined as independent, determines the evolution of a second results indicator.

Based on the aforementioned elements we have identified the relationship that exists at Romania level between the evolution of the final consumption (regarded as a summation of the two fundamental components - private consumption and public consumption) and change in gross disposable income. To this end we used as a method of simple linear regression analysis.

The main problem for any regression model is the model parameter estimation, an operation which can be carried out using least squares method (Least Squares). In doing so, it starts from simple linear regression model equation:

$$y_t = a + b \cdot x_t + \varepsilon_t; t = 1, 2, \dots, 25 \quad (1)$$

Where:

\hat{y}_t = theoretical values of y variable obtained only according to values of the essential factor x and the estimative values of the parameters a and b, respectively \hat{a} and \hat{b} .

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

Least squares method involves the minimization of the following function:

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

The minimum condition of this function results from:

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

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

Results

Data

To analyze the correlation between selected variables we used data on Romania, who have a yearly basis, covering the period 1990-2014 and were collected by the National Institute of Statistic's publications, and to ensure that data are comparable, I have deflated, taking as 1990 base.

This information can be summarized in table form

Table 1

Evolution of final consumption and gross disposable income in Romania during 1990-2014

Year	Final consumption (comparable prices) million lei	Gross disposable income (comparable prices) million lei	Year	Final consumption (comparable prices) million lei	Gross disposable income (comparable prices) million lei
1990	68.0	86.5	2003	79.5	95.4
1991	61.9	83.8	2004	88.9	107.5
1992	55.3	73.0	2005	97.0	113.0
1993	51.0	69.0	2006	106.9	126.7
1994	54.4	71.9	2007	118.3	144.2
1995	62.7	78.1	2008	134.2	166.5
1996	69.3	84.6	2009	122.9	155.3
1997	66.1	77.0	2010	121.2	152.1
1998	64.1	71.6	2011	118.8	154.2
1999	63.1	73.4	2012	121.8	157.3
2000	62.0	73.0	2013	122.2	160.4
2001	66.2	79.3	2014	128.3	165.3
2002	69.0	86.3			

Source: Romanian Statistical Yearbook, NIS, Bucharest, 2008, 2009, 2010, 2011, 2014

The Econometric Analysis

In order to achieve the analysis of correlation between the two indicators is necessary the identification of the particularities that regards the evolution of each scale considered in the specified time interval. In this regard, by using Eviews 7.2 I studied in a first stage the individual evolution of the two indicators.

Thus, studying the evolution of the final consumption of Romania during 1990-2014 allowed us to obtain the following information and significant graphics:

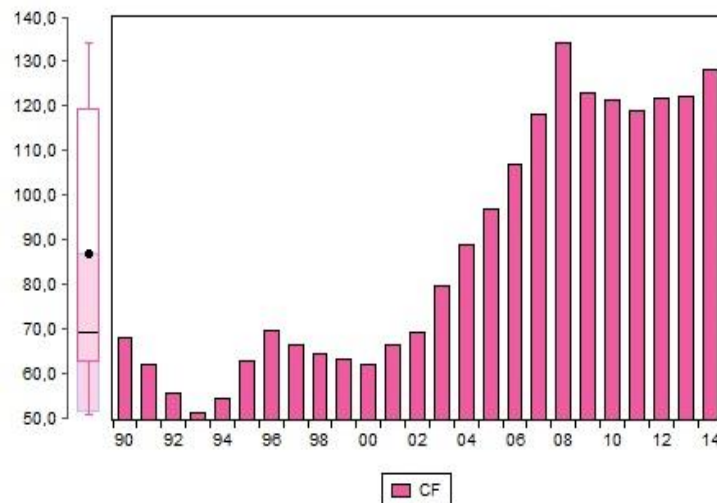


Chart 1. Evolution of final consumption in Romania during 1990-2014

As can be seen from analyzing the data series subjected to the research, and especially in the graph above, within the timeframe considered, the final consumption in Romania has seen a steady increase from year to year, with small fluctuations increases and decreases from 1990 until 2008, when it is found that, amid the financial crisis that has affected the whole world since the second half of 2008, the final consumption of Romania for 2009 has showed an decrease compared to the immediately preceding interval. Starting from 2012 until 2014 there is an increase in final consumption by 2.5% in 2012 compared to 2011, with 0.3% in 2013 compared to 2012 and by 5% in 2014 compared to 2013.

With Eviews 7.2 software package we performed a series of statistical tests to ensure an accurate picture of the evolution of final consumption in the period under review.

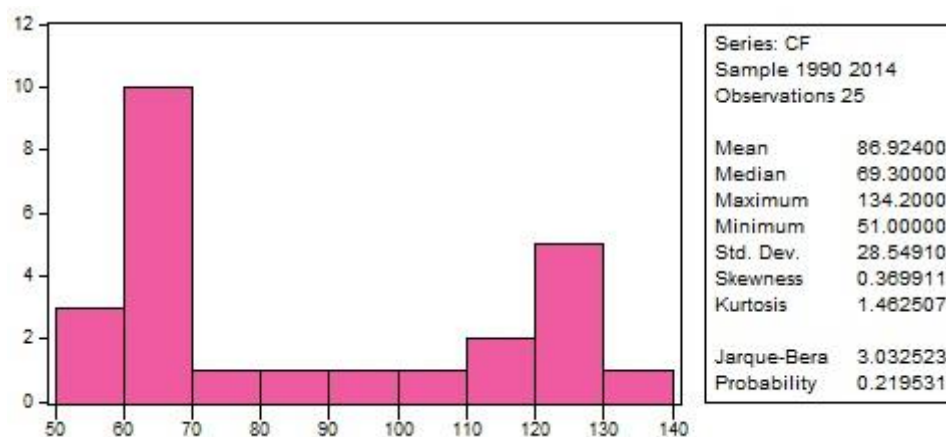


Chart 2. Statistical tests performed on the final consumption of Romania in the period 1990-2014

With Eviews we determined the range of variation of the investigated indicator, establishing that the value of final consumption falls from 51 million lei in 1993 to 134.2 million lei at the end of 2008. We have also been able to establish that the average value of

this indicator for the period 1990-2014 is 86.924 million lei. As you can see, the values of Skewness and Kurtosis tests allow us to state that the considered distribution is not perfectly symmetrical, predominant values located between the minimum and average values of the data series.

A similar analysis can be performed in terms of gross disposable income developments within the timeframe considered. Key information obtained from the analysis performed using the software Eviews 7.2 can be presented as follows:

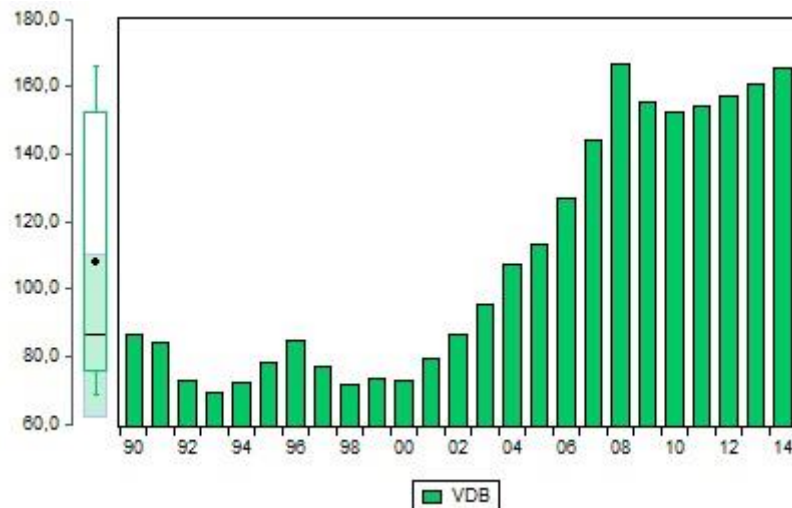
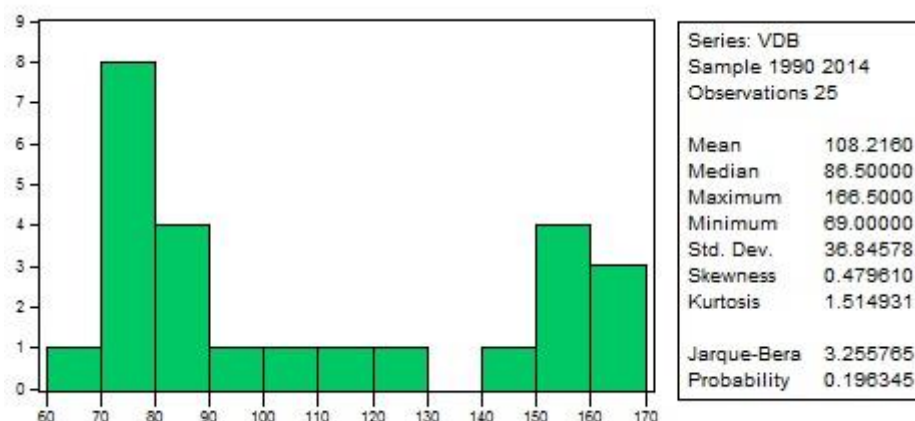


Chart 3. Evolution of gross disposable income in Romania during 1990-2014

Previous graphical representation helps us to affirm that the gross disposable income indicator registered small fluctuations, small increases and decreases in the time period covered by this research, but overall we observe an accentuated trend from one year to another. Similar observations seen at the final consumption development are also noticed in the evolution gross income.



Graph 4. Statistical tests performed on Romania's gross disposable income in the period 1990-2014

Thus, we can say that the average value of this indicator for the period 1990-2014 is 1087.216000 million lei, with a range between a minimum of 69 million lei (recorded at the end of 1993) and a maximum of 166, 5 million lei (at end 2008).

The values of the statistical tests previously conducted allow us to state that the distributions of gross disposable income for the period is not considered perfectly symmetrical (Skewness test value is zero), because Skewness test value is greater than zero we can say that the distribution is inclined to the left, with more extreme values to the right. Kurtosis test value being less than 3 means that we have a platikurtic distribution, flatter than a normal distribution, having values dispersed on a bigger interval around the average. The probability of extreme values is lower than a normal distribution.

From the two previous analyzes it was possible to get a very important conclusion on the analysis of the correlation between the two indicators of the research - final consumption and gross available income. Thus, it notes that the evolution of the two macroeconomic indicators is very similar, with sharp increases for the period 1990-2008, a decrease in the next two years and a return of the two indicators until the last year included in the time frame under investigation. Also, it can be seen that the statistical tests performed on the data sets for the two indicators are almost identical. Based on these findings, we can say that the value of final consumption and gross disposable income is highly interdependent.

Both to confirm this statement and to better image the data in Table 1 will proceed to their graphic representation in a two-dimensional coordinate system, the gross disposable income is entered as an independent variable horizontally and final consumption vertically as a dependent variable. The result of that representation, in Figure 5, gives an overview which is helpful in the intuition of the relationship between the two variables. The graph cloud of points of the pairs that includes the values of consumption and gross disposable income is as follows:

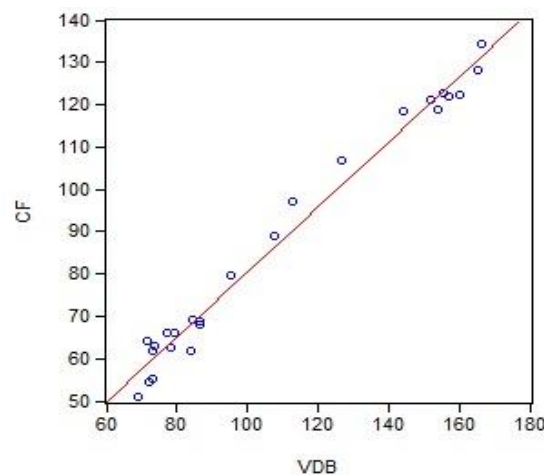


Chart 5. Correlation final consumption-gross disposable income

As can be seen from the chart above, the pair of points almost perfectly describe a straight path, so it is possible to analyze the phenomenon studied using simple linear regression model. Based on the graphic representation can be said that between final consumption and gross disposable income, there is a direct and linear form.

To build a linear regression model we defined gross disposable income as an independent variable, while the value of final consumption was considered a dependent variable (the result). So, regression model may be given under the following mathematical equation:

$$CF = a + b \cdot VDB \quad (3)$$

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

$$CF = a + b \cdot VDB + \varepsilon \quad (4)$$

Where:

- CF = final consumption → dependent variable (explained, endogenous, outcome);
- VDB = gross disposable income → independent variable (explanatory, exogenous);
- a, b → regression model parameters;
- ε → residual variable.

Dependent Variable: CF				
Method: Least Squares				
Date: 08/05/15 Time: 17:59				
Sample: 1990 2014				
Included observations: 25				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.791172	2.403207	1.577547	0.1283
VDB	0.768212	0.021066	36.46662	0.0000
R-squared	0.982998	Mean dependent var		86.92400
Adjusted R-squared	0.982259	S.D. dependent var		28.54910
S.E. of regression	3.802585	Akaike info criterion		5.585858
Sum squared resid	332.5720	Schwarz criterion		5.683368
Log likelihood	-67.82322	Hannan-Quinn criter.		5.612903
F-statistic	1329.814	Durbin-Watson stat		0.388278
Prob(F-statistic)	0.000000			

Figure 1. The results of the regression model parameter estimates

To interpret the results using linear regression model is necessary to establish, from the start, whether it can be regarded as correct and the results that it provides can be used in real macroeconomic analysis.

As you can see, the probability that this model is the correct one is very high - about 98.3%, this conclusion can be made based on the values determined by using Eviews for R-squared (0.982998) and Adjusted R-squared (0.982259) tests. In this example, the gross disposable income, x, explains the variation of final consumption, y, in a proportion of 98.3%. Resulting situation can be regarded as normal in the conditions in which it is known that the income is the main source of consumption.

Also, the validity of this regression model is confirmed by the F-statistic tests values (1329.814 - value far superior from the table level which is considered to be benchmark in the analysis of the validity of econometric models), the statistics value of F and t, corresponding to the regression slope verify the relationship $t^2 = F$, and also the degree of null risk (reflected by the value of the Prob F-statistic test).

For each independent and constant variable, Eviews reports the coefficient standard error, t-Statistic test and the associated probability. Working at 5% level of relevance, as the probability attached to the t-statistical test is below this level for VDB, than the coefficient is considered statistically significant. Free term coefficient is not significant because the probability attached to the t-statistical test is superior to the materiality threshold of 5%.

Based on the foregoing, we can consider the regression model that describes the correlation between the value of final consumption and gross disposable income as a fair, faithfully reflecting the real evolution of the two macroeconomic indicators. It is possible to transcribe the unifactorial linear regression model in the following form:

$$CF = 3.791172 + 0.768212 \cdot VDB$$

This regression model allows us to establish a number of issues concerning the relationship between the two variables considered. Thus, we can say that with the increase of one million lei of the gross disposable income, the final consumption will increase by 0.768212 million lei, so between the two variables studied there is a direct relationship. It is noted that between the two indicators studied in the period 1990-2014 there is a significant direct relation.

The positive free term (C) leads to the assertion that the indicators that were not taken into account when building the regression model contributed positively to the development of the final consumption. Even though, this model is well chosen and can be used properly, it can be further developed and deepened in order to ensure better results.

The correlation coefficient $r_{y/x} = 0.99146$ indicates a strong and direct relation between the two variables.

$$r_{y/x} = \sqrt{R^2} = \sqrt{0.982998} = 0.99146.$$

To check the meaning of the linear correlation coefficient t (student) test is applied, by calculating of the t_{calc} variable from the relation:

$$t_{calc} = \frac{r_{y/x}}{\sqrt{1-r_{y/x}^2}} \times \sqrt{n-2} ;$$

(5)

Where: $r_{y/x}$ = linear correlation coefficient;

n = number of pairs of values observed = 25.

$$t_{calc} = \frac{0.99146}{\sqrt{1-0.982998}} \times \sqrt{25-2} = 36.47$$

With a 95% probability and for 23 freedom degrees $t_{tabelat}$ has the value of 2.069. Because $|t_{calc}| > |t_{tabelat}|$, $|36.47| > |2.069|$ it can be appreciated that the hypothesis of the correlation significance is checked and that between the researched variables there is a significant relation, so $r_{y/x}$ is statistically significant and the analyse model is specified correctly.

Conclusions and Recommendations

The purpose of this article is to estimate the gross disposable income influence on the evolution of final consumption in Romania using correlation analysis and regression. In this context, we used simple linear regression to analyze the evolution of final consumption and developed a practical study in which we defined as independent variable the gross disposable income in the economy of Romania, in the period 1990-2014. The statistical data used were collected from publications made available by the National Institute of Statistics of Romania.

After the analyze, the result was that between final consumption and gross disposable income there is a linear connection (points are placed on the first bisecting direction), direct (positive slope of the regression line) and strong as being measured by the correlation coefficient $r_{y/x} = 0.99146$. The report determination confirms that the gross disposable income is a determining factor for final consumption growth, this influencing the variation of the final consumption rate of 98.3%.

The validity of this regression model is confirmed by the F-statistic tests values, higher value of the table level that is considered to be benchmark in the analysis of the validity of econometric models and also the null risk degree reflected by the value of Prob F-statistic test witch indicates a high significance of the estimation results, respectively of the analyzed model.

Based on the previous analyzes, we can say that the gross disposable income influences decisively the final consumption.

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