

Econometric Modeling of Final Consumption by Linear Multifactorial Regression

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Abstract *The interest of this article is the research of the final consumption in Romania, during 1990-2014. The article analyzes the final consumption correlated with the evolution of households and government consumption. To study the correlation between the three variables, the article suggests using multifactor model to explain the variation in final consumption based on the simultaneous influence of the two indicators mentioned above. In this model the final consumption is considered as a resultative variable and the households and government consumption as factorial variables. Data on a yearly frequency was used covering the period 1990-2014 and to ensure comparability of data we have it deflated, taking as a basis 1990.*

Key words Final consumption, household consumption, government consumption, regression, model, evolution

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1. Introduction

Biji, Lilea, Roșca, Vătui (2010), Anghelache (2008), Isaic-Maniu, Mitruț and Voineagu (2005), Anghelache and contributors (2007) provides a detailed overview of the consumption concept in contemporary economic context.

Consumption is that part of income spent on goods and services for the direct satisfaction of needs of the population and/or general needs of the society.

Final consumption includes all the expenditure that enables direct satisfaction of human needs, individual and collective. Depending on the subject of consumption, it is divided into two categories: household consumption and government consumption.

The household consumption includes, according to international statistical practice, all material goods and services purchased by population (private households) including those from its production in order to meet needs. The personal consumption is a major component of the quality of life, of the standard of living. The volume, the structure, the quality and the personal consumption dynamics outlines the degree of satisfaction of the multiple physiological, spiritual and social needs of the population.

The government consumption includes consumption of central and local administrative government institutions made for the public services performing. In other words, the government consumption (of the state) includes those expenditures made for social services administration which is available to the community without a special payment. This consumption can be quantified by summing the expenses of consumed or purchased goods for provision of public services (intermediate consumption of the state), depreciation of fixed capital, salaries in the public sector etc.

The increasing complexity of economic phenomena specific to the contemporary world caused a fundamental change in the typology of the analyzes performed on this field. Today, we speak less about the strict analysis of the evolution of a particular micro or macroeconomic indicator, focusing increasingly on the analysis of the existing correlations between the evolutions of two or more indicators specific to the economic system.

The objectives of this analysis are to determine the function that best describes the relationship of the three indicators, to observe the relation that is established between these three and to estimate a valid and statistically significant econometric model.

2. Methodology of research

The article presents the analysis of a possible relation of dependency between the value of final consumption, household consumption and the government consumption in Romania, in the period 1990-2014. The econometric description of the relation between the three variables can be done by using a multifactor model to explain the variation of the final consumption based on the simultaneous influence of the two indicators mentioned above:

$$y_i = f(x_{1i}, x_{2i}) + \varepsilon_i \quad (1)$$

In this context it is particularly important to specify and analyze the relationship between the three macroeconomic indicators using a multifactor regression model. From the mathematical point of view it can be transcribed as follows:

$$y_i = b_0 + b_1 \cdot x_{1i} + b_2 \cdot x_{2i} + \varepsilon_i, \quad i=1, 2, \dots, T \quad (2)$$

Where:

y - endogenous or resultative variable: final consumption (mil. lei);

x_1 - exogenous or causal variable: household consumption (mil. lei);

x_2 - exogenous or causal variable: government consumption (mil. lei);

ε - error variable (residual), random that sums up the influence of other variables on the final consumption, which are not specifically described in the model and are considered to be random factors with insignificant influence on the result variable;

b_0, b_1 și b_2 - unknown real parameters that we want to estimate.

We have T observations (25 years) on y, x_1 and x_2 .

The multifactorial linear model identified above can be written as a matrix as follows:

$$Y = X \cdot B + \varepsilon \quad (3)$$

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \begin{pmatrix} 1 & X_{11} & \cdots & X_{1k} \\ 1 & X_{21} & \cdots & X_{2k} \\ \vdots & \vdots & & \vdots \\ 1 & X_{n1} & \cdots & X_{nk} \end{pmatrix} * \begin{pmatrix} b_0 \\ b_1 \\ \vdots \\ b_k \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{pmatrix}$$

Where:

$n = 25 \rightarrow$ number of available observations;

$k = 2 \rightarrow$ number of exogenous variables.

The regression function matching the considered model, written as a matrix equation is:

$$\hat{Y} = X \cdot \hat{B} \quad (4)$$

To estimate the parameters we use the least squares method (LSM - Least Squares). For linear multifactor model this method involves minimizing the function:

$$F(\hat{B}) = \min \sum_{t=1}^n \varepsilon_t^2 = \min (Y - X \hat{B})^2 = \min (Y^T Y - 2 \hat{B}^T (X^T Y) + \hat{B}^T (X^T X) \hat{B})$$

which involves determining the derivative function regarding \hat{B} estimator and its cancellation:

$$(X^T X) \hat{B} = X^T Y.$$

The analysis of the contribution of each factor on an economic result that evolves differently from one year to another, while the factors are found simultaneously in different proportions in every economic result, shows interest also because the multifactorial approach is realistic and the interaction of the factors and conditions in which the process is developing are also taken into account, even indirectly.

Multifactor regression model offers a number of advantages compared to the unifactorial alternative: a more accurate description of the analyzed economic process because it is conducted under the impulse of the simultaneous action of several important factors, information on the structure of the process by quantifying causal relations, increasing the numerically expressed determination degree by its proximity to 1 (or 100%) of the determination report.

3. Results

3.1. Data

To analyze the correlation between selected variables we used data with a yearly frequency, starting in 1990 until 2014, regarding Romania, data that were published by the National Statistics Institute. The values of these variables were deflated using in this regard the consumer price index (used by National Institute of Statistics to calculate the inflation rate in Romania) which reflects the evolution of the goods prices and final services tariffs purchased by the population in the current year compared to 1990, chosen as the reference period.

3.2. The econometric analysis

In this article we identified the main factors of the influence of the final consumption's evolution in Romania during 1990-2014 and their influence was estimated using correlation and regression analysis. The first step consisted in selecting the variables that described the evolution of the final consumption, namely household and government consumption.

Multiple linear regression models can also be used in the Romanian economy. To build the linear multiple regression models we defined private consumption and public consumption as independent variables, while final consumption value was considered a dependent variable (the result).

The three indicators can be presented in summary form as follows:

Table 1. Evolution of final consumption, of household and government consumption in Romania between 1990-2014

Year	Final consumption (comparable prices) million lei	Household consumption (comparable prices) million lei	Government consumption (comparable prices) million lei
1990	68.0	55.8	12.2
1991	61.9	49.0	12.9
1992	55.3	44.7	10.6
1993	51.0	42.4	8.6
1994	54.4	44.5	9.9
1995	62.7	51.9	10.8
1996	69.3	58.0	11.3
1997	66.1	56.3	9.8
1998	64.1	59.1	5.0
1999	63.1	59.1	4.0
2000	62.0	56.8	5.2
2001	66.2	61.0	5.2
2002	69.0	63.5	5.6
2003	79.5	70.4	9.1

Year	Final consumption (comparable prices) million lei	Household consumption (comparable prices) million lei	Government consumption (comparable prices) million lei
2004	88.9	80.6	8.2
2005	97.0	87.6	9.3
2006	106.9	97.3	9.6
2007	118.3	107.4	10.9
2008	134.2	121.7	12.5
2009	122.9	109.8	13.1
2010	121.2	110.5	10.7
2011	118.8	109.3	9.5
2012	121.8	112.0	9.8
2013	122.2	110.9	11.4
2014	128.3	115.0	13.2

Source: Statistical Romania Yearbook - Gross domestic product, by categories of uses, NIS, Bucharest, 2008, 2009, 2010, 2011, 2014

For multiple regression model parameters estimation we used the software Eviews 7.2, where we defined the equation that has as resultative variable the final consumption (CF) and as factorial variables household consumption (CP) and government consumption (CPL). I also thought that this regression model will contain the free term C, planning to reflect the influence of the terms that were not considered when building the model. The estimation method defined in the software is least squares method - Least Squares.

The results obtained by using Eviews 7.2 are as follows:

Dependent Variable: CF
 Method: Least Squares
 Date: 07/16/15 Time: 16:31
 Sample: 1990 2014
 Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.022720	0.038298	-0.593228	0.5591
CP	1.000097	0.000380	2629.857	0.0000
CPL	1.002014	0.003875	258.6122	0.0000

R-squared	0.999998	Mean dependent var	86.92400
Adjusted R-squared	0.999997	S.D. dependent var	28.54910
S.E. of regression	0.046931	Akaike info criterion	-3.168092
Sum squared resid	0.048456	Schwarz criterion	-3.021827
Log likelihood	42.60115	Hannan-Quinn criter.	-3.127524
F-statistic	4440556.	Durbin-Watson stat	1.826056
Prob(F-statistic)	0.000000		

Figure 1. The results of the regression model parameter estimates

From the above, multiple regression model describing the relationship between macroeconomic indicators covered in this article may be given in the form of equation as follows:

$$CF = - 0.02272 + 1.000097 \cdot CP + 1.002014 \cdot CPL$$

As can be seen, household and government consumption are significant influence factors in the evolution of the final consumption in Romania.

It is noted that in this case household consumption growth with one million lei will lead to final consumption growth with 1.000097 million lei, while maintaining the other variables constant. For government consumption, the difference is not big, so it can be determined that, in Romania, every million lei spent in public scheme brings an increase of 1.002014 million lei in final consumption levels, the other factors included in the model remaining constant.

There is therefore a direct relationship between the final consumption and household consumption, respectively government consumption in Romania in the period 1990-2014.

C, free term, so b_0 coefficient is -0.02272 and shows the average level of the dependent variable when all the explanatory variables level is zero. So the final consumption that would be obtained if household and government consumption was not made, would be -0.02272 million lei. It should be noted that the influence of the free term as image of the factors that were not included in the econometric analysis model, causes a reduction in the value of final consumption.

From the point of view of statistical tests that verify the accuracy of the econometric model considered, it can be seen that the values of tests R^2 and R^2 - adjusted are very close to the maximum ($R^2 = 99.99\%$, and R^2 adjusted = 99.99%) which allows us to say that the analyzed model is correct and with a minimum risk for an economic analysis.

The determination report shows that 99.99% of the variation in the dependent variable is explained by the simultaneous variation of household and government consumption in Romania during 1990-2014, namely a strong relation between the endogenous variable and the two exogenous variables, as confirmed by the adjusted coefficient of determination (adjusted R-squared = 0.9999), which takes into account the number of sightings and the number of exogenous variables. The correlation report ($R = 0.9999$) tending towards 1 demonstrates that the estimated regression model approximates observation data very well, with high reliability.

The validity of the regression model is confirmed by the F-statistic test value, value that is superior to the table level which is considered to be benchmark in the analysis of the validity of econometric models and also the value of the test Prob(F-statistic) which is zero.

For each independent and constant variable, Eviews reports the coefficient's standard error, t-Statistic test and its associated probability. Working at 5% level of relevance, as the probability attached to the t-Statistical test is lower for both exogenous variables, the coefficients are considered statistically significant. The free term coefficient is not significant because the probability attached to the t-Statistical test is higher than the threshold of 5%.

4. Conclusions and recommendations

The multiple regression analysis has followed the evolution of final consumption in terms of changing household and government consumption in Romania. The statistical data used were collected from publications made available by the National Institute of Statistics of Romania and covers the period 1990-2014. A linear relationship between the variables subject to the research was identified. A positive influence on the evolution of the final consumption was the household consumption; the regression coefficient for this indicator had the value of 1.000097 and the government consumption, with a regression coefficient of 1.002014. Estimated multiple regression model proved to be a precise one, having a determination ratio close to 1 and suggest a strong dependence between the resultant variable final consumption and the factorial variables included in the model. Finally, test the value of Prob (F-statistic) is zero, which confirms the claims above, whereby an econometric regression model using the resultant variable final consumption, and as factorial variables household and government consumption is a correct one and it, can be used to predict the economic developments in Romania.

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