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STUDY ON THE IMPACT OF SOVEREIGN DEBT ON THE DEGREE OF SELF-REGULATION OF ROMANIAN ECONOMY

Alexandra Maria CONSTANTIN*, PhD Candidate
* Bucharest University of Economic Studies, Faculty of Cybernetics, Statistics and Informatics, Bucharest, Romania

Abstract:
The self-regulation degree of national economy system, represented through: monetary policy rate; the minimum wage; government spending was studied in relation to sovereign debt volume. Thus, based on the data set related parameters considered: monetary policy rate, minimum wage, government spending and debt in the medium and long term, contains monthly data, period of analysis being the 2003-2014, period was estimated to what extent is adjusted national economy in terms of increasing the system, with a given value of the country's debt volume. The obtained Error Correction Model reflects the degree of national economic self-tuning, concretized on the macroeconomic strategy function, based on the loan. According to the study presented, significant rate, adjusting the economic system by means of loans made by the government will induce, in Romania, a sovereign rate becoming more pronounced. In Romania, the strategies for maintaining national economy, at a minimum necessary condition of survival by making loans, are not sustainable in the long term, but short term.

Key words: ECM, sovereign debt crisis, self-regulation degree of national economy system

1.Introduction[1]

The degree of self-regulation of the national economic system - emphasized through indicators like the monetary policy rate, the minimum wage and government spending - will be studied in relation to the volume of sovereign debt. Thus, based on the data set afferent to the considered parameters - monetary policy rate, minimum wage, government spending and medium and long term debt – which contains analysis of monthly data from the 2003-2014 period, we will estimate the extent to which the system of national economy adjusts when the volume of national debt increases with a given amount. The estimated Error Correction Model will reflect the degree of self-regulation of the national economy corresponding to the adopted macroeconomic strategy based on debt.

2.The ECM model

According to Systems' Theory, system self-regulation is a part of artificial intelligence and consists of maintaining the system inside certain targeted parameters obtained as a result of the permanent exchange between the system and its internal and external components.

Adjustment at the macroeconomic level is obtained by regulating the national economy system through the strategies adopted at this level. The mechanism of self-regulation is centered on the rapport between long-term balance and short-term balance.

[1] Part of the information presented in this paper is also found in the author's doctoral thesis entitled „Sovereign debt crisis – a complex approach"

Given that Romania, more and more indebted, tends to increase the degree of turbulence at the level of its national economic system, there is a need to estimate the degree of self-regulation of the considered parameters of the macroeconomic-financial system. Estimating the interdependency equation between short-term and long-term equilibrium involves also studying the correlation in order to detect the falsity of the estimated equation.

Cointegration is the best solution for "diagnosing the falsity of the researched relationship and for deducting the correct relationship between the two variables represented by data series" (Stancu, Constantin & Stancu, 2012). It should be noted that the data series, which present unit roots in their structure, are characterized by unsteadiness.

3. The data set used

The data set afferent to the considered parameters - monetary policy rate, minimum wage, government spending and medium and long term debt - contains monthly data, analyzed in the 2003-2014 period.

Data sources are as follows:

- the statistical database on the official website of the European Commission, EUROSTAT: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home used for extracting data for:
  - government spending (as a percentage of GDP);
  - medium and long-term debt (expressed in millions of euro).
- the statistical database on the official website of the National Bank of Romania, the section of monetary indicators: http://www.bnr.ro/Indicatori-de-politica-monetara-1744.aspx, used for extracting data for the monetary policy interest rate (expressed in percentages).
- the statistical database on the official website Google Public Data (offered by Eurostat): https://www.google.ro/publicdata/directory, used for extracting data for the minimum wage (expressed in Euros).

4. The software used

The software used in this study, EViews7, is a statistic software product developed by Quantitative Micro Software (QMS) that facilitates complex processing of data sets through an interface based on object oriented programming (Bhave, 2012). In this manner, time series, data series, systems of equations and more are designed as objects through the EViews7 programming.

On the other hand, we can mention another advantage of EViews, namely to provide a complete statistical package containing:

- Autocorrelation and partial autocorrelation functions, cross-correlation functions;
- Tests on the existence of the unit root[2], cointegration tests, causality tests etc.

Remarks:

1) According to WolframMathWorld, the cross-correlation function of two functions, f(t) and g(t), noted $f \lozenge g$, is defined by:

$$f \lozenge g \equiv \overline{f}(-t) * g(t) \tag{1}$$

where:

[2] Among the tests implemented in EViews7 which verify the existence of unit root, we can mention: ADF, Phillips-Perron, KPSS, DFGLS, ERS or Ng-Perron, for time series, and Levin-Lin-Chu, Breitung, Im-Pesaran-Shin, Fisher or Hadri, for panel data series.

$*$ − designates convolution;
$\overline{f}(-t)$ − is the conjugate function of $f(t)$.
Convolution is defined as follows:

$$f * g = \int_{-\infty}^{\infty} f(\theta) f(t-\theta) d\theta \tag{2}$$

Or, more exactly:

$$(f * g)(t) = \int_{-\infty}^{\infty} \overline{f}(-\theta) f(t-\theta) d\theta . \tag{3}$$

In the condition when $\theta' = -\theta$ and $d\theta' = -d\theta$, relationship (3) becomes:

$$f * g = \int_{-\infty}^{\infty} \overline{f}(\theta') f(t+\theta')(-d\theta') = \int_{-\infty}^{\infty} \overline{f}(\theta) f(t+\theta) d\theta . \tag{4}$$

2) The intercorrelation satisfies the following identity:

$$f \diamond g = f * g \tag{5}$$

On the other hand, VAR[3] (Vector AutoRegression) and ECM[4] can be estimated by EViews7 by accounting for the corresponding criteria. Later, one can opt to examine the impulse-response functions and to decompose the momentum variance for VAR or ECM. VAR impulse-response functions are accompanied by standard errors, calculated by using analytical methods or the Monte Carlo method, and are outlined in a variety of formats.

5. Empirical results

A first step in conducting the study based on representative data is to check the series' stationarity by using tests such as ADF (Augmented Dickey-Fuller)[5] and PP (Phillips-Perron). Since all the considered data series presented unsteadiness, they were stationised through order I differentiation.

By performing the co-integration study upon the considered time series the following was obtained:

- **The case of a single equation (Engle–Granger Cointegration Test):**

Series: DAT PROC_CHELT_IN_PIB RATA_DOB_POL_MON SAL_MIN
Sample: 2003Q1 2014Q2
Included observations: 46
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C

[3] For more details regarding the VAR model and ECM model, consult: Stancu, S., **Constantin, A.M.**, Stancu(Popa) V.S. (2012) *Efectele crizei datoriilor suverane asupra echilibrului la nivel macroeconomic*, Revista Studii şi Cercetări de Calcul Economic şi Cibernetică Economică, ISBN:0585-7511, available at: http://www.revcib.ase.ro/12-2012/Stelian%20Stancu.pdf

[4] Error Corection Model

[5] For more details regarding the ADF and PP tests, consult: Stancu, S. (2011) *Econometrie. Teorie şi aplicaţii utilizând EViews, Capitolul 10*, pp.421-423, ISBN:978-606-505-462-2, Editura ASE, Bucureşti.

Automatic lags specification based on Schwarz criterion (maxlag=9)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
DAT	-2.144068	0.8267	-8.312685	0.8478
PROC_CHELT_IN_PIB	-4.262874	0.0599	-26.47833	0.0482
RATA_DOB_POL_MON	-2.282041	0.7769	-10.14240	0.7463
SAL_MIN	-2.027664	0.8627	-8.032344	0.8612

*MacKinnon (1996) p-values.

Intermediate Results:

	DAT	PROC_CHELT_IN _PIB	RATA_DOB_P OL_MON	SAL_MIN
Rho – 1	-0.184726	-0.588407	-0.140167	-0.178497
Rho S.E.	0.086157	0.138031	0.061422	0.088031
Residual variance	21213805	23.84493	1.021564	64.31053
Long-run residual variance	21213805	23.84493	2.762810	64.31053
Number of lags	0	0	1	0
Number of observations	45	45	44	45
Number of stochastic trends**	4	4	4	4

**Number of stochastic trends in asymptotic distribution

Table 1

According to table 1, the probability associated to each variable exceeds the 0.05 threshold and we can therefore say that the four analyzed variables are cointegrated, each with I(1).

- **The matrix case (Johansen Cointegration Test):**

Sample (adjusted): 2003Q3 2014Q2
Included observations: 44 after adjustments
Trend assumption: Linear deterministic trend
Series: DAT PROC_CHELT_IN_PIB RATA_DOB_POL_MON SAL_MIN
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.444207	42.49873	47.85613	0.1452
At most 1	0.240416	16.65489	29.79707	0.6654
At most 2	0.098161	4.555583	15.49471	0.8540
At most 3	0.000217	0.009531	3.841466	0.9219

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.444207	25.84384	27.58434	0.0821
At most 1	0.240416	12.09931	21.13162	0.5379
At most 2	0.098161	4.546051	14.26460	0.7977

At most 3	0.000217	0.009531	3.841466	0.9219

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DAT	PROC_CHELT_IN_PIB	RATA_DOB_POL_MON	SAL_MIN
4.76E-05	0.187085	0.256682	0.005206
7.18E-05	0.130500	-0.330844	-0.068683
-7.98E-05	-0.010561	-0.030987	0.046390
7.04E-05	-0.044119	0.057142	0.003816

Unrestricted Adjustment Coefficients (alpha):

D(DAT)	323.4094	20.20593	327.8894	-24.13259
D(PROC_CHELT_IN_PIB)	-2.977659	-1.242917	0.222969	-0.032420
D(RATA_DOB_POL_MON)	-0.151973	0.049203	0.187074	0.005196
D(SAL_MIN)	-2.304684	2.000990	-0.660058	-0.035412

1 Cointegrating Equation(s): Log likelihood -710.7382

Normalized cointegrating coefficients (standard error in parentheses)

DAT	PROC_CHELT_IN_PIB	RATA_DOB_POL_MON	SAL_MIN
1.000000	3929.644	5391.517	109.3593
	(766.103)	(1608.97)	(222.093)

Adjustment coefficients (standard error in parentheses)

D(DAT)	0.015397
	(0.01528)
D(PROC_CHELT_IN_PIB)	-0.000142
	(3.7E-05)
D(RATA_DOB_POL_MON)	-7.24E-06
	(5.6E-06)
D(SAL_MIN)	-0.000110
	(4.5E-05)

2 Cointegrating Equation(s): Log likelihood -704.6885

Normalized cointegrating coefficients (standard error in parentheses)

DAT	PROC_CHELT_IN_PIB	RATA_DOB_POL_MON	SAL_MIN
1.000000	0.000000	-13198.30	-1871.838
		(3429.34)	(469.877)
0.000000	1.000000	4.730660	0.504167
		(1.10198)	(0.15099)

Adjustment coefficients (standard error in parentheses)

D(DAT)	0.016849	63.14178
	(0.02767)	(73.2265)
D(PROC_CHELT_IN_PIB)	-0.000231	-0.719274

	(6.5E-05)	(0.17091)	
D(RATA_DOB_POL _MON)	-3.70E-06	-0.022011	
	(1.0E-05)	(0.02663)	
D(SAL_MIN)	3.40E-05	-0.170042	
	(7.6E-05)	(0.20106)	

3 Cointegrating Equation(s): Log likelihood -702.4155

Normalized cointegrating coefficients (standard error in parentheses)

DAT	PROC_CHELT_IN_PIB	RATA_DOB_POL_MON	SAL_MIN
1.000000	0.000000	0.000000	-625.8074
			(182.470)
0.000000	1.000000	0.000000	0.057553
			(0.07165)
0.000000	0.000000	1.000000	0.094408
			(0.02233)

Adjustment coefficients (standard error in parentheses)

D(DAT)	-0.009308	59.67896	66.16823
	(0.03718)	(72.2917)	(132.930)
D(PROC_CHELT_IN _PIB)	-0.000249	-0.721629	-0.360009
	(8.8E-05)	(0.17089)	(0.31424)
D(RATA_DOB_POL _MON)	-1.86E-05	-0.023987	-0.061084
	(1.3E-05)	(0.02574)	(0.04733)
D(SAL_MIN)	8.67E-05	-0.163071	-1.233134
	(0.00010)	(0.19979)	(0.36737)

Table 2

Based on the output shown in Table 2, the Trace statistic doesn't indicate any cointegrating relation, for a significance level of 5%, as all values of Trace statistics are lower than the critical values.

Note: According to Stancu, **Constantin** & Stancu (2012), the information generated from the application of the Johansen test refers to "the number of cointegration relationships in a model and not in relation to variables that are cointegrated."

Following the estimation through the Error Correction Model, EViews7 generated the following output:

Vector Error Correction Estimates
Sample (adjusted): 2003Q4 2014Q2
Included observations: 43 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
PROC_CHELT_IN_PIB(-1)	1.000000
RATA_DOB_POL_MON(-1)	6.639378
	(1.34719)
	[4.92830]
SAL_MIN(-1)	0.793608
	(0.22975)
	[3.45428]

C	-202.0655		
Error Correction:	D(PROC_CHELT_IN_PIB)	D(RATA_DOB_POL_MON)	D(SAL_MIN)
CointEq1	-0.082209	-0.004000	-0.286950
	(0.06824)	(0.00911)	(0.06223)
	[-1.20473]	[-0.43888]	[-4.61124]
D(PROC_CHELT_IN_PIB(-1))	-0.253940	-0.012670	0.016771
	(0.17669)	(0.02360)	(0.16113)
	[-1.43723]	[-0.53691]	[0.10408]
D(PROC_CHELT_IN_PIB(-2))	-0.158918	-0.015446	0.009597
	(0.17260)	(0.02305)	(0.15740)
	[-0.92073]	[-0.67005]	[0.06097]
D(RATA_DOB_POL_MON(-1))	0.940771	0.678121	0.674294
	(1.27052)	(0.16969)	(1.15862)
	[0.74046]	[3.99618]	[0.58198]
D(RATA_DOB_POL_MON(-2))	0.211275	-0.152583	3.553147
	(1.50096)	(0.20047)	(1.36877)
	[0.14076]	[-0.76112]	[2.59587]
D(SAL_MIN(-1))	-0.014484	-0.001715	-0.165040
	(0.16062)	(0.02145)	(0.14648)
	[-0.09017]	[-0.07993]	[-1.12674]
D(SAL_MIN(-2))	0.005495	0.018687	-0.233250
	(0.15555)	(0.02078)	(0.14185)
	[0.03533]	[0.89944]	[-1.64430]
C	0.957751	-0.228614	3.651947
	(1.85458)	(0.24770)	(1.69124)
	[0.51643]	[-0.92295]	[2.15933]
DAT	-2.00E-05	9.74E-07	6.69E-05
	(6.0E-05)	(8.0E-06)	(5.4E-05)
	[-0.33645]	[0.12249]	[1.23223]
R-squared	0.149289	0.362835	0.422571
Adj. R-squared	-0.050879	0.212914	0.286705
Sum sq. resids	1232.386	21.98404	1024.871
S.E. equation	6.020518	0.804108	5.490288
F-statistic	0.745819	2.420174	3.110209
Log likelihood	-133.1578	-46.59036	-129.1935
Akaike AIC	6.611989	2.585598	6.427603
Schwarz SC	6.980612	2.954221	6.796227
Mean dependent	0.050930	-0.343023	2.777209
S.D. dependent	5.872967	0.906365	6.500706
Determinant resid covariance (dof adj.)		616.1965	
Determinant resid covariance		304.6145	
Log likelihood		-306.0026	
Akaike information criterion		15.62803	
Schwarz criterion		16.85677	

Table 3

Based on the results generated by Eviews7 for ECM, we can say that the degree of self-regulation at the level of the macroeconomic system is of approximately 0.002%, based on the loans made by the government.

6. Conclusions

According to the study presented, the too low - and therefore insignificant - rate of economic system adjustment by means of governmental loans will induce an increasingly pronounced sovereign rate in Romania.

In the case of Romania, the strategies for maintaining the national economy at a minimum necessary survival condition by making loans are not sustainable in the long term, but only in the short term.

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[1] Stancu, S., **Constantin, A.M.**, Stancu (Popa), V.S. (2012) *Efectele crizei datoriilor suverane asupra echilibrului la nivel macroeconomic*, Revista Studii şi Cercetări de Calcul Economic şi Cibernetică Economică, ISBN:0585-7511, available at: http://www.revcib.ase.ro/12-2012/Stelian%20Stancu.pdf

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