

The Correlation Analysis Between the Public Debt, the Budget Deficit and GDP in Romania

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Abstract:

The way in which the state manages the public debt represented always and will continue to represent a subject of real importance, and the discussions regarding the level of budget deficit, the degree of indebtedness and their implications on social prosperity are of important actuality as much as national level as also at European Union level. In this paper it is presented the dependence between the Romanian public debt and its budget deficit, the dependence between the Romanian public debt and its GDP, in tandem with the ARX model time variation, rendering evident the residuum.

Keywords: public debt, budget deficit, GDP

JEL: H62, H63

1. Introduction

According to a prestigious international world wide organization, The World Economic Forum, based on a public report regarding the economic situation of European Union member states concerning the prosperity level and the economic development, Romania occupies the last place (Brezeanu, 1998; Andrei & Bourbonnais, 2008 Stancu, Andrei, Iacob & Tusa, 2008; Dumitru, Budică & Motoi, 2016). Concerning the level of economic performance, Romania is unfortunately surpassed even by Bulgaria. In these circumstances Romania is situated among the last countries in European Union with the perspective of achieving the 2020 Europe Strategy objectives, being situated at a significant distance from her Nordic colleague, Sweden (Matei & Marcel, 2008; Moistica Preda, 2009; Dima, 2014). As we can see in the Table 1, Romania has reached a budget deficit of 2,96% from GDP in 2012, and 2,22% from GDP, in 2013. Comparing the percentages realized by Romania in 2013, in what regards the budget deficit, with those realized by countries with a strong economic growth as Holland, Sweden and Denmark we can say that the Romania budget deficit as a GDP percentage, is one close to that of Holland, it is 0,89% bigger than the one of Sweden and with 1,84% bigger than that of Denmark. Unfortunately, same as Hungary, Romania has not succeeded to achieve in any year budget excess. However, in 2014, Romania was one of the E.U. member states which had budget excess. The biggest value of Romanian budget deficit, between 2000-2013 was in 2009, and the lowest, in 2004. Concerning the public debt, Romania has reached a percentage of 37, 46% from GDP in 2012, and one of 37,44% from GDP in 2013, reduced by 0,02% from the precedent year. Unlike Romania, Holland's public debt, in 2013, is almost double. Up against Sweden, Romanian public debt is by 0,23% smaller, and regarding Denmark, the Romanian public debt has decreased by 7, 56%.

In what regards our western neighbor, Hungary has a public debt larger than Romania by 76,06%. The Romanian public debt has registered the lowest value in 2000, and the highest in 2013.

Table 1. Romania's Budget deficit, GDP and public debt between 2000-2013

Year	Budget deficit		GDP Millions Euro	Public debt Millions Euro
	Millions Euro	%GDP		
2000	-1.897,30	- 4,65	40.797,20	7.532,80
2001	-1.582,70	-3,47	45.503,50	10.917,20
2002	-973,00	-1,99	48.810,90	10.757,10
2003	-786,20	-1,48	52.931,60	10.309,50
2004	-744,30	-1,21	61.404,50	11.768,70
2005	-923,60	-1,15	80.225,60	12.397,60
2006	-2.186,60	-2,22	98.418,60	12.585,60
2007	-3.632,50	-2,89	125.403,40	14.763,00
2008	-7.940,60	-5,57	142.396,30	17.158,60
2009	-10.677,30	-8,86	120.409,20	27.970,50
2010	-8.424,10	-6,64	126.746,40	37.451,20
2011	-7.288,70	-5,46	133.305,90	44.688,30
2012	-3.973,30	-2,96	133.806,10	50.128,60
2013	-3.224,00	-2,23	144.664,40	54.170,00

Source: Eurostat

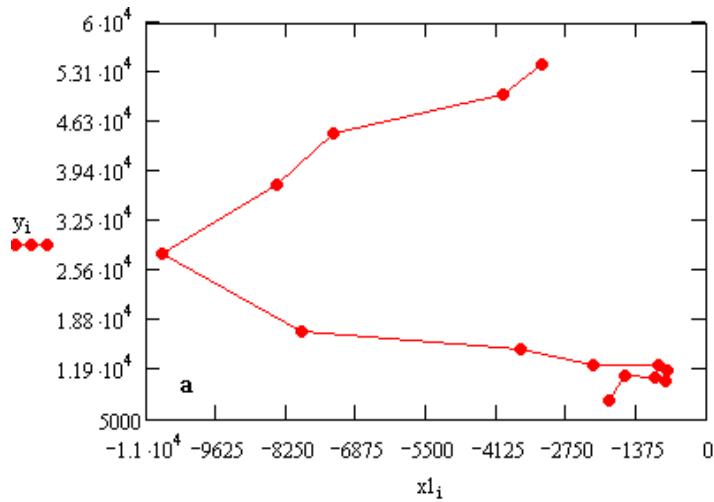


Figure 1. Dependence graphic between Romania's public debt and budget deficit

Source: Author processing

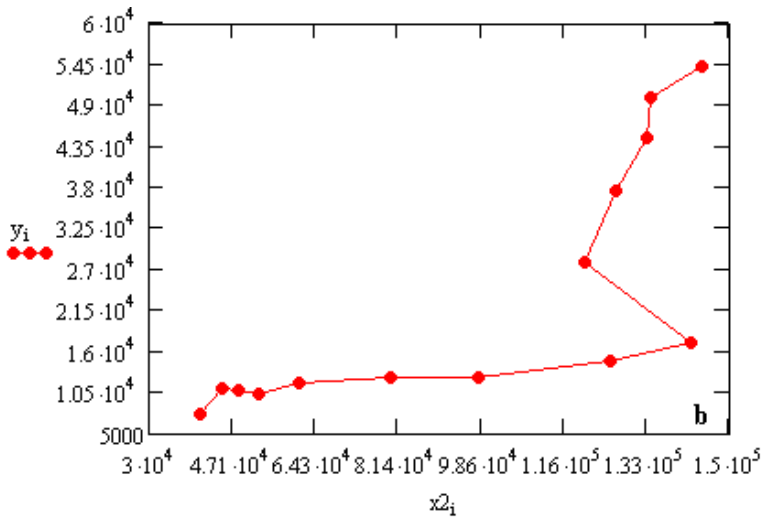


Figure 2. Dependence graphic between Romania's public debt and its GDP

Source: Author processing

From Figure 1 and Figure 2 it can be observed that the relation which settles the link between dependent variable Y (public debt) and the independent variable X^1 (budget deficit), respectively the independent variable X_2 (GDP), it is one nonlinear which determines the utilization of a nonlinear regression

model. Also, it can be observed that the analyzed it is a MISO type model (more entry variables and only one output variable).

The dependence analysis between the three variables is realized with the help of an **ARX** type model, because this model brings the best results to approximate the data series of the three variables which come between the model's frames. The **ARX** model parameters will be determined with the help of least squares method (LSM), using EViews program. The **ARX** model is described in this case, by the following equation:

$$y_t = c_1 \cdot y_{t-1} + c_2 \cdot y_{t-2} + c_3 \cdot y_{t-3} + c_4 \cdot y_{t-4} + c_5 \cdot (x_1)_{t-1} + c_6 \cdot (x_1)_{t-2} + c_7 \cdot (x_2)_{t-1} + c_8 \cdot (x_2)_{t-2} + c_9 \cdot (x_2)_{t-3} + e_t \quad (1.1)$$

The **ARX** model parameters (**4, 2, 3, 1**), c_1, c_2, \dots, c_9 will be determined with the help of least square method. The values of these coefficients are:

$$\begin{aligned} c_1 &= -0,109066; c_2 = 0,9800226; c_3 = -0,5197041; \\ c_4 &= 0,4891018; c_5 = -2,269792; c_6 = -0,165641; \\ c_7 &= -0,0511268; c_8 = -0,0433414; c_9 = 0,03357105 \end{aligned} \quad (1.2)$$

Table 2. The estimated values of the ARX model parameters (4,2,3,1)

Dependent Variable: Y Method: Least Squares Date: 05/28/15 Time: 15:16 Sample (adjusted): 2004 2013 Included observations: 10 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	0.602113	0.455258	1.322576	0.4121
Y(-2)	0.137883	0.242420	0.568777	0.6708
Y(-3)	-0.519704	0.364915	-1.424180	0.3897
Y(-4)	0.462543	0.308675	1.498477	0.3746
X1(-1)	-0.080853	0.476413	-0.169713	0.8930
X1(-2)	-0.600425	0.573896	-1.046226	0.4856
X2(-1)	0.105393	0.123902	0.850623	0.5513
X2(-2)	0.360313	0.137108	2.627954	0.2315
X2(-3)	-0.228304	0.229695	-0.993944	0.5019
R-squared	0.996486	Mean dependent var	68515.25	
Adjusted R-squared	0.968371	S.D. dependent var	10232.86	
S.E. of regression	1819.858	Akaike info criterion	17.34832	
Sum squared resid	3311882.	Schwarz criterion	17.62065	
Log likelihood	-77.74160	Hannan-Quinn criter.	17.04958	
Durbin-Watson stat	2.931724			

Source: Author processing

For seeing how strong the link between the analyzed variables is, we calculated the R correlation report. After the conducted calculations we obtain the value of R 0,998241. The R value close to 1 indicates a very strong direct link between public debt, budget deficit and GDP.

From table 2 it can be observed that R-squared is 0, 99. The high value of this indicator demonstrates that the public debt dynamic between 2000-2013 it is well specified through included variables in the models frame.

The standard errors (Std. Error) of the estimated parameters are calculated. These errors are used for the t statistics calculations in order to test the parameters signification. All these are calculated in the t-statistic column as a report between the coefficient and the standard error. Because the associated p values are close to 0 (Prob.), it can be said that the estimators are significant.

On the other hand, in the table there are presented the values of the two criteria: Akaike criterion and Schwartz criterion, these values presenting the fact that the chosen model is a very good one.

2. Five scenario

The **Durbin-Watson** test is applied for verifying the hypotheses through which the residuum series are uncorrelated. The actual value of this statistic

(DW=2, 931724) is compared with the table values of this statistic. In this case, for a significance threshold of 5%, and for a number of 15 observations, the table values of the Durbin-Watson statistic are $d_1=0,95$ $d_2=1,54$. Because the test is accomplished, one can conclude that the residuum series are independent.

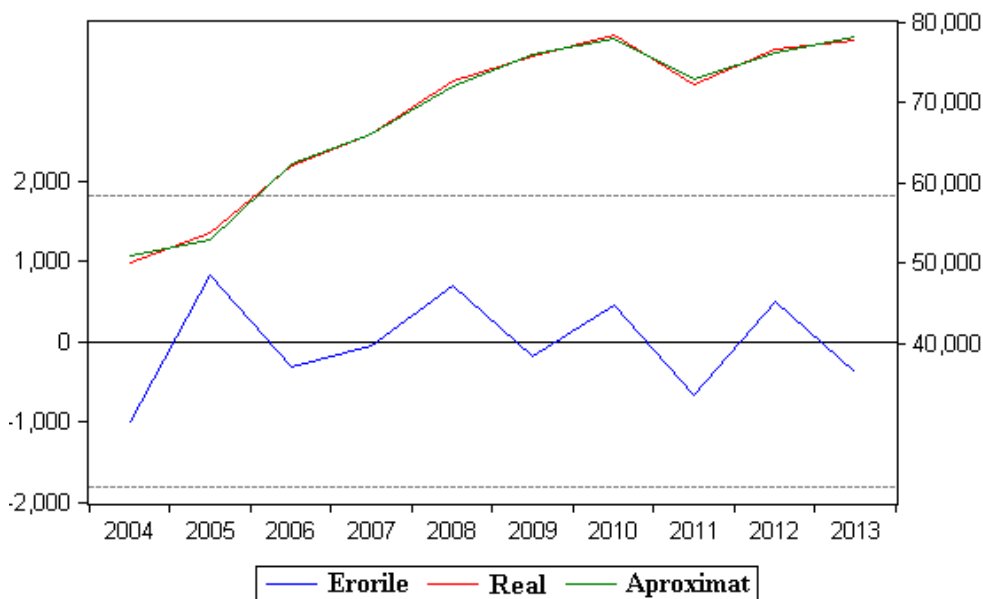


Figure 2. The time variation of the real public debt series for Romania (red), in tandem with the variation in time of the ARX model (green), highlighting the residuum (blue)

Source: Author processing

In figure 2, it is shown a comparison between Romania's public debt variation in time and the ARX model variation in time. As it can be observed in the residuum graphic, the proposed model has a good approximation, the residuum being small enough.

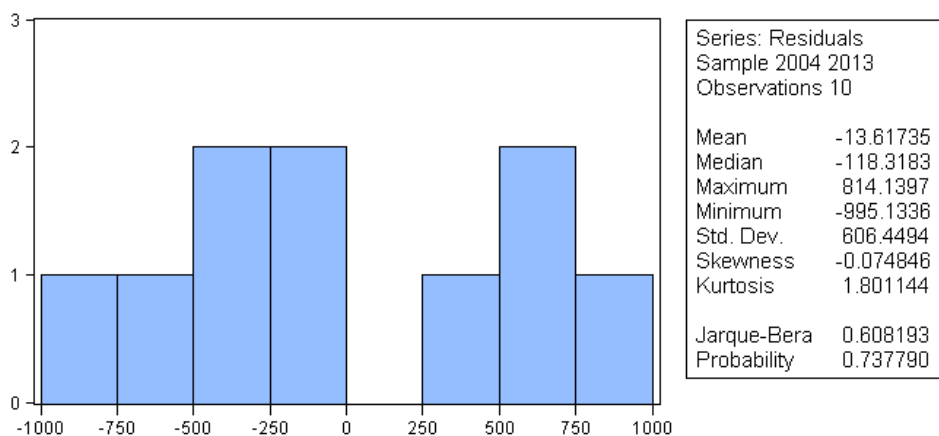


Figure 3. The Histogram and the characteristics of the estimated residuum
Source: Author processing

In order to verify the residuum normality, hypothesis one will be apply the Jarque-Berra test. Utilizing the Eviews programs packet we can ascertain that the calculated value of this statistic is $JB = 0,608193$. The table value of the statistic χ^2 for a significance threshold of 5% and for a number of 10 observations (see Figure 3), is 3,940. Comparing the calculated value of the Jarque-Berra statistic, with the statistic table value χ^2 , it can be observed that $JB < \chi^2$, that is to say the residuum normality hypothesis is accomplished. Based on the ARX model equation we will analyze if the ascending tendency of a variable implies an ascending tendency, descending or none tendency of the others variables (Spircu & Ciumara, 2007; Stoicuța & Mândrescu, 2012; Voinea, Busu, Opran & Vladutescu, 2015). Based on the obvious link between the model variables, we will realize more scenarios regarding the output variable values from model's frame, depending on the imposed values of the two other values which enter in the model (Duran, 2006; Dima & Man, 2015; Zhuravskaya, M., Morozova, E., Anashkina & Ingaldi, 2016).

In other words, we will study the public debt modification depending on the budget deficit modifications and/or on those of GDP.

Scenario 1: Will be determined the estimated value of the public debt in 2014 based on the data from Table 1, utilizing the ARX model equation (1.1):

$$y_{2014} = c_1 \cdot y_{2013} + c_2 \cdot y_{2012} + c_3 \cdot y_{2011} + c_4 \cdot y_{2010} + c_5 \cdot (x_1)_{2013} + c_6 \cdot (x_1)_{2012} + c_7 \cdot (x_2)_{2013} + c_8 \cdot (x_2)_{2012} + c_9 \cdot (x_2)_{2011} \quad (1.3)$$

Based on the data obtained, it can be observed that the public debt in 2014 will be 37.567,39 million euro given that the budget deficit in 2013 represents 2,23% of GDP, and the GDP is 144.664,40 million euro.

Scenario 2: Will be determined the estimated value of the public debt for 2014 based on the data from Table 1, using the ARX model equation (1.1), given that the budget deficit in 2013 will decrease with 1% from GDP, that is 3.182,6 million euro, and the GDP will remain unchanged.

Based on the relation (1.3), we will obtain a public debt value of 37.483,63 million euro. It can easily be observed that the Romanian public debt for 2014, is decreasing by 0,22% (comparing with the obtained value in the first scenario), given that the GDP remains unchanged for the precedent year, and budget deficit decreases with 1%.

Scenario 3: Will be determined the estimated value of the public debt for 2014 based on the Table 1 data, utilizing the ARX model equation (1.1), given that the budget deficit in 2013 will remain unchanged, and the GDP will grow with 10%.

In the specified conditions in this scenario, the public debt of Romania will decrease at 36.827,7 million euro, that said with 1,97% comparing with the estimated value in the first scenario. One can conclude that along with the GDP growth with a certain percentage (10% in this case), the public debt of Romania will decrease, given that the budget deficit does not change. This conclusion is correct from an economic perspective, the GDP growth leading to public debt decrease, when it is desired.

Scenario 4: Will be determined the estimated value of the public debt in 2014 based on the Table 1 data, utilizing the ARX model equation (1.1), given that the budget deficit in 2013 will grow with 1% from GDP, and the GDP will grow by 10%.

From this relation (1.3), given the specified conditions in this scenario, we will obtain a public debt value of 36900, 96 million euro. It can be observed that at a budget deficit growth of 1% from GDP, and at a GDP growth of 10%, this does not lead to a public debt decrease but at a growth of it by 0,19% from the obtained value in the precedent scenario. Practically, if the deficit grows with the GDP's growth, but in a smaller percentage, the public debt decreases compared with the estimated value in the frame of the first scenario, but grows compared with the obtained value in the Scenario 3, where only the GDP grows with 10%.

Scenario 5: Will be determined the estimated value of the public debt for 2014 based on the Table 1 data, using the ARX model equation (1.1), given that the budget deficit in 2013 will grow with 1% from GDP, and the GDP will decrease by 2%.

Based on this relation (1.3), we will obtain a public debt value of 37.492,33 million euro. In this case, it can be observed that public debt value is close to the obtained value in the scenario 2 (greater by 0, 02%), there where the GDP decreases by one percentage. This growth is owed equally, to budget deficit growth by 1%.

Based on the five scenario analyzed previously, one can conclude that Romania's public debt will decrease given that the Romania's GDP is growing with a certain percentage, and the budget deficit will decrease with a certain percentage. From an economic perspective this conclusion is the most plausible, given that it is desired a decrease of the public debt. But, on the other hand, a public debt decrease does not signify a higher standard of living or a life improvement (Ristea & Trandafir, 2005; Văcărel, 2007; Moșteanu, 2011).

3. Conclusions

In this article is presented the dependence analysis between Romania's public debt through a period of 14 years, and its budget deficit and GDP. As a result of this analysis, as also from the proposed scenarios previously, regarding the managing way of the public debt level for Romania, it is observed that, depending on the government's complaints to grow or to decrease the public debt, this is not reflected in the living standard growth for the Romania's population. We can observe this from the situation review of some countries, where the public debt is very large comparing with the one in Romania, but the living standard/capita it is much higher than in our country. In other words, the Romania's public debt must be kept under control, first for respecting the imposed normative through the Growth and Stability Pact (GSP) of E.U., through which the budget deficit cannot exceed 3% from GDP, and its public debt cannot exceed 60% from GDP, and second along with the growth of GDP and the decrease of budget deficit, this can be reduced from year to year.

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