

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

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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 an major actuality at national level and also at European Union level. In this paper it is presented a comparative analysis between Romania and Holland 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 Holland, 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 worldwide 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 this 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 budget deficit only, touching a maximum of -8.86% deficit in 2009 and a minimum of -1.15% in 2005. Concerning the Romania's public debt, it had an ascending trend, touching a percentage of 37.46% from GDP in 2012,

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and 37.44% from GDP in 2013, in decrease with 0.02% comparing with the precedent year.

In table 2 is presented Holland's situation regarding budget deficit, its GDP and public debt. In the analyzed period, Holland has registered budget deficit and also budget excess. The highest budget deficit has been registered in 2009 at -5.45% and the lowest in 2005 at -0.28%. Budget excess has been registered in 2001, 2006, 2007 and 2008. Holland's public debt had also an ascending trend, touching a percentage of 66.51% from GDP in 2012, and one of 68.60% from GDP in 2013, growing with 2.09% from the precedent year.

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

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

Source: Eurostat

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

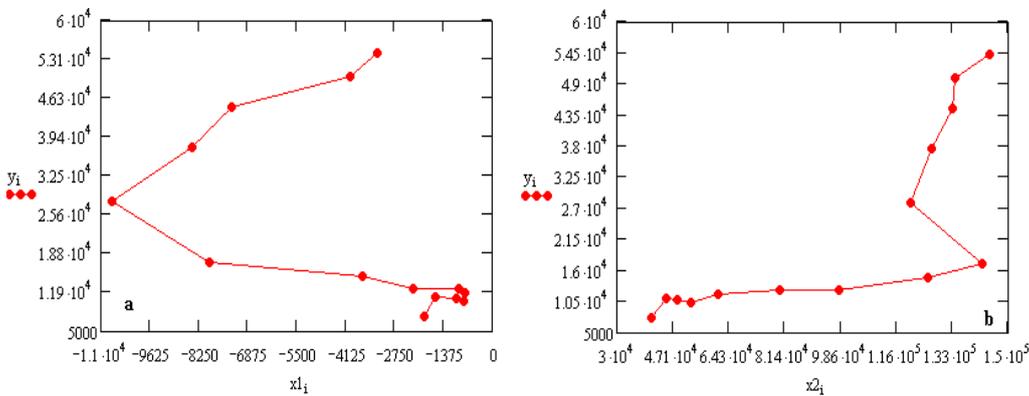
Year	Budget deficit		GDP Million Euro	Public debt Million Euro
	Million Euro	%GDP		
2000	8374.00	1.86	448701.00	230311.00
2001	-1736.00	-0.36	476157.00	232299.00
2002	-10402.00	-2.10	493555.00	238415.00
2003	-15405.00	-3.04	505833.00	249852.00
2004	-9140.00	-1.75	520322.00	259984.00
2005	-1514.00	-0.28	540656.00	267066.00
2006	1081.00	0.18	573444.00	257615.00
2007	1075.00	0.17	608729.00	259880.00
2008	1239.00	0.19	635794.00	348129.00
2009	-33718.00	-5.45	617650.00	348864.00

2010	-31866.00	-5.04	631512.00	372627.00
2011	-27835.00	-4.32	642929.00	393872.00
2012	-25330.00	-3.95	640644.00	426145.00
2013	-14629.00	-2.27	642851.00	441039.00

Source: Eurostat

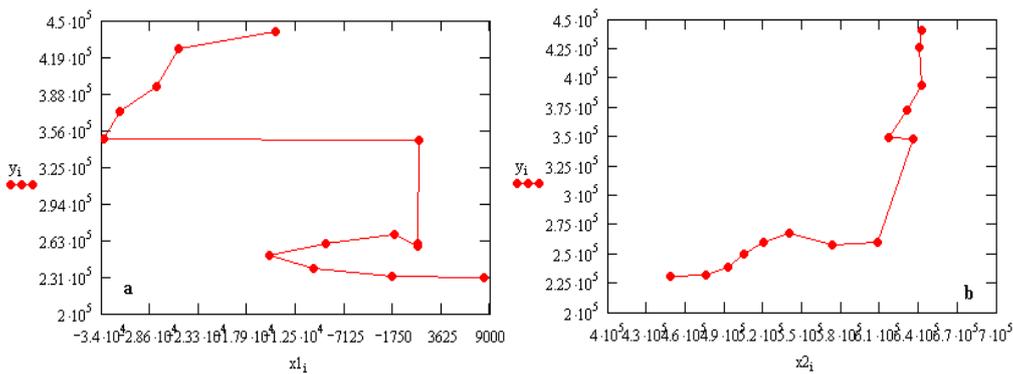
Comparing the percentages achieved by Romania in 2013, regarding the budget deficit, with those achieved by countries with a strong economic growth as Holland, we can say that Romania's budget deficit as percentage from GDP, is one close to that of Holland.

Unlike Romania, Holland's public debt, in 2013, is almost double.



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) Holland's public debt and its budget deficit, (b) Holland'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, with 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 Holland 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 Holland 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 Holland

Dependent Variable: Y Method: Least Squares Date: 05/28/15 Time: 13:03 Sample (adjusted): 2004 2013 Included observations: 10 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	0.515931	0.045799	11.26499	0.0564
Y(-2)	1.583407	0.162511	9.743388	0.0651
Y(-3)	2.597846	0.130340	19.93127	0.0319
Y(-4)	-4.546907	0.246345	-18.45750	0.0345
X1(-1)	-0.648566	0.272225	-2.382465	0.2530
X1(-2)	-8.962652	0.626862	-14.29766	0.0445
X2(-1)	1.607431	0.220162	7.301128	0.0867
X2(-2)	10.92404	0.606121	18.02288	0.0353
X2(-3)	-12.83228	0.613550	-20.91480	0.0304
R-squared	0.999849	Mean dependent var	337522.1	
Adjusted R-squared	0.998641	S.D. dependent var	71963.14	
S.E. of regression	2652.527	Akaike info criterion	18.10183	
Sum squared resid	7035900.	Schwarz criterion	18.37415	
Log likelihood	-81.50914	Hannan-Quinn criter.	17.80309	
Durbin-Watson stat	3.473562			

Source: Author processing

For seeing how strong the link between the analyzed variable is, we calculate the R correlation report. As a result of the calculations made for Romania we achieve R's value of 0.998241 and for Holland one of 0.999924. The R's value close to 1 signifies a strong direct link between the public debt, budget deficit and GDP.

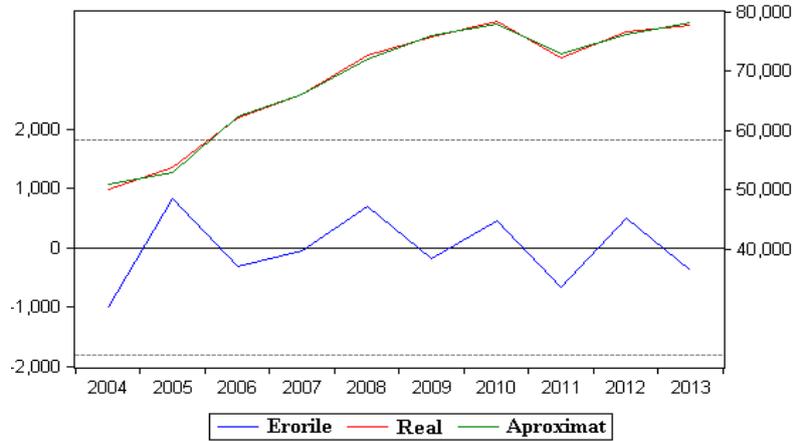
From table 3 and 4 it can be observed that R-squared is 0.99. The high value of this indicator demonstrates that the dynamic of public debt between 2000-2013 is well specified through included variables in the model's frame.

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 chosen model it is a very good one.

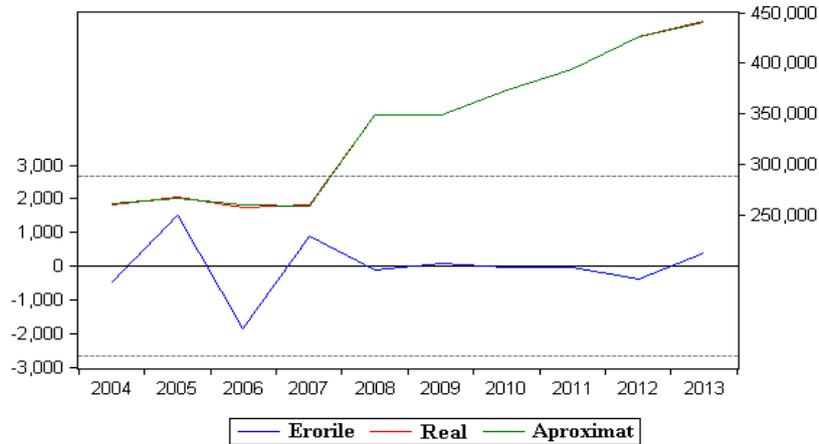
The Durbin-Watson test is applied for verifying the hypotheses through which the residuum series are uncorrelated. In Romania's case the calculated value of this statistic (DW=2.931724) is compared with the table values of this statistic. For a significance threshold of 5%, and for a number of 15 observations, the table values of the Durbin-Watson statistic are $d_1=0.95$ $d_2=1.54$. In Holland's case the calculated value of this statistic (DW=3.473562) is compared with the table values of this statistic. In this case, for a significance threshold of 5%, and for a number of 14 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 Holland (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 Holland'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.

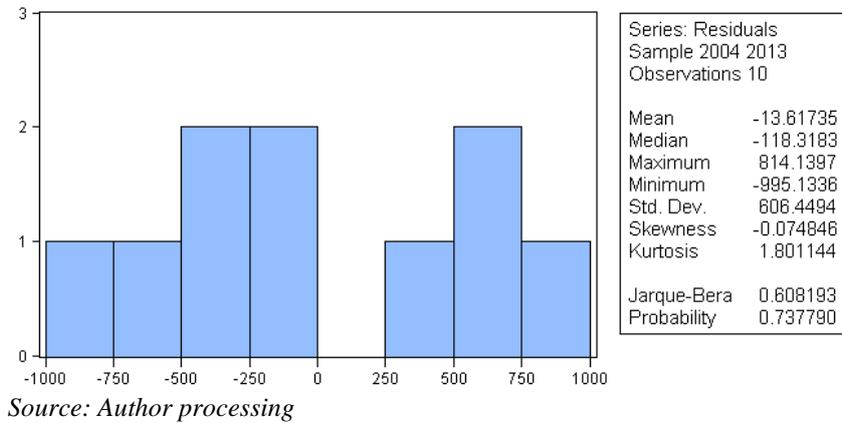


Figure 5. The histogram and the estimated residuum characteristics for Romania

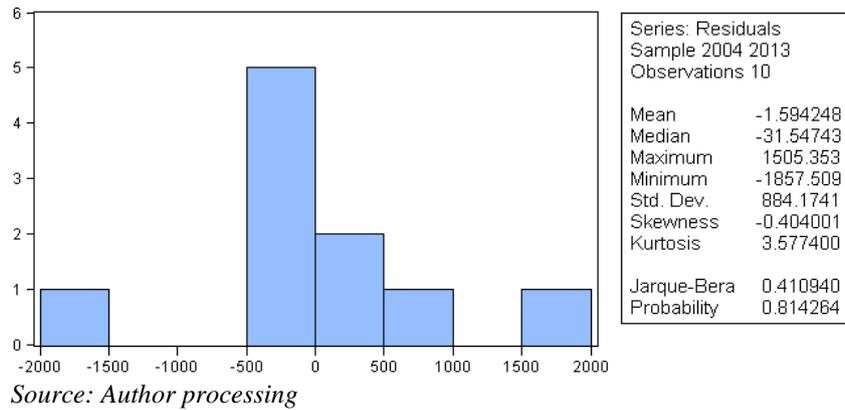


Figure 6. The histogram and the estimated residuum characteristics for Holland

In order to verify the residuum normality hypothesis the Jarque-Berra test will be applied. Utilizing the Eviews programs package we 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 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.

On the other hand, in figure 6, are represented the flattening and asymmetry coefficient's values, as also the Jarque-Bera statistic value $J - B = 0.410940$.

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

CONCLUSIONS

In this paper it 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 Holland's public debt through a period of 14 years, and its budget deficit and GDP. As a result of the realized analysis one can spot the existence of a very strong direct link between public debt, budget deficit and GDP for Romania as also for Holland.

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

Contrary to Romania, Holland's public debt, in 2013, is almost double.

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.

Holland had registered in the same year a budget deficit of -2.27% from GDP, respecting the imposed normative from E.U.'s Growth and Stability Pact (GSP) from this point of view, but not from the perspective of public debt, this being at a level of 68.60% from GDP.

Even if Holland's public debt it is almost double comparing to Romania, the living standard/capita it is much higher than in our country, and the economic growth is significantly higher.

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