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ASSESSING FISCAL SUSTAINABILITY USING COINTEGRATION FOR A GROUP OF EURO AREA CANDIDATES

Abstract. *This study performs a simple sustainability assessment of fiscal policy in three euro area candidates, the Czech Republic, Poland and Romania. The focus is on the government's Intertemporal Fiscal Constraint, according to which the current value of public debt is less than or equals the discounted sum of future government surpluses. Not respecting the constraint implies that the government is financing its activities through a Ponzi scheme, which means public finances are not sustainable in the long run. This would seriously deteriorate the country's rating and risk premium, along with investor confidence. The empirical approach uses econometric techniques to evaluate the constraint, specifically, we test for the existence of cointegration between government revenues and expenditures. Results indicate that the constraint is respected in Romania and the Czech Republic, while in Poland, the two series are not cointegrated.*
Keywords: fiscal sustainability, intertemporal fiscal constraint, cointegration.

JEL Classification: E60, E62

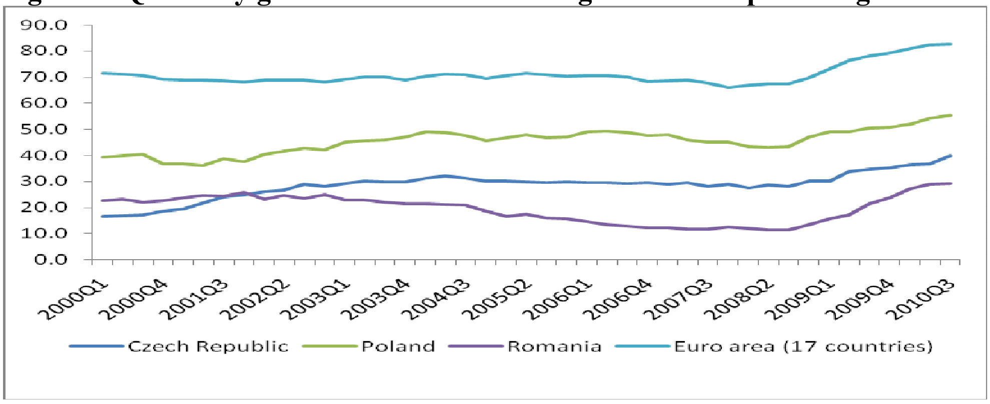
1. Introduction

Issues concerning fiscal policy have always benefited from much attention in the context of the European Monetary Union, in which there is a common monetary policy, and fiscal policy is the attribute of each sovereign state. Moreover, due to the current economic situation, the focus is on fiscal policy, not only because interest rates are at historically low levels, and fiscal measures are perceived as the only way of restoring the economies back on the track of sustainable growth, but also because it seems that in the aftermath of the Great Financial Crisis, a sovereign debt crisis has emerged, affecting countries in the euro area (henceforth EA). Against this background, the paper approaches the issue of fiscal sustainability, with an empirical study on the economies of three EA candidates, the Czech Republic, Poland and Romania.

The motivation for this study is twofold. First of all, given the context described above, it is instructive to assess the fiscal position of a government. In most countries, stimulus packages and/or bailout costs determined a rise in public spending, and since the general slowdown of economic activity meant lower public revenue, debt issuing gained a very preeminent role. Nowadays governments find it increasingly difficult to finance their activities at reasonable rates of return, as there is growing concern that some of them will not be able to pay back what they owe and default. It is therefore important to evaluate the situation in the three economies, in order to understand if there is need for concern from this point of view. The second reason is that we are dealing with candidates for euro adoption. It is interesting to gain understanding on whether they add to the strength or to the weakness of the monetary union, from a fiscal point of view.

At first glance, the three countries appear not to be in a worse position than the EA taken as a whole, as the government debt to GDP ratio average in the EA well exceeds that in the analyzed economies (this is shown in figure 1).

Figure 1: Quarterly government consolidated gross debt as percentage of GDP



Source: Eurostat

However, Reinhart and Rogoff (2010) point out that the risk premium for a country begins to rise sharply as the debt levels rises towards that specific country's historical limit, facing the government with difficult tradeoffs because it needs to enforce a tight fiscal policy in order to maintain credibility. Giammarioli *et al.* (2007) notice that "neither theory nor practical experience give a clear indication of which debt level is too high and would thus threaten the fiscal sustainability of a country". They also refer to an IMF World Economic Outlook which finds that more than half of the sovereign debt crises have occurred at public debt levels of below 40% and two thirds at levels below 60%. A straightforward conclusion is that it would not be safe to assume that an economy has a sustainable fiscal position just because its debt to GDP ratio is at a low level compared to other economies. The use of this indicator has been improved along several directions (for example, using net debt instead of gross debt, or taking into account other liabilities such as government guarantees, etc.), still it is rather obvious that it delivers useful information without being able to paint a complete picture.

Fiscal sustainability is a research issue which concerns financial institutions like the IMF or the ECB and academia alike. Numerous approaches have been developed, the interested reader can consult Chalk and Hemming (2000) or Giammarioli el al. (2007) for a review of empirical techniques. This paper focuses on the government's Intertemporal Fiscal Constraint (henceforth IFC), according to which the current level of government debt is less than or equals the sum of discounted values of future government surpluses. Not respecting the constraint consequently implies that the government is financing its activities through a Ponzi scheme, which means public finances are not sustainable in the long run. This would seriously deteriorate the country's rating and risk premium, along with consumer and investor confidence. The empirical approach uses econometric techniques to evaluate the constraint, namely, we test for the existence of cointegration between government revenues and expenditures. More details on the theoretical model and the empirical tests are given in the following sections, however at this point we can provide an intuitive explanation. Cointegration between revenues and expenditures would imply the existence of a long run equilibrium between the two series, meaning that even if they are not stationary, they "never drift far apart from each other", which indicates fiscal soundness.

Results indicate that the constraint is respected in Romania and the Czech Republic, while in Poland, the series are not cointegrated.

2. Theoretical model

In this section we briefly present the theoretical background of the paper, following Bohn (2007). The macroeconomic variables can be defined in nominal, real or per-capita terms, or they can be expressed as percentages of GDP.

In every period, the government's budget constraint is:

$$B_t = G_t^0 - T_t + (1 + r_t) \cdot B_{t-1} \quad (1)$$

The government uses currently issued debt (B_t) to cover its deficit (G_t^0 is public spending without debt payments, T_t is public revenue) and the payments on the previous period's debt. The following notations are often used:

$$\Delta B_t = B_t - B_{t-1} = G_t^0 + r_t \cdot B_{t-1} - T_t \quad (2)$$

ΔB_t is the first difference of government debt and the period's *with interest deficit*. Excluding the interest payment from (2), we get the period's primary or no interest deficit:

$$DEF_t = G_t^0 - T_t \quad (3)$$

In order to obtain the IFC for each period's budget constraint, assumptions are made regarding the interest rate process. The most common are:

- ✓ The interest rate is positive and constant: $r_t = r > 0$
- ✓ The interest rate is uncorrelated over time with a positive constant conditional expectation: $E_t r_{t+1} = r > 0$
- ✓ The interest rate is a stationary process with mean $r > 0$.

For the last assumption, additional restrictions may be imposed to assure that the process G_t (government adjusted spending) has similar properties to G_t^o:

$$G_t = G_t^0 + (r_t - r) \cdot B_t \qquad (4)$$

For either assumption, writing (1) for period *t+1,* with information from the current period *t*, and defining $G_t = G_t^0$ in the first two cases, we get:

$$B_t = \frac{1}{1+r} E_t (T_{t+1} - G_{t+1} + B_{t+1}) \qquad (5)$$

Iterating forward for *N* periods, and taking $N \to +\infty$, we obtain:

$$B_t = \lim_{N \to +\infty} \left(\frac{1}{1+r} \right)^N \cdot E_t B_{t+N} + \sum_{i=1}^{+\infty} \left(\frac{1}{1+r} \right)^i \cdot (T_{t+i} - G_{t+i}) \qquad (6)$$

The IFC is respected if and only if the first term of the right-hand side of (6) (the so-called *bubble term*) is 0, that is:

$$\lim_{N \to +\infty} \left(\frac{1}{1+r} \right)^N \cdot E_t B_{t+N} = 0 \qquad (7)$$

This corresponds to the non Ponzi game condition, so that the current value of public debt equals the discounted value of future government surpluses.

It is useful to derive from (7) a condition which can be empirically tested, that takes into account government revenues and expenses. To this purpose, one can first define the government spending including interest payments on debt as:

$$G_t^r = G_t + r_t \cdot B_{t-1} \qquad (8)$$

With this notation, from (2) we obtain:

$$\Delta B_t = G_t^r - T_t \qquad (9)$$

Bohn (2007) shows that if G_t^r is $I(m_G)$ and T_t is $I(m_T)$, than the IFC holds if B_t is $I(m)$ and $m \le \max(m_G, m_T) + 1$. However, if both G_t^r and T_t are $I(1)$ and cointegrated such that:

$$T_t = \mu + b \cdot G_t^r + \varepsilon_t \qquad (10)$$

with ε_t stationary, from (9) we get that:

$$\Delta B_t = -\mu + (1-b) \cdot G_t^r - \varepsilon_t \qquad (11)$$

meaning that ΔB_t is stationary (if $b = 1$) or $I(1)$, so B_t is either $I(1)$ or $I(2)$. In this case, convergence in (7) is much faster. Hence, the cointegration of public revenues and expenditures is a sufficient condition for the IFC to hold.

3. Literature review

A number of papers empirically test the IFC and derive necessary and sufficient conditions for it to hold. Hamilton and Flavin (1986) use (6) (with a slightly different notation, and without the limit) to form a regression model and test if the bubble term is significant. They notice that if it is statistically insignificant, and government surplus is stationary then debt must be also stationary, so a way to test the IFC is to see if government debt is a stationary process, assuming the same for the government surplus. Trehan and Walsh (1991) consider in their analysis two cases: constant and variable interest rate. In the first case, they analyze the relationship between debt and the primary deficit, showing that if they are cointegrated, the IFC is respected. In the second case, they show that if interest rate is a positive stochastic process, a sufficient condition for the IFC is that the *inclusive of interest deficit* (which equals the first difference of government debt, see (2)) is stationary, so if debt is an $I(1)$ process, the IFC holds. Focusing on government revenues and expenditures, Hakkio and Rush (1991) use a modified version of (6) to show that if the two variables are cointegrated, the IFC is respected, even though expenses rise faster than revenue (this happens if $b < 1$ in (10)). Still, they argue that in this case, government credibility is affected which makes financing deficits more difficult. Their empirical approach relies on the Engle and Granger (1987) and Stock and Watson (1988) methodologies, which are applied on the whole data sample and also on different subsamples, determined exogenously. Quintos (1995) distinguishes between a strong and a weak condition for fiscal sustainability: she shows that revenue and expenditure cointegration is a sufficient but not necessary condition for the bubble term in the fiscal constraint to converge to 0, still a faster convergence is achieved when the debt process is stationary or I(1) (this corresponds to the strong condition). Furthermore, unlike previous studies in which subsamples are determined exogenously, structural breaks in the cointegration relationship are determined endogenously.

Empirical testing of the IFC relies on verifying if these conditions (stationarity of the debt process, cointegration between expenditures and revenues) hold. The studies mentioned above focus on the U.S. economy, and similar approaches have been put forward in papers that focus on other economies. The literature on the subject is quite extensive, for a review of some of the main results see Afonso (2005). Recent papers study the IFC using panel data (see for example Prohl and Schneider (2006), Afonso and Rault (2007), Holmes *et al.* (2007)). Panel studies have the advantage of providing an increased number of degrees of freedom, since the great majority of papers in this strand of literature use time series with annual frequency (a notable exception is Arghyrou and Luintel (2007) who use data with quarterly frequency, and we intend to follow their approach in this study). However, this type of analysis can only be sound if data are poolable in a panel, and in our case, this raises concerns about including the EA candidates and the EA members in the same model (panel), since, for example, Kočenda *et al.* (2008) find that a significant level of heterogeneity exists in fiscal convergence between the new members of the European Union and the old members (EU 15).

Other papers adopt critical points of view with reference to the IFC methodology. Bohn (1995) studies the problem in an economic environment with uncertainty, and finds that the non Ponzi condition differs from (7) (which is the condition for an environment without uncertainty). The difference comes from the stochastic discount factor which cannot be expressed only based on the rate of return on government debt. Bohn (2007) conducts an analysis in an environment without uncertainty, and proves that the IFC is satisfied if public debt follows an integrated process of any finite order (this is also shown in Bergman (2001)). He argues against a strict econometric approach, that generally delivers weak conditions in a sense that one can show that the IFC is satisfied, and still that economy could default. However, the author follows Quintos (1995) and regards with tolerance a qualitative evaluation, the general idea being that the larger the order of integration for the debt series, the weaker the sustainability of government finances (even though strictly speaking the IFC continues to hold and (7) is respected, the convergence is much slower the higher the integration order of debt). The author favors an approach that places more value on economic intuition, like for example estimating and interpreting a fiscal reaction function (a recent paper that studies fiscal rules for the economies of the EU is Afonso and Hauptmeier (2009), for a study on Romania, see Socol and Socol (2009)).

4. Empirical results

This paper assesses fiscal sustainability in three EA candidates, the Czech Republic, Poland and Romania, using the IFC framework. The empirical approach focuses on testing if cointegration exists between public revenue and expenditures. While a thorough argument for this approach has been given in sections 2 and 3, an intuitive motivation is that cointegration would imply the existence of a long run equilibrium relationship between the two variables, meaning that even if revenues and expenditures are not stationary, a linear combination of the two series is in fact stationary, so they will never drift "too far away" from each other, which is an indicator for the stability of the government's fiscal position.

Data covers the period 1999Q1-2010Q3 (47 observations). As mentioned before, most of the studies in this strand of literature use annual data, because they mainly focus on developed economies, for which long time series are available. In this paper, we use quarterly data, because the sample would not otherwise allow obtaining statistically significant estimates. The variables are expressed in real terms as millions of 1999 national currency (using the CPI of each country) and the econometric analysis uses the natural logarithms of the series. The series were deseasonalised using the Tramo/Seats procedure available in Eviews 5. Nominal data on government revenues and expenditures come from the Eurostat. Data on the CPI come from the statistical offices of the three countries.

Before applying the formal cointegration procedures, a visual inspection of the evolution of the variables is necessary (to conserve space, the charts were not included, but are available upon request). What we are looking for is a "co-movement" of the series, such that even though they are not stationary, they never "drift too far apart from one another". The general impression in all three cases is that indeed there is such a co-movement between government revenue and expenditure, except for the last few observations in the sample, when the gap between the variables seems to widen. This corresponds to the fall in revenues and the rise in budget deficits due to the economic crisis. All in all, it would seem that revenues and expenditures are cointegrated in all the analyzed countries, however, formal tests need to be implemented in order to obtain robust results. They are performed using the Engle and Granger (1987) and the Johansen (1988, 1991) methodologies. For a general discussion on these procedures and their applications, see Enders (2004) or Ruxanda and Stoenescu (2009).

The Engle-Granger procedure

Cointegration in its original sense requires the series to be integrated of the same order. In step one of the Engle-Granger procedure, we determine the orders of integration of the time series in question, using the Augumented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Results are reported in table 1.

Table 1: ADF and PP results for government revenues and expenditures

Series	Level		First difference		Conclusion
	ADF	PP	ADF	PP	
CZ: exp	-1,7290	-1.8569	-9,8333***	-12.0821***	Series is *I(1)*
CZ: rev	-1,2117	-1.3068	-9,1026***	-8.9756***	Series is *I(1)*
PL: exp	0,8345	0.8342	-4,9270***	-6.9339***	Series is *I(1)*
PL: rev	-0,2213	-0.1896	-2,6981*	-5.4011***	Series is *I(1)*
RO: exp	-0,3249	-0.0995	-9,5354***	-9.5336***	Series is *I(1)*
RO: rev	-0,5076	-0.4270	-7,9129***	-7.8762***	Series is *I(1)*

Source: My own calculations in Eviews 5.

*Note: * and *** stand for statistical significance at the 90%, and 99% level respectively.*

Both unit root tests indicate that all the series are *I(1)*, therefore we can continue with the procedure. The second step is to estimate the regression depicted by (10) (slope estimations are summarized in table 2), and determine whether the residuals are stationary (test statistics of the ADF and PP are presented in table 3). If this is true, it would mean that $T_t - b \cdot G_t^r$ is a stationary combination of nonstationary variables, *T* and *G* being therefore cointegrated.

Table 2: Estimations for the slope coefficient in regression (10)

Slope estimation $\hat{b}$ (CZ)	Slope estimation $\hat{b}$ (PL)	Slope estimation $\hat{b}$ (RO)
1,0100	0,9215	0,8730

Source: My own calculations in Eviews 5.

We can notice that in the case of Romania and Poland, these estimations are below unity, which corresponds to expenses rising faster than revenues in the two economies. According to Hakkio and Rush (1991), this can create difficulties in maintaining fiscal credibility.

Table 3: ADF test results for residual stationarity in (10)

Country	ADF	PP	Conclusion
CZ	-4.0426***	-4.1057***	Stationary
PL	-2.5449	-1.7536	Not stationary
RO	-3.3266**	-3.3106**	Stationary

Source: My own calculations in Eviews 5

The results indicate the regression residuals are stationary in the case of the Czech Republic and Romania, which means that in these countries, government revenues and expenditures are cointegrated. This is an indicator of fiscal sustainability. In Poland, it would seem that the two series are not cointegrated.

The final step of the Engle-Granger procedure implies estimating the error correction model (ECM) for revenues and expenditures. According to the Granger representation theorem, two $I(1)$ series are cointegrated if and only if there exists an ECM that shows how the variables return to their long run equilibrium, and has the following representation:

$$\Delta T_t = \alpha_0 + \alpha_1 \cdot \left(T_{t-1} - b \cdot G^r_{t-1}\right) + \sum \lambda_i \cdot \Delta T_{t-i} + \sum \pi_i \cdot \Delta G^r_{t-i} \quad (12)$$

$$\Delta G^r_t = \beta_0 + \beta_1 \cdot \left(T_{t-1} - b \cdot G^r_{t-i}\right) + \sum \rho_i \cdot \Delta T_{t-i} + \sum \sigma_i \cdot \Delta G^r_{t-i} \quad (13)$$

Parameters α_1 and β_1 show the speed with which the variables return to their long run equilibrium, given by equation (10), and are known as *speed of adjustment* parameters. If the estimations of (12) and (13) reveal that these parameters are not significant, than the model is not one of error correction.

We estimate the ECM on Romanian and Czech data. Before we discuss estimation results, two things need to be mentioned. First, the saved residuals of the regression of revenues on expenditures serve as an instrument for the expression $T_{t-1} - b \cdot G^r_{t-1}$, because we have that:

$$\hat{\varepsilon}_{t-1} = T_{t-1} - \hat{b} \cdot G^r_{t-1} \quad (14)$$

In (12) and (13), the saved residuals will appear as explanatory variables. The second thing refers to lag selection in the ECM. Given that we use quarterly data, we test for a maximum of four lags and choose between different specifications using the Akaike and Schwarz Information Criteria. Finally, we exclude insignificant terms. Speed of adjustment estimations are summarized in table 4. Full estimation results are given in annex 1.

Table 4: Speed of adjustment estimations in the ECM

Rev. speed of adj. est. (CZ)	Exp. speed of adj. est. (CZ)	Rev. speed of adj. est. (RO)	Exp. speed of adj. est. (RO)
-0.28***	0.25**	0.21*	0.46***

Source: My own calculations in Eviews 5

Results show that for both economies, we have significant speed of adjustment parameters, in both revenue and expenditure equations. However, while for the Czech Republic, the adjustment can be deemed "normal", meaning that a positive deviation from the equilibrium relationship, given by a revenue increase or an expenses decrease, will determine positive expenditure and negative revenue dynamics in the following period, in order to restore equilibrium, for Romania this is not the case. Specifically, it would seem that only expenses react towards restoring equilibrium, whereas revenues adjust towards disequilibrium, indeed at a slower rate than expenses.

The Johansen procedure

Enders (2004) points out a number of defects of the Engle-Granger methodology. For example, when we test for cointegration between two series, different results can be obtained depending on our choice of dependent vs. explanatory variable in the long run relationship, due to relatively short samples (asymptotic theory guarantees obtaining identical results, but because limited data availability, this theory doesn't apply here). Moreover, the methodology relies on a two-step estimation, namely the stationarity test is performed on error estimations from the long run relationship between the variables (see (14)), instead of the true series of errors. The Johansen methodology manages to solve these problems.

Intuitively, this procedure can be seen as an extension to the multivariate case of the Dickey-Fuller procedure, and it involves building the following model:

$$\Delta x_t = \pi \cdot x_{t-1} + \sum_{i=1}^{p-1} \pi_i \cdot \Delta x_{t-i} + u_t \qquad (15)$$

where x is a vector containing the variables for which cointegration is being testes, in our case, $x_t = \begin{pmatrix} T_t & G_t^r \end{pmatrix}^{trans}$ and $u_t = \begin{pmatrix} u_{1t} & u_{2t} \end{pmatrix}^{trans}$, both series of residuals being stationary. The key intuition of the Johansen procedure is that we can use the rank of the matrix π to determine whether the components of x are cointegrated. We have that x is a 2 x 1 vector, so π is a 2 x 2 matrix, this means that the rank of π can either be 0, 1 or 2. I analyze each case in turn. If the rank is 2, in order for (15) to hold, both components of x have to be stationary. In the previous subsection we established that revenues and expenditures are both $I(1)$, so this case can be eliminated. If the rank is 0 (this would mean that all the elements of π are 0), (15) always holds because we have stationary series both in the left hand side and the right hand side members. If the rank is 1, there has to be a stationary linear combination of revenues and expenditures so that (15) is respected, which means that revenues and expenditures are cointegrated.

Johansen (1988, 1991) introduces the *trace* and the *maximum eigenvalue* tests to determine the rank of the matrix. Both of them rely on the fact that rank equals the number of eigenvalues that are different from 0. Suppose the eigenvalues of π are $\lambda_1 \geq \lambda_2 \geq ... \geq \lambda_n$ (in our case, *n=2*) and we obtain estimations for them from (15). The trace test has the null hypothesis that the rank of the matrix is *r* against a general alternative, and the statistic is:

$$\lambda_{trace} = -N\_obs \cdot \sum_{i=r+1}^{n} \ln\left(1-\hat{\lambda}_i\right) \qquad (16)$$

where *N_obs* is the number of observations. The maximum eigenvalue test has the same null, against the alternative that the rank is $r + 1$. The statistic is:

$$\lambda_{\max}\left(r, r+1\right) = -N\_obs \cdot \ln\left(1-\hat{\lambda}_{r+1}\right) \qquad (17)$$

Critical values for the statistics are computed *via* Monte Carlo procedures.

We estimate the model given by (15) and apply the trace and the maximum eigenvalue tests to determine the rank of π and see whether public revenues and expenditures are cointegrated. Regarding the number of lags to include in the model, we base our selection between specifications on the value of the likelihood function and the Akaike Information Criterion. Test results are reported in annex 2.

Results are in line with those obtained from running the Engle-Granger procedure. Both tests point to the absence of cointegration between revenues and expenditures in Poland, while for the Czech Republic and Romania the results are mixed, specifically, for both countries, the trace test rejects the null of no cointegration at the 90% level, and the maximum eigenvalue test cannot reject the null at the same level, although it comes rather close.

5. Conclusions

In this paper we set out to establish whether in the Czech Republic, Poland and Romania, public revenues and expenditures are cointegrated. According to the Intertemporal Fiscal Constraint methodology, finding this type of relationship between the variables would constitute an indicator of fiscal sustainability, meaning that even though the variables are not stationary, they don't "drift apart" from one another. The visual inspection of the evolution of public revenues and expenditures pointed to a co-movement of the variables in all three cases, which is a first indicator of cointegration. Formal econometric testing is done using the Engle-Granger and Johansen methodologies.

For the Czech Republic, the Engle-Granger procedure and the Johansen trace test indicate cointegration, while the Johansen maximum eigenvalue test points to absence of cointegration. Similar results are obtained for Romania, with the observation that in the error correction model, only public expenses adjust towards restoring equilibrium. We can conclude with some reserves that the IFC framework indicates long run fiscal sustainability for the Czech Republic and Romania. Revenue and expenditure cointegration in Poland is rejected by both methodologies, indicating that public finances are not sustainable in the long run.

Acknowledgements:
This article is a result of the project POSDRU/6/1.5/S/11 "Doctoral Program and PhD Students in the education research and innovation triangle". This project is co funded by European Social Fund through The Sectorial Operational Programme for Human Resources Development 2007-2013, coordinated by The Bucharest Academy of Economic Studies.

Annexes

Annex 1: ECM estimation results

1.1 Czech Republic:

Dependent Variable: DL_CZ_C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009663	0.006309	1.531605	0.1331
RES_CZ(-1)	0.253470	0.121218	2.091028	0.0426
DL_CZ_C(-1)	-0.261348	0.148997	-1.754043	0.0867

R-squared	0.232477	Mean dependent var	0.007467
Adjusted R-squared	0.195929	S.D. dependent var	0.046327
S.E. of regression	0.041542	Akaike info criterion	-3.459903
Sum squared resid	0.072480	Schwarz criterion	-3.339459
Log likelihood	80.84781	F-statistic	6.360757
Durbin-Watson stat	1.965747	Prob(F-statistic)	0.003863

Dependent Variable: DL_CZ_V

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007415	0.005007	1.481138	0.1460
RES_CZ(-1)	-0.289595	0.096193	-3.010577	0.0044
DL_CZ_C(-1)	-0.255918	0.118237	-2.164452	0.0362

R-squared	0.193292	Mean dependent var	0.005392
Adjusted R-squared	0.154877	S.D. dependent var	0.035859
S.E. of regression	0.032965	Akaike info criterion	-3.922379
Sum squared resid	0.045642	Schwarz criterion	-3.801935
Log likelihood	91.25353	F-statistic	5.031714
Durbin-Watson stat	2.254735	Prob(F-statistic)	0.010991

1.2. Romania:

Dependent Variable: DL_RO_C

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.022909	0.008699	2.633392	0.0118
RES_RO(-1)	0.462496	0.111803	4.136719	0.0002
DL_RO_C(-1)	-0.334551	0.120394	-2.778801	0.0081

R-squared	0.376494	Mean dependent var	0.018319
Adjusted R-squared	0.346803	S.D. dependent var	0.070031
S.E. of regression	0.056599	Akaike info criterion	-2.841297
Sum squared resid	0.134547	Schwarz criterion	-2.720853
Log likelihood	66.92918	F-statistic	12.68051
Durbin-Watson stat	2.072198	Prob(F-statistic)	0.000049

Dependent Variable: DL_RO_V

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.022176	0.008470	2.618267	0.0125
RES_RO(-1)	0.211531	0.120206	1.759734	0.0863
DL_RO_V(-1)	-0.336152	0.183479	-1.832094	0.0746
DL_RO_C(-2)	0.259412	0.113799	2.279574	0.0282
DL_RO_V(-2)	-0.342343	0.169674	-2.017647	0.0505

R-squared	0.231331	Mean dependent var	0.017034
Adjusted R-squared	0.152493	S.D. dependent var	0.052027
S.E. of regression	0.047896	Akaike info criterion	-3.132913
Sum squared resid	0.089468	Schwarz criterion	-2.930164
Log likelihood	73.92408	F-statistic	2.934268
Durbin-Watson stat	1.763269	Prob(F-statistic)	0.032594

Annex 2: Trace and maximum eigenvalue test results

2.1 Czech Rebublic:

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.218432	13.76785	15.49471	0.0895
At most 1	0.057763	2.677450	3.841466	0.1018

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.218432	11.09040	14.26460	0.1497
At most 1	0.057763	2.677450	3.841466	0.1018

2.2 Poland:

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.131162	6.437133	15.49471	0.6438
At most 1	0.012587	0.532015	3.841466	0.4658

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.131162	5.905118	14.26460	0.6254
At most 1	0.012587	0.532015	3.841466	0.4658

2.3 Romania:

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.242898	14.77337	15.49471	0.0640
At most 1	0.055879	2.530034	3.841466	0.1117

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.242898	12.24334	14.26460	0.1018
At most 1	0.055879	2.530034	3.841466	0.1117

REFERENCES

[1] **Afonso, A. (2005),** ***Fiscal Sustainability: the Unpleasant European Case***; *FinanzArchiv* 61(1), 19 – 44;
[2] **Afonso, A. and S. Hauptmeier (2009),** ***Fiscal Behavior in the European Union. Rules, Fiscal Decentralization and Government Indebtness***; *European Central Bank Working Paper No. 1054;*
[3] **Afonso, A. and C. Rault (2007),** ***What Do We Really Know about Fiscal Sustainability in the EU? A Panel Data Diagnostic***; *ECB Working Paper No. 820*;
[4] **Arghyrou, M. and K. Luintel (2007),** ***Government Solvency: Revisiting some EMU Countries***; *Journal of Macroeconomics* 29, 387-410;
[5] **Bergman, M. (2001),** ***Testing Government Solvency and the No Ponzi Game Condition;*** *Applied Economic Letters*, 8, 27-29;
[6] **Bohn, H. (1995),** ***The Sustainability of Budget Deficits in a Stochastic Economy ;*** *Journal of Money, Credit and Banking*, 27(1), 257-271;
[7] **Bohn, H. (2007),** ***Are Stationarity and Cointegration Restrictions Really Necessary for the Intertemporal Budget Constraint*?;** *Journal of Monetary Economics* 54, 1837-1847;
[8] **Chalk, N. and R. Hemming (2000),** ***Assessing Fiscal Sustainability in Theory and Practice***; *IMF Working Paper No. 81;*
[9] **Enders, W. (2004),** ***Applied Econometric Time Series*** **;** Second Edition, John Wiley & Sons;
[10] **Engle, R. and C. Granger (1987),** ***Co-Integration and Error Correction: Representation, Estimation and Testing*** **;** *Econometrica*, 55(2), 251-276;

[11] **Giammarioli, N., C. Nickel, P. Rother and J. P. Vidal (2007),** ***Assessing Fiscal Soundness. Theory and Practice*** **;** *ECB Occasional Paper No. 56;*
[12] **Hakkio, C. and M. Rush (1991),** ***Is the Budget Deficit 'Too Large*****?;** *Economic Inquiry*, 29 (3), 429-446;
[13] **Hamilton, J. and M. Flavin (1986),** ***On the Limitations of Government Borrowing: A Framework for Empirical Testing*** **;** *American Economic Review* 76, 808-819;
[14] **Holmes, M., J. Otero and T. Panagiotidis (2007),** ***Are EU Budget Deficits Sustainable*****? ;** *Longborough University Working Paper No. 13;*
[15] **Johansen, S. (1988),** ***Statistical Analysis of Cointegration Vectors*** **;***Journal of Economic Dynamics and Control,* 12(2-3), 231-254;
[16] **Johansen, S. (1991),** ***Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models*** **;** *Econometrica*, 59(6), 1551-1580;
[17] **Kočenda, E., A. Kutan, and T. Yigit (2008),** ***Fiscal Convergence in the European Union*** **.** *North American Journal of Economics and Finance* 19, 319-330;
[18] **Quintos, C. (1995),** ***Sustainability of the Deficit Process with Structural Shifts*** **.** *Journal of Business & Economic Statistics*, 13(4), 409 – 417;
[19] **Prohl, S. and F. Schneider (2006),** ***Sustainability of Public Debt and Budget Deficits: Panel Cointegration Analysis for the European Union Member Countries ;*** *Johannes Kepler University of Linz Working Paper No. 0610*;
[20] **Reinhart, C. and K. Rogoff (2010),** ***Growth in a Time of Debt.*** *NBER Working Paper No. 15639;*
[21] **Ruxanda, G. and S. Stroescu (2009),** ***Bivariate and Multivariate Cointegration and Their Application in Stock Markets*** **.** *Economic Computation and Economic Cybernetics Studies and Research,* 43(4);
[22] **Socol, C. and A. G. Socol (2009),** ***The Analysis of Fiscal Policy Management in Romania: Lessons for Emerging Countries*** **;** *African Journal of Business Management,* 3(5), 240-247;
[23] **Stock, J. and H. Watson (1988),** ***Testing for Common Trends*****;** *Journal of the American Statistical Association,* 83, 1097-1107;
[24]**Trehan, B. and C. Walsh (1991),** ***Testing Intertemporal Budget Constraints: Theory and Applications to U. S. Federal Budget and Current Account Deficits*****;** *Journal of Money, Credit and Banking*, 23 (2): 206 – 223.