A PVAR MODEL BUILT ON THE RICARDIAN APPROACH TO DEFICITS IN CENTRAL AND EASTERN EUROPE

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Abstract
In the current times, the issue of the deficits became very problematic for the economists, as well as for the practitioners and theoreticians. The purpose of this paper consists in the construction of a Panel VAR model, which has the role to test the Ricardian approach to deficits in several countries from Central and Eastern Europe. The analyzed countries are Austria, Czech Republic, Hungary, Bulgaria, Romania and Ukraine and the time interval starts in 1998 and it ends in 2013. The used variables are the gross national saving rate and the budget balance for each of the six countries. Our results show that in this geographical-economical area, the Ricardian approach to deficits does not hold as a valid macroeconomic theory.

Key words: *deficits, balance, panel VAR, ricadian equivalence, savings rate.*

JEL Classification: *C33, H61, H62.*

I. INTRODUCTION

In these times, facing a new threat for the worldwide economic recovery, with regard to the China's latest problems and to the Greek crisis, the deficits' issue became a topic up to date. According to the neoclassical theory, one can see large deficits when the fiscal spending is high or when the output is temporary low (Barro (1979) tax-smoothing model). We can all say that from the above-mentioned deficits "criteria", the general cause of the worldwide deficits is the low output. Of course, there are exceptions too. According to the *World Economic Forum's Global Competitiveness Report 2014-2015*, the good news are coming from over the Atlantic for the first time since the Crisis; so, in The United States, the deficit continues to narrow and public debt is lower than the previous years. Also, in Europe, in almost all of the countries, the deficit started to be lower than in the previous years, but the levels are still high. A short brief of the worldwide deficits levels can be found in Table no. 1.

Table 1: Deficits worldwide status

Country	Condition
Finland	high, but still manageable
Japan	deficit hovering around 10 percent
United Kingdom	lower levels of fiscal deficit and public debt
Sweden	low levels of public debt and deficits
Denmark	European Commission closes the procedure that assesses excessive deficits
Belgium	a lower public deficit since the previous report
Ireland	a high budget deficit
France	a small reduction in the deficit, but with an increase in the public debt
Spain	reform program managed to curb the high budget deficit from the last year
Portugal	high levels of deficits and public debt
Czech Republic	deficit fell below the 3 percent mark
Croatia	a fairly high budget deficit
Greece	a sharp reduction in the budget deficit, but still high levels of public debt
Asia and Pacific	huge infrastructure deficit
Australia	small increase in the budget deficit
China	public deficit has been reduced and also the public debt-to-GDP ratio

Source: WEF – The Global Competitiveness Report 2014 - 2015

Also, the structural problems are the root of the main macroeconomic imbalances in Europe. In the moment of writing this paper, on question remains still opened: are the structural problems that caused a lot of fiscal trouble for the countries in Europe going to be managed and solved in a proper way? (Belingher, 2015) Having in mind, the generalized deficits' issue, the purpose of this paper is to analyze the Ricardian approach to deficits in six countries from Central and Eastern Europe (*Austria, Czech Republic, Hungary, Bulgaria, Romania and Ukraine*), through a PVAR model.

II. LITERATURE REVIEW

The panel VAR approach represents a hybrid econometric methodology between the classic panel model and the vector autoregressive model. First, was introduced to the scientific community by Gilchrist and Himmelberg (1995, 1998), who have analized, by using a PVAR methodology, the relationship between investment, future capital productivity and companies' cash flow. They have used a two-stage estimation procedure to obtain measures of so-called "fundamental" q and "financial" q. Soon after, Gallecati and Stanca (1999) conducted a study with regard to the relationship between firms' balance sheets and investment for UK's economy. In 2003, Love and Zicchino are using a PVAR approach to study the dynamic relationship between firms' financial conditions and investment, in 36 countries. Their findings show that impact of financial factors is significantly larger in countries with less developed financial systems. Also, a paper in which PVAR in Stata was made available to other researchers, was the one of Love and Zicchino (2006). The latest version of this package is best described in Abrigo and Love (2015).
Other authors who have used the PVAR methodology are Roache (2007), who is using the panel VAR to test the impact of the public investment on the economic growth and Cannova and Ciccarelli (2013), who is realizing a survey based on this methodology.

Regarding the Ricardian approach to defticts, this paper represents the extension of Belingher's (2015) paper, in which the author builds a VAR model to test this hypothesis for the Romanian economy. He uses as variables Gross National Savings Rate and Budget Balance. This paper had as a starting the papers of Barro (1989) and Rose and Hakes (1995). Barro (1989) is facing the standard model of deficits with his Ricardian view. By sketching the standard model, this represents an explanation of why, when a government decides to create a deficit to finance the current taxation, the aggregate demand should grow. With other words, the private saving drops less than the taxation cut and in accordance to this the national saving must grow (Barro, 1996). The antithesis of the standard model, is the Ricardian approach: when a government spending is financed through deficit, this will reflect in future in bigger taxes, which will have the same value with initial tax cut. Every spending you generate must be paid now or later. Second, consumers are trying to maximize the present value of lifetime consumption (according to the permanent-income/life cycle hypothesis) (Belingher, 2015). Rose and Hakes (1995), are considering the Ricardian Equivalence the logical extension of the permanent income/life cycle hypothesis.

Same authors are explaining why one of the implications of Ricardian Equivalence Hypothesis (REH) is that the deficits are neutral. Related to this, the deficits could not affect other macroeconomic variable, such as the interest rate. They conclude that the deficit neutrality to the interest rate is a necessary condition to the Ricardian Equivalence, but not sufficient.

The model, which is described in the following section of this paper, bases on Rose and Hakes (1995) assumption that the budget deficit should increase household saving. Due to the availability of the data, instead of the household saving, was used the gross national saving rate. The data used is also described in the next section.

III. RESEARCH METHODOLOGY AND ECONOMETRIC EVIDENCE

Abrigo and Love (2015) are describing the following k-variate panel VAR of order p, with panel-speciffic fixed effects represented by the following system of linear equations:

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + \cdots + Y_{it-p+1}A_{p-1} + Y_{it-p}A_p + X_{it}B + u_{it} + e_{it} \qquad (1)$$
$$i \in \{1, 2, \ldots, N\}, t \in \{1,2, \ldots, T_i\}$$

, where Y_{it} is a (*1xk*) vector of dependent variables; X_{it} is a (*1xl*) vector of exogenous covariates; u_{it} and e_{it} are (*1xk*) vectors of dependent variable-specific fixed-effects and idiosyncratic errors. The (*kxk*) matrices $A_1, A_2, \ldots, A_{p-1}, A_p$ and the (*lxk*) matrix B are parameters to be estimated. The authors are assuming that the innovations have the following characteristics $E[e_{it}] = 0, E[e'_{it}, e_{it}] = \Sigma$ and $E[e'_{it}, e_{is}] = 0$, for all $t>s$.

The parameters above may be estimated jointly with the fixed effects, or alternatively, without, after some transformations, through OLS. However, with the lagged variables on the right side of the equation, for a large number of N, the results would be biased according to (Nickell, 1981). Abrigo and Love (2015), are describing in the above-mentioned paper, the estimating methodology, through GMM. Also, Roodman (2009), provides a very good discussion about GMM estimation in a dynamic panel setting and its applications in Stata.

Data used in the estimation process consists in two macroeconomic variables: **Budget Balance (BBal)** and **Gross National Saving Rate (GNSR)**. There are analyzed six countries (Austria, Czech Republic, Hungary, Bulgaria, Romania and Ukraine) and the data set starts in 1998 and it ends in 2013. The frequency is yearly and there are a total number of 96 observations. There were assigned IDs, numbers from 1 to 6, to each country, according to the previously defined list.

The first step in the estimation process, was to check the data for stationarity. The results revealed the fact that *BBal* series is stationary and the *GNSR* series is variable in first difference. As a consequence, the model will be run using the first differences of the variables. Also, the first difference is used for removal of the panel-specific fixed effects.

The second phase was to estimate the optimal moment and model selection, according to Andrews and Lu (2001). The output of the test is very similar to the one built on likelihood-based criteria (AIC, BIC and HQIC values): the preferred model is the one with the lowest values. Their model selection criteria is based on Hansen's (1982) *J statistic* of over-identifying restrictions. The results of the tests are presented in *Table no. 2*:

Table no. 2: PVAR's optimal moment and model selection criteria

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Selection order criteria
Sample:  2002 - 2012                          No. of obs      =        66
                                              No. of panels   =         6
                                              Ave. no. of T   =    11.000
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lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.8210533	18.73626	.0950952	-31.5396	-5.263742	-15.64658
2	.8169326	15.17502	.0558304	-18.34222	-.8249815	-7.746875
3	.8462757	6.743975	.1500525	-10.01464	-1.256025	-4.716971

Source: Own computations

One can observer that the row corresponding to the first lag has the lowest values. In order to this, we have decided that the optimal model should include the variables from the *t period* and *t-1 period.* Also, running the post-estimation test, we have seen that the first lag model is more stable than the other potential models.

The proper PVAR model was run using lags 1 to 4 as instruments, using the first difference method the remove the panel-specific fixed effects. One can found PVAR's output in *Table no. 3*.

Table no. 3: PVAR's estimates

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Panel vector autoregresssion

GMM Estimation

Final GMM Criterion Q(b) =      .212
Initial weight matrix: Identity
GMM weight matrix:     Robust
                                                  No. of obs      =        72
                                                  No. of panels   =         6
                                                  Ave. no. of T   =    12.000
```

		Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
GNSR							
	GNSR L1.	.1040427	.1924143	0.54	0.589	-.2730825	.4811679
	BBal L1.	.4316862	.2002509	2.16	0.031	.0392017	.8241707
BBal							
	GNSR L1.	-.1243287	.0791748	-1.57	0.116	-.2795084	.0308511
	BBal L1.	.1688117	.1317577	1.28	0.200	-.0894287	.427052

Instruments : l(1/4).(GNSR BBal)

Source: Own computations

From the above equations, where all the variables are considered endogenous, the one that represents the core of our research is the first one, **GNSR** equation. The post estimation tesst showed that the VAR is stable and Budget Balance is Granger-causal for Gross National Saving Rate. Further, the post-estimations tests are displayed:

Table no. 4 & 5: PVAR's post-estimation tests

Eigenvalue stability condition

Eigenvalue Real	Eigenvalue Imaginary	Modulus
.1364272	.2293953	.2668981
.1364272	-.2293953	.2668981

All the eigenvalues lie inside the unit circl
pVAR satisfies stability condition.

panel VAR-Granger causality Wald test
Ho: Excluded variable does not Granger-cause Equation v
Ha: Excluded variable Granger-causes Equation variable

Equation \ Excluded	chi2	df	Prob > chi2
GNSR			
BBal	4.647	1	0.031
ALL	4.647	1	0.031
BBal			
GNSR	2.466	1	0.116
ALL	2.466	1	0.116

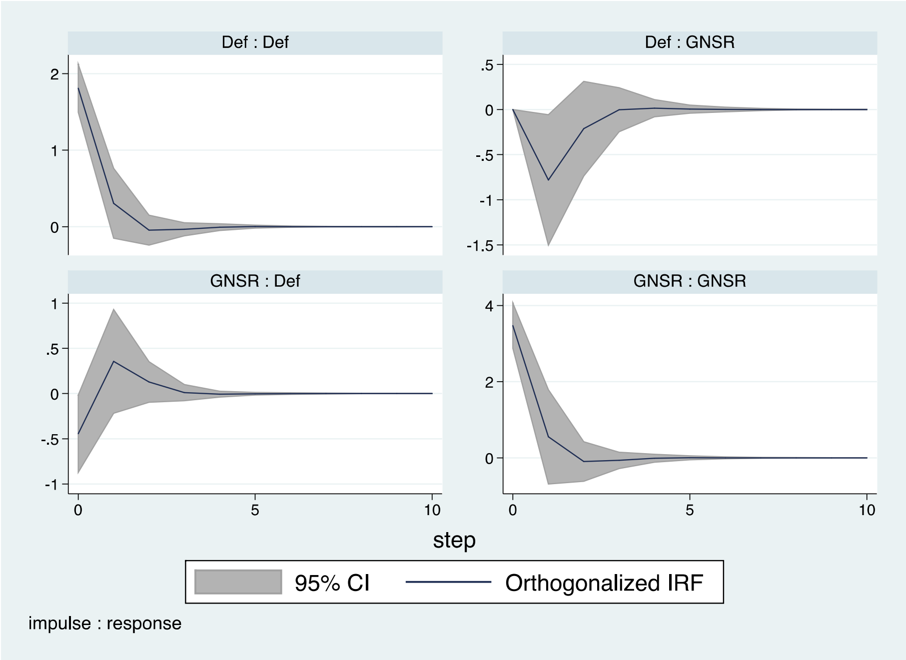
Source: Own computations

Also, the stability condition of the PVAR model, as Abrigo and Love (2015) are describing it, implies the model is invertible and has an infinite-order vector moving-average (VMA) representation, "providing known interpretation to estimated impulse-response functions and forecast-error variance decompositions. The simple IRF Φ_i, may be computed by rewriting the model as an infinite VMA, where Φ_i are the VMA parameters:

$$\Phi_i = \begin{cases} I_k \quad , & i = 0 \\ \sum_{j=1}^{i} \Phi_{t-j} A_j, & i = 1,2,.. \end{cases} \tag{2}$$

In our model, actually, the IRF is the core of the research, because we are trying to understand what happens with the Gross National Saving Rate, when a shock in the Deficit occurs. In order to obtain the needed results, we need to multiply the Budget Balance variable with the (-1) constant, because, in the original model, when a positive shock happens in this variable, it really means the deficit is decreasing. This is the reason for which we have multiplied variable **BBal** by (-1). In the following chart, one can observe PVAR's IRF:

Fig.1: Re-done VAR's IRF with the Deficit variable multiplied by -1



Source: Own computations

It is clearly, as figure nr. 1 can tell us, that when the deficit increases in the defined block of countries, the gross national saving rate follows a downward curve. The shock is fully absorbed after the third year.

IV.CONCLUDING REMARKS AND FURTHER DEVELOPMENT

The estimations of our model are not in accordance with Rose and Hakes (1995) paper and are disagreeing the Ricardian approach to deficits. Although, even the countries are geographically related, the countries not have all very similar economies. In order to obtain this results, there has been used Panel Vector Autoregression with one lag model and based on its estimations, the impulse-response function was revealed in the previous section. Due to the fact that the PVAR methodology and the package used to obtain the estimates are quite recent, the estimations can have methodological problems. Also, from our experience, this is the first attempt to test the Ricardian approach to deficits through a PVAR model. Anyhow, the results are in line with Belingher (2015) paper, which includes estimates for the Romanian economy.

As a further development, it is analyzed the potential extension of the PVAR model built in this paper, by adding several countries from Central/Eastern Europe. Also, it would be a plus to add some more years in the further computations, for a better accuracy in processing.

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VI. NOTE

This research was conducted by using the *pvar.ado* implemented in Stata by Inessa Love and Michael Abrigo. The first version of this package was described in "*Financial Development and Dynamic Investment Behavior: evidence from Panel VAR*" (Inessa Love with Lea Ziccino), The Quarterly Review of Economics and Finance, 46 (2006), 190-210.

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