Multiple Regressions Used in Analysis of Private Consumption and Public Final Consumption Evolution

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Abstract	This paper approaches the evolution of the final consumption recorded at the level of the Romanian economy. The main variable of the analysis is the final consumption, which the authors assume to be influenced by the private consumption and the public consumption. The correlation between the main parameter and its influence factors is analyzed through a regression model, designed with the help of Eviews. The model is tested using standard methods and the results of the tests are also commented within the article.
Key words	Consumption, public, private, econometric, parameters

1. Introduction

The private consumption and the public consumption are two of the factors that contribute to the calculation and, thus, the evolution of the Gross Domestic Product. According to the statistical methodology, the public and private consumption are two of the components of the final consumption. The study of the correlation between the main indicator, that is the final consumption, and its two influence factors can be analyzed, simply, by using an approach based on the balance method of economic analysis. But, the econometric methods offer a more detailed set of results upon their proper application in such instance. The model we propose in this paper is designed according to the best practices in econometric applications and we have used the EViews software to estimate the parameters of the model. We have focused on multiple regressions, which estimate the combined action of the two factors, representing a source of information which offers further insight from the simple regressions that could be designed for each type of consumption.

2. Literature review

The use of econometric models in macroeconomic analysis has been approached by Anghelache (coord., 2014), who focused, mainly, with the utility of econometric models in calculating and forecasting macroeconomic indicators, a chapter is dedicated to the use of multiple regression models, also Anghelache *et al.* (2014) are preoccupied with the application of this class of models. The researches and works of Anghelache (2008), Voineagu *et al.* (2007) provided the basis of statistical and econometric instruments and concepts included in our research. A thorough analysis of consumption in Romania is presented by Anghelache (2014). Censolo and Colombo (2008) study the composition of the public consumption in a growing economy; we consider that the Romanian economy is generally perceived as growing. Bastagli and Hills (2013) develop on the households' consumptions and the correlation between private and public consumption. Scutaru *et al.* (2009) focus on the study of the two components of the consumption from the perspective of the GDP. Various aspects of public and private consumption were also approached in the works of Wolff *et al.* (2003), Mir Nahid and Mansur (2012), and Bachman (2011).

Analysis of the contribution of each factor on a different indicator of economic results that evolves from one year to another, while the factors manifest simultaneously in different proportions, is interesting to be done for any macroeconomic result indicator, including the final consumption of a country (Anghelache, 2014). The multifactorial approach (Anghelache, 2014) is realistic and describes the interaction of factors and conditions, taken into account even indirectly.

Multifactor regression model (Anghelache *et al.* 2014) offers a number of advantages compared to unifactorial alternative: a more accurate description of the economic process analyzed because it is conducted under the assumption of the simultaneous action of several important factors, it generates information on the structure of the process by quantifying causal links, increasing determination ratio, numerically expressed by its proximity to 1 (or 100%).

A significant argument in using multiple linear regression can be considered to be the high enough value of free quotient (as the influence of the other influence factors that were not included in the model) that could be specific to be encountered in single factor approaches, where the main indicator keeps is role as dependent variable and the influence factors become, in turn, independent variables in distinct, dedicate models.

3. Research methodology. Dataset

Multiple linear regression model can be used in macroeconomic analyses the Romanian economy, and it can complement analyses performed using proper simple linear models. To build a linear multiple regression model we have defined the private consumption and the public consumption (Bachman 2011, Bastagli and Hills 2013, Censolo and Colombo 2008, Scutaru *et al.* 2009, Wolff *et al.* 2003, Mir Nahid and Mansur 2012) as independent variables, while final consumption value was considered a dependent variable (the result). To analyze the correlation between selected variables, we used a dataset with annual frequency, starting in 1990 until 2014 on Romanian economy, data that were published by the National Statistics Institute. The values of these variables were deflated using the consumer price index this regard (by regulations of the National Institute of Statistics, this index is used to calculate the inflation rate in Romania, as stated by Anghelache (2008), reflecting the evolution of prices and tariffs of goods and services purchased by the population in the current year compared to 1990, chosen as a reference comparison year. The structure of the dataset is presented in the table below:

Table 1. Evolution of final consumption, private and public consumption in Romania during 1990-2014

Year	Final consumption (comparable prices) million RON*	Private consumption (comparable prices) million RON*	Public consumption (comparable prices) million RON*
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
2004	88,9	80,6	8,2

Year	Final consumption (comparable prices) million RON*	Private consumption (comparable prices) million RON*	Public consumption (comparable prices) million RON*
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

* Romanian currency, at the level of 1 $ = 4.00 RON on August 5th, 2015

Source: Statistical Yearbook of Romania - gross domestic product by category of uses, NIS, Bucharest, 2008, 2009, 2010, 2011, 2014.

Based on this information, we have analyzed the existence of any correlation between the value of final consumption (resultant variable y), on the one hand and private consumption (causal variable x_1) and public consumption (causal variable x_1).

The econometric approach (Voineagu *et al.*, 2007) allows three separate models to be defined in order to describe the correlation between these variables:

- A single linear regression model that is supposed to explain the variation in final consumption achieved on private consumption in Romania;

- A single linear regression model that would explain the variation in final consumption based on the change in public consumption level achieved in Romania;

- A multifactorial regression model to explain the variation of final consumption based on the simultaneous influence of the two indicators used in single regressions described above.

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:

$$y_i = b_0 + b_1 \cdot x_{1i} + b_2 \cdot x_{2i} + \varepsilon_i \tag{1}$$

4. Research results. Econometric model

We have chosen Eviews 7.2 software to estimate the multiple regression model, in which the three variables were defined in compliance with the role assigned to each one: the resultant is the final consumption (CF) and the factorial variables are the value of private consumption (CP) and the public consumption (CPL). Also, to emphasize the existence and influence of other factors, not considered in this model, we have included the free term C. The estimation of the parameters is based on the least squares method. The processing by Eviews 7.2 returned the following results (figure 1).

From the figure 1, the multiple regression model describing the relationship between macroeconomic indicators subject of this research may be given in the following equation:

CF = - 0,02272 + 1,000097 · CP + 1,002014 · CPL

As it can be observed, the amount of private and public consumption is macroeconomic factors that significantly influence the final consumption trends in Romania.

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

It is to be retained that in the case of this model, private consumption increase by one million RON will lead to the growth of final consumption by 1,000,097 RON, while maintaining the other variable constant. For public consumption, the difference is not great, being able to determine that, in Romania, every million RON spent in public scheme brings an increase of 1,002,014 RON of final consumption level, as the other factor included in the model remained stable.

We therefore conclude that there is a direct relationship between final consumption and private and public consumption in Romania respectively for the reference interval 1990-2014. The conclusions drawn allow us to state that the use of multifactor regression models is recommended in all macroeconomic analysis.

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 tests are very close to the maximum value (R^2 = 99.99%, and adjusted R^2 = 99.99%) which leads to the conclusion that the model is correct and can be used with minimum risk for macroeconomic analysis or forecasts.

The coefficient of determination shows that 99.99% of the variance in the dependent variable is explained by the simultaneous variation of private and public consumption in Romania during 1990-2014, i.e. a strong link is established between endogenous variable and two exogenous variables, as confirmed by the coefficient the determination adjusted (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 the observation data very well, with high reliability.

The validity of the regression model is also emphasized by the test F value - statistically superior value to the table level, used to assess the validity of econometric models, and also by the fact that the value of the test sample (F - statistic) is zero.

For each independent variable and constant coefficient, Eviews provided the standard error, t-statistic test and the associated probability. Working at the level of relevance of 5%, as the data processing shows that probability attached to statistical t-test this level is lower for both exogenous variables, the coefficients are to be considered statistically significant. Free term coefficient is not significant because the probability attached of its statistical t-test is higher than 5% significance limit.

Finally, the value of Prob (F-statistic) test is zero, which confirms the conclusions stated above, whereby the designed econometric regression model, using as resultant the final consumption and as factorial variables the public and private consumption, is correct and reliable, therefore it can be used to make accordingly reliable forecasts for the Romanian economy.

5. Conclusions

Based on all information gathered from the analysis of Romania's final consumption using the regression model described above, we conclude that this indicator is significantly influenced by changes in private and public consumption.

The authors wish to state that the reliability of the multiple regression model designed in this paper does not exclude the possibility to analyze, in parallel, the single correlations between the indicators, as described above.

The model is representative for the purpose of this research, and it accurately describes the relationship between the final consumption and its factors: household consumption and public consumption.

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