CORRELATION ANALYSIS BETWEEN THE PUBLIC DEBT AND THE BUDGET DEFICIT AND GDP IN ROMANIA COMPARED TO SWEDEN

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ABSTRACT: *The modality in which the state manages the public debt has always represented and will continue to represent a subject of real importance, and the discussions regarding the level of budget deficit, the indebtedness degree and its implications on the social wellness are representing a big actuality at national level as also at European Union level. In this paper is presented a comparative analysis between Romania and Sweden in what regards the dependence between public debt and budget deficit and its GDP, as also the real public debt's variation in time series for Romania and Sweden, in tandem with the variation in time of ARX model, highlighting the residuum.*

KEY WORDS: *public debt, budget deficit, GDP.*

JEL CLASSIFICATION: *H62, H63.*

According to an impressive international world wild 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, Holland occupies the first place in classification, and Romania occupies the last place. Concerning the level of economic performance, Romania is unfortunately surpassed even by Bulgaria. In these circumstances Romania is situated among the last countries in the European Union with the perspective of achieving the 2020 Europe Strategy objectives.

Performing an analysis for the table 1 it can be observed that between 2000-2013 Romania has registered only budget deficit, touching a maximum of -8.86% deficit in 2009 and a minimum of -1.15% in 2005. Concerning Romania's public debt,

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it had an ascending trend, touching a percentage of 37.46% from GDP in 2012, and 37.44% from GDP in 2013, in decrease with 0.02% comparing with the preceding year. In table 1 is presented Sweden's situation regarding budget deficit, its GDP and public debt.

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

Year	Budget deficit		GDP	Public debt	
	Million Euro	%GDP	Million Euro	Million Euro	%GDP
2000	-1897.30	- 4.65	40797.20	7532.80	18.46
2001	-1582.70	-3.47	45503.50	10917.20	23.99
2002	-973.00	-1.99	48810.90	10757.10	22.03
2003	-786.20	-1.48	52931.60	10309.50	19.47
2004	-744.30	-1.21	61404.50	11768.70	19.16
2005	-923.60	-1.15	80225.60	12397.60	15.45
2006	-2186.60	-2.22	98418.60	12585.60	12.78
2007	-3632.50	-2.89	125403.40	14763.00	11.77
2008	-7940.60	-5.57	142396.30	17158.60	12.04
2009	-10677.30	-8.86	120409.20	27970.50	23.22
2010	-8424.10	-6.64	126746.40	37451.20	29.54
2011	-7288.70	-5.46	133305.90	44688.30	33.52
2012	-3973.30	-2.96	133806.10	50128.60	37.46
2013	-3224.00	-2.23	144664.40	54170.00	37.44

Source: Eurostat

Table 2. Sweden's budget deficit, GDP and public debt between 2000-2013

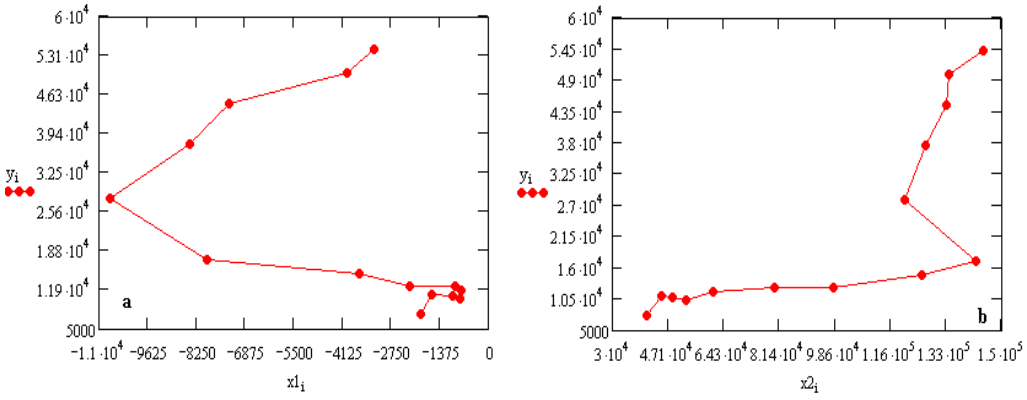
Year	Budget deficit		GDP	Public debt	
	Million Euro	%GDP	Million Euro	Million Euro	%GDP
2000	9119.00	3.23	281859.30	138267.80	49.05
2001	3853.00	1.43	267758.30	138134.40	51.58
2002	-4121.70	-1.46	280520.50	140086.00	49.93
2003	-3853.10	-1.31	293444.50	144885.90	49.37
2004	1003.30	0.32	307433.40	148918.10	48.43
2005	5672.30	1.81	313218.00	149305.50	47.66
2006	7315.10	2.18	334876.50	147983.10	44.19
2007	11897.20	3.33	356434.30	133497.60	37.45
2008	6882.30	1.95	352317.10	114554.40	32.51
2009	-2222.30	-0.71	309678.70	129307.20	41.75
2010	-107.60	-0.02	369076.60	144195.40	39.06
2011	-320.40	-0.07	404945.50	148033.10	36.55
2012	-3917.30	-0.92	423340.70	156193.90	36.89
2013	-5821.10	-1.33	436458.30	164420.20	37.67

Source: Eurostat

In the analyzed period Sweden has registered budget deficit and also budget excess. The highest budget deficit has been registered in 2002 at -1.46% and the lowest in 2010 at -0.02%. Budget excess has been registered between 2000-2001 and 2004-2008. Sweden's public debt had also an ascending trend, touching a percentage of 36.89% from GDP in 2012, and one of 37.67% from GDP in 2013, growing by 0.78% from the precedent year.

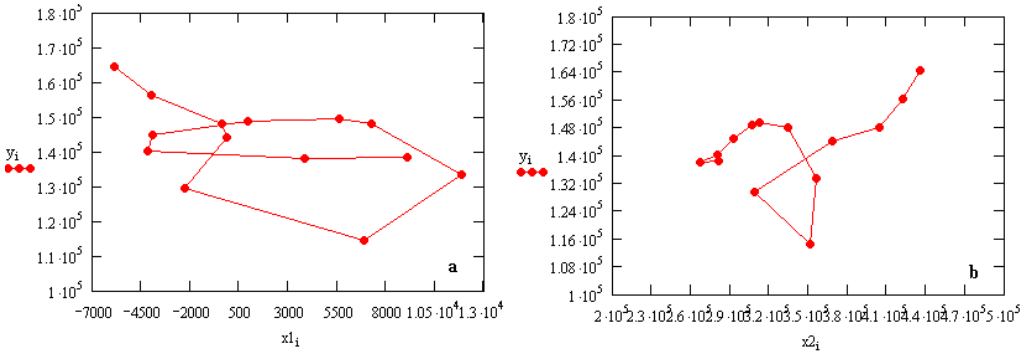
Comparing the percentages achieved by Romania in 2013 regarding the budget deficit, with those achieved by countries with a strong economic growth as Sweden, we can say that Romania's budget deficit as percentage from GDP, it is double comparing to Sweden.

Comparing the percentages achieved by Romania and Sweden in 2013, regarding the indebtedness degree, we can say that Romania's public debt as percentage from GDP, is approximately equal with the one registered by Sweden.



Source: Author processing

Figure 1. The dependence chart between: (a) Romania's public debt and its budget deficit, (b) Romania's public debt and its GDP



Source: Author processing

Figure 2. The dependence chart between: (a) Sweden's public debt and its budget deficit, (b) Sweden's public debt and its GDP

From figure 1 and figure 2 we can observe that the relation which determines the link between the dependent variable Y (public debt) and independent variable X_1 (budget deficit), respectively the independent variable X_2 (GDP), it is a nonlinear one which determines the use of a nonlinear regression model. Also it can be observed that the analyzed model is a MISO type model (more input variables and only one output variable).

The dependence model between the three variables it is realized with the help of an ARX type model, because this model gives the best results for approximating data series for the three variables which intervene in the model's frame. The ARX model parameters will be determined with the help of least square method (LSM), using the EViews program.

The ARX model is described in Romania's case, by the following equation:

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

and for Sweden by the following equation:

$$y_t = c_1 \cdot y_{t-1} + c_2 \cdot y_{t-2} + c_3 \cdot y_{t-3} + c_4 \cdot y_{t-4} + c_5 \cdot (x_1)_{t-1} + c_6 \cdot (x_1)_{t-2} + \\ + c_7 \cdot (x_2)_{t-1} + c_8 \cdot (x_2)_{t-2} + c_9 \cdot (x_2)_{t-3} + e_t \quad (1.2)$$

The ARX model parameters will be determined with the help of the least square method. The coefficients values for Romania are presented in table 3, and for Sweden in table 4.

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

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

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

Dependent Variable: Y
Method: Least Squares
Date: 05/28/15 Time: 14:51
Sample (adjusted): 2004 2013
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	-0.996972	0.841966	-1.184101	0.4465
Y(-2)	5.388093	2.454246	2.195417	0.2721
Y(-3)	-3.678985	1.746954	-2.105942	0.2822
Y(-4)	0.238468	0.594272	0.401277	0.7571
X1(-1)	-4.625444	1.820586	-2.540635	0.2387
X1(-2)	2.673405	2.260676	1.182569	0.4469
X2(-1)	-1.045297	0.500324	-2.089243	0.2842
X2(-2)	0.681176	0.357454	1.905632	0.3077
X2(-3)	0.468226	0.365447	1.281243	0.4219

R-squared	0.975076	Mean dependent var	143640.9
Adjusted R-squared	0.775687	S.D. dependent var	14306.62
S.E. of regression	6775.855	Akaike info criterion	19.97753
Sum squared resid	45912205	Schwarz criterion	20.24986
Log likelihood	-90.88767	Hannan-Quinn criter.	19.67879
Durbin-Watson stat	3.217951		

Source: Author processing

In order to see how strong the link between the analyzed variables is we calculated the R correlation report. As a result of the calculations made for Romania we achieve R's value of 0.998241 and for Sweden one of 0.987459. The R's value close to 1 signifies a strong direct link between the public debt, budget deficit and GDP.

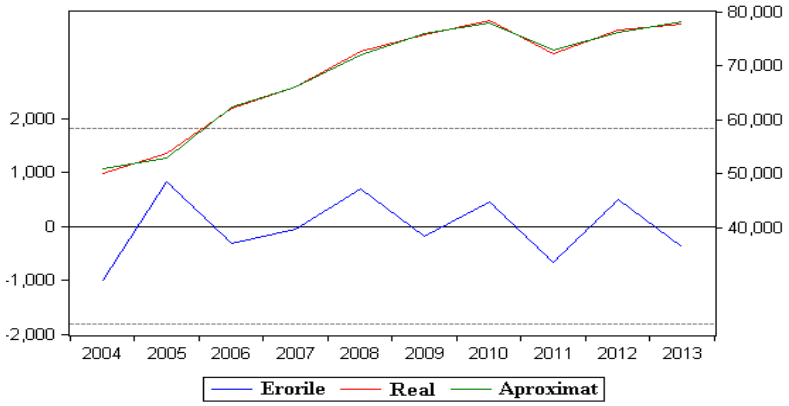
From table 3 and 4 it can be observed that R-squared is 0.99 respectively 0.97. The high value of this indicator demonstrates that the dynamic of public debt between 2000-2013 it is well specified through included variables in the model's frame.

The standard errors (Std.Error) of the estimated parameters are calculated. These errors are used for the t statistic calculation for testing the parameter's signification. 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 zero (Prob.), it can be said that the estimators are significant.

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

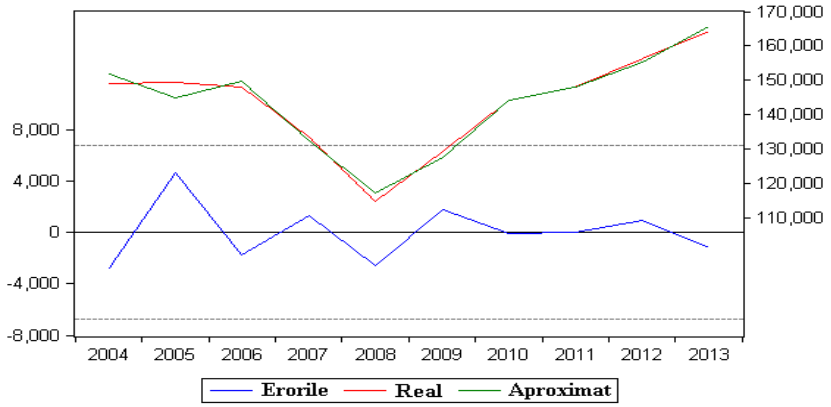
The Durbin-Watson test is applied for verifying the hypotheses through which the residuum series are uncorrelated. In Romania's case the calculated value of this statistic (DW=2.931724) is compared with the table values. For a significance threshold of 5%, and for a number of 15 observations, the table values of the Durbin-Watson statistic are d_1=0.95 d_2=1.54. In Sweden's case the calculated value of this statistic (DW=3.217951) it is compared with the table values. 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 $d_2 < DW < 4 - d_1$, we can conclude that the residuum series are independent.



Source: Author processing

Figure 3. The variation in time series of real public debt for Romania (red), in tandem with the variation in time of ARX model (green), highlighting the residuum (blue)



Source: Author processing

Figure 4. The variation in time series of real public debt for Sweden (red), in tandem with the variation in time of ARX model (green), highlighting the residuum (blue)

In Figure 3 and figure 4, there is a comparison between the variation in time of Romania's and Sweden's public debt and the variation in time of the ARX model. As it results from the residuum chart, the proposed model has a good approximation, the residuum being small enough.

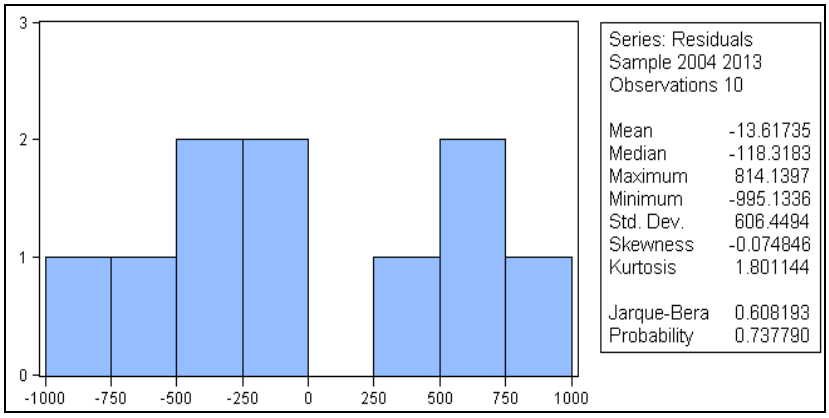


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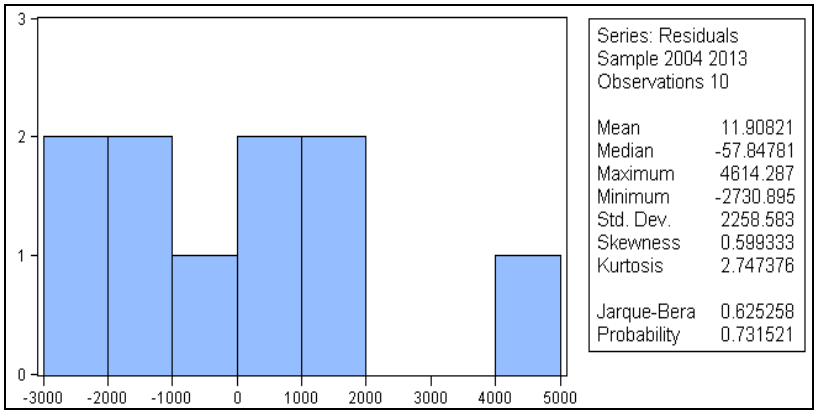
Figure 5. The histogram and the estimated residuum characteristics for Romania



Source: Author processing

Figure 6. The histogram and the estimated residuum characteristics for Sweden

In order to verify the residuum normality hypothesis one applies the Jarque-Berra test. Utilizing the Eviews programs packet we can ascertain that the calculated value of this statistic for Romania is JB = 0.608193. The table value of the χ^2 statistic for a significance threshold of 5% and for a number of 10 observations it 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< χ^2 , that is to say the residuum normality hypothesis is accomplished.

On the other hand, in figure 6, there are represented the flattening and asymmetry coefficient's values, and also the Jarque-Bera statistic value J-B=0.625258.

Comparing this statistic value, with the statistic table value χ^2=19.812 for a number of two input variables and for a significance threshold of 10%, it is noted that $J-B<\chi^2$, thus accepting the residuum normalization hypothesis.

CONCLUSIONS

In this paper is presented on one hand the dependence analysis between Romania's public debt through a period of 14 years, and its budget deficit and GDP, and on the other hand the dependence analysis between Sweden's public debt through a period of 14 years, and its budget deficit and GDP. As a result of the realized analysis we can see the existence of a very strong direct link between public debt, budget deficit and GDP for Romania as also for Sweden.

Comparing Romania's realized percentages in 2013, regarding the budget deficit, with the ones realized by countries with a strong economic growth as Sweden, we can say that Romania's budget deficit as a percentage from GDP is approximately 1 percentage higher than the one of Sweden.

Also we can conclude that Romania's public debt as a percentage from GDP, in 2013, is close to the one of Sweden.

In 2013 Romania also respected the imposed normative from the E.U.'s Growth and Stability Pact (GSP), through which the budget deficit cannot exceed 3% from GDP, and its public debt cannot exceed 60% from GDP and had registered a deficit of -2.23% from GDP and a public debt of 37.44% from GDP.

Sweden has registered in the same year a budget deficit of -1.33% from GDP, respecting the imposed normative from EU's Growth and Stability Pact (GSP) from this point of view, but also from the public debt's perspective, this being at a level of 37.67% from GDP.

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