Professor Ioan TALPOS, PhD
Associate Professor Bogdan DIMA, PhD
Senior Lecturer Mihai MUTASCU, PhD
Senior Lecturer Cosmin ENACHE, PhD
Faculty of Economics and Business Administration
West University of Timisoara

EMPIRICAL EVIDENCES FOR THE BUDGET DEFICITS CO-INTEGRATION IN THE OLD EUROPEAN UNION MEMBERS: ARE THERE ANY INTERLINKAGES IN FISCAL POLICIES? (PART ONE)

Abstract. *In the last years, the fiscal harmonization among the European Union members has become a pillar of economic integration and of fiscal and financial stability in the European area. The institutional changes, the semi-failure of the "old" Stability and Growth Pact as well as the recent waves of enlargements all these were put a greater emphasis on this issue inducing a higher pressure for fiscal discipline.*
In this context, the objective of the paper is to examines recent empirical evidences for bilateral and multilateral integration between fiscal policies, as this are synthesised by budget deficits, of old European Union members in the framework of the Johansen co-integration procedure with a preliminary appliance of the principal component analysis. The study finds that the dynamic of European fiscal policies takes place under the impact of some common driving forces which leads to a differentiate behaviour of two sub regional-groups individualized by the budget deficit series evolutionary patterns. Overall, it concludes that there could be find empirical evidences to support the thesis that a process of fiscal integration is currently running at least at the level of old European Union countries.
Key words: *Fiscal policies in E.U., budget deficits, co-integration, Johansen Test.*

JEL CLASSIFICATION: F15, H00, H61

1. Introduction

As Prohl and Schneider (2006, 2) noticed "In recent years, growing attention is paid to fiscal sustainability in Europe. Both, the debt and the deficit criteria, which are defined in the Maastricht Treaty, and the Stability and Growth Pact, are relevant to ensure the sustainability and stabilization of the public finance in the European Union (EU) member countries". Also as de Córdoba and Torres (2007,

2) argues" Fiscal harmonization for the European Union member states is a goal that encounters major difficulties for its implementation. Each country faces a particular trade-off between fiscal revenues generated by taxation and the productive efficiency loss induced by the tax code". The results of such trade-offs takes a special content in the context of the actual architecture of European Union.

There are several possible arguments for the existence of long-run relationships between fiscal policies of the old European Union members as this are synthesised by budget deficits. A minimal list of such arguments could include:

1) *The fiscal criteria of the Maastricht Treaty and the Stability Pact effects*

The Maastricht Treaty with its guideline philosophy of "Member States shall avoid excessive government deficits" and with the Protocol specification of "3% for the ratio of the planned or actual government deficit to gross domestic product at market prices" and respectively "60% for the ratio of government debt to gross domestic product at market prices" was established, at least theoretically, a common ceil on fiscal expansion for the European Union members and was imposed a sort of maximal reference for the fiscal discipline.

Also the Stability Pact set out to prevent one country from borrowing excessively at the expense of others, contributing to ensure the financial stability in the euro area. But from our point of view it is not yet clear what kind of effects will be induced by the "new" Pact of March 2005 with the differentiated "medium-term objectives"(MTO), the new provisions concerning the adjustment effort that should be made in order to reach the MTO, the fact that both the MTOs and the adjustment path towards them will be measured in cyclically adjusted terms and with *"exceptional circumstances" clause*, the taking into account of a long and detailed list of *"other relevant factors"* when assessing whether a deficit above 3% of GDP is excessive and with the specification that the initial deadline for correcting an excessive deficit should be set such that a minimum fiscal adjustment of 0.5% of GDP per annum is required.

2) *The automatic responses of government budget balances to the business cycle*

This argument could be formulated as follows: if a) the fiscal policy is based on countercyclical reactions and if b) the economic integration leads at the manifestation in the European Union of some common economic development trends than the budget deficits are moving together under the impact of cross-countries economic environment determinants.

The countercyclical case of fiscal policy is perhaps most clearly resumed by Alesina and Perotti (1995) which are arguing that that during episodes of energetic fiscal policy behaviour, governments make atypical choices between taxes and public investment, on the one hand, and public consumption and transfers, on the other. During major expansions, politicians predominantly raise consumption and transfers, while during vigorous consolidation they raise taxes and limit investment. But it should be noticed that the empirical support for this thesis is still controversial (see for an example Mélitz (2000)).

3) *The fiscal and monetary coordination*

The creation of EMU was raising a set of concerns about the coordination of fiscal and monetary policies since potentially the existence of the single monetary policy could substantially alter discretionary fiscal behaviour. Also a more permissive fiscal policy should be counterbalanced by a more tightly monetary policy. But as Mélitz (2000, 2) noticed "there is no support for the pessimistic view that monetary policy accommodates loose fiscal policy. The tightening of fiscal policy in response to easier monetary policy, in turn, results entirely from spending behaviour. Taxes do not contribute at all". Even this position is accepted in a "weaker" version still it could be argued that in a sense or other the autonomous fiscal policies should have a common type of reactions to the changes in the single monetary policy.

4) *The less" ideological" nature of fiscal policy*

The conception and the appliance of fiscal policies in European Countries (as well as in the developed non-European ones) tends to be rather "pragmatic" than "ideological". This implies that the structure of public expenditures is more willing to respond to economic and social similar objectives with less attention paid to the shifting in the public power doctrinal orientation. And of course, Brussels' over national structures are a strong supportive determinant of such "pragmatic" approach.

Such factors (and, of course, many others) explains why different studies, such as Prohl and Schneider (2006), finds that the deficit- and the debt-GDP ratios are co-integrated (for this study, the conclusion stands for France, Germany, Luxembourg, Portugal, Sweden, and the UK). Similar conclusions are reached in Alfonso (2005).

In this context, the objective of this paper is to provide some empirical evidences for the existence of long-run relationships between fiscal policies of old European Union members, policies which are captured by the evolutions of budget deficits.

The paper is organized as follows: Section 2 presents the involved methodology while Section 3 discusses the data and the empirical results. Section 4 provides the concluding remarks and some possible further research directions.

2. Methodology

The co-integration among the old European Union old members' fiscal policies synthesised by the budget deficit to GDP ratios is analysed in two stages. First, a preliminary *principal component* analysis is applied in order to identify the possible grouping configuration between different possible "fiscal families". Second, pairwise Johansen co-integration tests are conducted to examine the long-run relations established among the considered set of countries.

*2.1. **Principal component** analysis*

Principal components analysis models the variance structure of a set of observed variables using linear combinations of the variables. These linear combinations, or *components*, may be used in subsequent analysis, and the combination coefficients, or *loadings*, may be used in interpreting the components.

The *principal components* of a set of variables are obtained by computing the eigenvalue decomposition of the observed variance matrix. The first *principal component* is the unit-length linear combination of the original variables with maximum variance. Subsequent *principal components* maximize variance among unit-length linear combinations that are orthogonal to the previous components.
From the singular value decomposition, a (nxp) data matrix Y of rank r could be represented as:

$$Y = UDV' \qquad (1)$$

where U and V are orthonormal matrices of the left and right singular vectors, and D is a diagonal matrix containing the singular values.
More generally, one could write:

$$Y = AB' \qquad (2)$$

where A is an (nxr), and B is a (pxr) matrix, both of rank r, and

$$A = n^{\frac{\beta}{2}} UD^{1-\alpha}$$
$$B = n^{\frac{-\beta}{2}} VD^{\alpha} \qquad (3)$$

so that $0 \le \alpha \le 1$ is a factor which adjusts the relative weighting of the left (observations) and right (variables) singular vectors, and the terms involving β are scaling factors where $\beta \in \{0, \alpha\}$.
The basic options in computing the scores A and the corresponding loadings B involve the choice of (loading) weight parameter α and (observation) scaling parameter β.
In the *principal components* context, let $\sum$ be the cross-product moment (*dispersion*) matrix of Y, and let perform the eigenvalue decomposition:

$$\sum = L\Lambda L' \qquad (4)$$

where L is the pxp matrix of eigenvectors and Λ is the diagonal matrix with eigenvalues on the diagonal. The eigenvectors, which are given by the columns of L, are identified up to the choice of sign. It could be observed the facts that since the eigenvectors are by construction orthogonal, $L'L = LL' = I_m$.

There could be done some settings as $U = YLD^{-1}, V = L, D = (n\Lambda)^{\frac{1}{2}}$, so that:

$$A = n^{\frac{\beta}{2}} YLD^{-\alpha}$$
$$B = n^{-\frac{\beta}{2}} LD^{\alpha} \quad (5)$$

A could be interpreted as the *weighted principal components scores*, and B as the *weighted principal components loadings*.
Others detail of this procedure concerns an appropriate choice of the weight parameter α and the scaling parameter β through which different *scores* and *loadings* with various properties could be constructed.

2.2. The Johansen co-integration test

A further analytical step consists in taking into account the possible inter-linkages between the markets. This could be done based on *a JOHANSEN co-integration test* able to capture the "co-movements" between two or more non-stationary series. More exactly, Engle and Granger [1987] pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be co-integrated. The stationary linear combination is called the *co-integrating equation* and may be interpreted as a "long-run" equilibrium relationship among the variables. To test for the existence of such co-integrating relationships between the indices we will employ the methodology developed in Johansen (1991, 1995).

Thus lets consider y_t a k -vector of non-stationary *I(1)* variables, x_t a d - vector of deterministic variables, and ε_t a vector of innovations. Then the data generating process for y_ty is a *Gaussian vector autoregressive model* of finite order k, *VAR (k)* which could be write as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + Bx_t + \varepsilon_t \quad (6)$$

where:

$$\Pi = \sum_{i=1}^{p} A_i - I,\ \Gamma_i = -\sum \qquad (7)$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank $r < k$, then there exist kxr matrices α and β each with rank such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is I(0). r is the number of co-integrating relations (the *co-integrating rank*) and each column of β is the co-integrating vector. The

elements of α are known as the *adjustment parameters* in the *VEC model*. Johansen's method is to estimate the Π matrix from an unrestricted *VAR* and to test whether one can reject the restrictions implied by the reduced rank of Π.
The empirical time series may have nonzero means and deterministic trends as well as stochastic trends. Similarly, the co-integrating equations may have intercepts and deterministic trends. The asymptotic distribution of the LR test statistic for co-integration does not have the usual χ^2 distribution and depends on the assumptions made with respect to deterministic trends. Therefore, in order to carry out the test, one needs to make an assumption regarding the trend underlying the analysis data.

Usually, these assumptions imply the following five deterministic trend cases considered by Johansen (1995, p. 80–84):
1. The level data y_t have no deterministic trends and the co-integrating equations do not have intercepts:

$$\Pi y_{t-1} + Bx_t = \alpha\beta' y_{t-1} \qquad (8)$$

2. The level data y_t have no deterministic trends and the co-integrating equations have intercepts:

$$\Pi y_{t-1} + Bx_t = \alpha\left(\beta' y_{t-1} + \rho_0\right) \qquad (9)$$

3. The level data y_t have linear trends but the co-integrating equations have only intercepts:

$$\Pi y_{t-1} + Bx_t = \alpha\left(\beta' y_{t-1} + \rho_0\right) + \alpha_\perp \gamma_0 \qquad (10)$$

4. The level data y_t and the co-integrating equations have linear trends:

$$\Pi y_{t-1} + Bx_t = \alpha\left(\beta' y_{t-1} + \rho_0 + \rho_1 t\right) + \alpha_\perp \gamma_0 \qquad (11)$$

5. The level data y_t have quadratic trends and the co-integrating equations have linear trends:

$$\Pi y_{t-1} + Bx_t = \alpha\left(\beta' y_{t-1} + \rho_0 + \rho_1 t\right) + \alpha_\perp \left(\gamma_0 + \gamma_1 t\right) \qquad (12)$$

The terms associated with $\alpha_\perp$ are the deterministic terms "outside" the co-integrating relations. When a deterministic term appears both inside and outside the co-integrating relation, the decomposition is not uniquely identified. Johansen (1995) identifies the part that belongs inside the error correction term by orthogonally projecting the exogenous terms onto the α space so that $\alpha_{\perp}$ is the null space of α such that $\alpha^{'}\alpha_{\perp} = 0$.

In order to estimate the number of co-integration relationships, two tests could be employed:
The ***trace statistic*** tests the null hypothesis of r co-integrating relations against the alternative of k co-integrating relations, where k is the number of endogenous variables, for $r = 0,1,...k-1$. The alternative of k co-integrating relations corresponds to the case where none of the series has a unit root and a stationary VAR may be specified in terms of the levels of all of the series. The trace statistic for the null hypothesis of co-integrating relations is computed as:

$$LR_{tr}(r \mid \mathrm{k}) = -T \sum_{i=r+1}^{k} \log(1-\lambda_i) \quad (13)$$

where λ_i is the $i-th$ largest eigenvalue of the Π matrix.
The ***maximum eigenvalue statistic*** tests the null hypothesis of r co-integrating relations against the alternative of $r+1$ co-integrating relations. This test statistic is computed as:

$$LR_{\max}(r \mid \mathrm{r}+1) = -T \sum_{i=r+1}^{k} \log(1-\lambda_{r+1}) = \\ = LR_{tr}(r \mid \mathrm{k}) - LR_{tr}(r+ \mid \mathrm{k}) \quad (14)$$

REFERENCES

[1]**Afonso, A. (2005),** ***Fiscal Sustainability: The Unpleasant European Case,*** *FinanzArchiv*, 61 (1), pp. 19-44;
[2] **Alesina, A., Perotti, R. (1995),** ***Fiscal Adjustment: Fiscal Expansions and Adjustments in OECD Countries***. *Economic Policy* 21, October, pp. 205-48;
[3] Banerjee, A.,Carrion-i-Silvestre, J. L. (2006), ***Cointegration in Panel Data with Breaks and Cross-section Dependence***. ECB WP N. 591;
[4] **Blanchard, O., Perotti, R. (1999),** ***An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output***, *NBER Working Paper* 7269 (July);

[5] **De Córdoba, G. F.,Torres, J. L. (2007),** ***Fiscal Harmonization in the Presence of Public Inputs***. *Centro de Estudios Andaluces Economic Working Papers* E2007/08;
[6] **Gabriel, K. R. (1971),** ***The Biplot-graphic Display of Matrices with Application to Principal Component Analysis*****.** *Biometrika*, 58, pp.453-467;
[7] **Johnson, Richard A., Wichern, D. W. (1992),** ***Applied Multivariate Statistical Analysis***. *Third Edition, Upper Saddle River, New Jersey: Prentice-Hall, Inc*.;
[8] **Johansen, S. (1995).** ***Likelihood-based Inference in Cointegrated Vector Autoregressive Models***. *Oxford University Press*, Oxford;
[9] **Johansen, S., Juselius, K. (1990),** ***Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money***. *Oxford Bulletin of Economics and Statistics*, 52, pp.169-210;
[10] **Johansen, S. (1988*), Statistical Analysis of Cointegrating Vectors***, *Journal of Economics Dynamics and Control*, 12,pp. 231-254;
[11] **Levine, P., Brociner, A. (1994) ,** ***Fiscal Coordination under EMU and the Choice of Monetary Instrument***. *Journal of Economic Dynamics and Control* 18, pp. 699-729;
[12] **Mélitz, J. (2000) *,Some Cross-Country Evidence about Fiscal Policy Behaviour and Consequences for EMU.*** *European Economy*, *Reports and Studies* 2, 3-21;
[13**] Perraudin, W. R. M., Pujol, T. (1990),** ***European Fiscal Harmonization and the French Economy***. *IMF Working Paper* WP/90/96;
[14] **Prohl, S., Schneider, F. (2006) ,** ***Sustainability of Public Debt and Budget Deficit: Panel Cointegration Analysis for the European Union Member Countries***. *Department Of Economics, Johannes Kepler University of Linz Working Paper* 0610, July 2006;
[15] **Sokal, R. R., Rohlf, F. J. (1995) *,Biometry.*** *New York: W. H. Freeman and Company.*