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EMPIRICAL EVIDENCIES FOR THE BUDGET DEFICITS CO-INTEGRATION IN THE OLD EUROPEAN UNION MEMBERS: ARE THERE ANY INTERLINKAGES IN FISCAL POLICIES?

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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 $0 \leq \alpha \leq 1$ 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:

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

.
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_t y 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:

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

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:

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

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:

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

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:

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

3. Data and empirical results

Data consists on quarterly budget deficit values for 14 European Union old members' countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Spain, Sweden and United Kingdom (in order to ensure the data homogeneity and completeness the case of Portugal was excluded) from *Quarterly Summary Government Finance Statistics template tables*, *Eurostat 2008*.

The choice of data frequency was based on Blanchard and Perotti (1999,2) argument:" with enough institutional information about the tax and transfer systems and the timing of tax collections, one can construct estimates of the automatic effects of unexpected movements in activity on fiscal variables, and, by implication, obtain estimates of fiscal policy shocks".

Of course, we are aware of the counter-arguments which make a case for the usage of year frequency data (see, for instance, Mélitz (2000, 24) position according to which "the move to the quarterly frequency may do little. If government expenditures (especially those on goods and services) really respond automatically to the cycle, no amount of institutional detail about taxes and transfers will account adequately for the automatic responses, any more at the quarterly than the annual frequency"). Still, we consider that since there is an unclear empirical support for the "automatic" response of fiscal policies in European Union it could be with an acceptable analytical price take into consideration such a data frequency. All the values are expressed as percentage of GDP ensuring the scale comparability. The time span of the analysis is almost 7 years (2000:04-2007:03).

Table 1 provides the descriptive statistics of the data. The budget deficit series are positively *skewed* (with the exception of Austria, Belgium, Netherlands, Spain and United Kingdom) and "flat" (*platykurtic*) relative to the normal (with the exception of Austria, Belgium and Greece data).

Table 2 reports the correlation coefficients between the analyzed budget deficit series. There could be identified three groups of correlation coefficients: one with high values between 0.63 and 0.73 for Austria, Belgium, Finland, France and Luxemburg, one with medium values of 0.49 and 0.71 for United Kingdom, Ireland and Sweden and one with low/negative values for Spain, Greece and Italy and Denmark.

3.1. The principal components results

The results from the appliance of *principal components* analysis are reported in Table 3. The "header" describes the sample of observations, the method used to compute the dispersion matrix, and information about the number of components retained (in this case, all nine).

The next section summarizes the eigenvalues, showing the values, the forward difference in the eigenvalues, the proportion of total variance explained, etc. Since there is performed a *principal components* analysis on a correlation matrix, the sum of the scaled variances for the fourteen variables is equal to 14. The first *principal component* accounts for 50% of the total variance, while the second contributes with 25% and the third with 11% of the total. Together the first three components generated 86% of the global variance.

The second section describes the linear combination coefficients. We see that the first principal component (labelled "PC1") is a roughly-equal linear combination of all 14 indices and could be interpreted as an "overall deficit". The second *principal component* (labelled "PC2") has negative loadings for the Austria, Belgium, Finland, France, Italy and Luxemburg and positive loading for the rest of the countries suggesting the existence of at least two sub-regional groups of fiscal families.

The third section of the output displays the calculated correlation matrix with significant high levels of ordinary correlations.

3.2. The Johansen co-integration test

The first task in performing a co-integration analysis is to check if the used series are integrated of order "1". For this purpose, several unit root tests are employed (The Augmented Dickey-Fuller, the Phillips-Perron, and Kwiatkowski, Phillips, Schmidt, and Shin tests are implemented and provide the same results) (Table 4). These tests significantly confirm at all levels (1%, 5% and 10%) that the budget deficit series are not stationary in levels. Complementary, the same tests (not reported here) had been done on first order differences confirming that the indices' evolution could be described as an *I(1)* process .

Based on these results we proceed with the co-integration, applying the methodologies described previously. The analysis strategy consists in applying the Johansen procedure for each pair of countries selecting the lag length by using both *Akaike's information criterion* and *Schwarz Bayesian Information Criterion*. The involved length was established by taking into account the common results of these measures of the goodness of fit. All the five deterministic trends cases were tested. In order to count for the effects of the "new" Stability Pact an exogenous dummy variable with "0" before and "1" after the second quarter of 2005 was included in the tests.

The Table 5 reports the results considering that the co-integration hypothesis is supported by both ***trace statistic*** and ***maximum eigenvalue statistics*** that confirms the existence of 1 co-integration relation at a 5% level. Supplementary, the residuals for the co-integration equations had been tested in terms of stationarity and only the cases for which this stationarity was confirmed according to all the three mentioned stationarity tests had been retained. The statistic significance of the adjustment coefficients for the pairs of countries we detected co-integration relations was used to accept / reject the hypothesis that one of the index dominates the existing common trend with the other one. For most of the pairs, there was not found a clear evidence for such domination.

After a co-integration status was detected on individual pairs, for each of the deficits there was a re-run of the procedure on a multi-dimensional system with all the connections that was founded significant. The co-integration relations are reported in Table 6. It could be noticed the fact that all the co-integration coefficients are significant and overall the considered co-integration relations seems to be stable for the analysis period.

The main findings are resumed by Figure 1. This depicted the sub-groups of countries and the interlinkages between them (the groups are constructed based on the principle "all are co-integrated with all"). A first group is composed by continental countries (Germany, Austria, Finland, Netherlands, Denmark, Greece, and Spain). A second group is formed by Ireland and United Kingdom. Interesting, France and Sweden are also integrated in this group. There also three countries (Italy, Luxemburg and Belgium) which are also co-integrated with the majority of the first group members (with the notable exceptions of no co-integration relationships with Austria, Belgium, Denmark and Greece).

4. Conclusions and further research

In this paper, we examine the long-run relations between 14 European budget deficits data. Our results suggest that in terms of co-integration status there could be highlighted the existence of two sub-groups of countries with non-uniform degree of co-integration.

Two main points emerge from the analysis performed. First, we find evidences that there are long-run connections between fiscal unbalanced evolutions at the level of old European Union members. These evidences are consistent with the alternative empirical studies. Second, according to these results there could be distinguishing between two main cases of association in the evolutions of the fiscal disequilibrium: the "continental" and respectively the "Anglo-Saxon / Nordic plus France" ones.

Of course, these results could be ample criticised since the underline analytical framework have a large number of weakness. Between these:

(1) <u>What kind of transmission mechanism?</u>
One of the major weaknesses of the proposed analysis consists in the fact that there is no associated formal explanation of the fiscal imbalances propagation among the considered countries. So that, there is no clear how the mentioned results could be fitted in a conceptual approach of the fiscal interlinkages issue.

(2) <u>What are the determinants?</u>
In the absence of a theoretical background there is no possible to count for the influence of a possible explanatory variables such as Maastricht Treaty and the Stability and Growth Pact.

(3) <u>What about other analytical methods?</u>
The *principal component* method is used as complementary analysis to the Johansen procedure and it tends to support its conclusions but nothing is mentioned about the approached used in other studies such as *Dynamic Conditional Correlation* (DCC) and *Markov Switching ARCH-L* more proper designed to deal in an adequate manner with co-integration. Also, as for instance is mentioned in Alfonso (2005) the panel co-integration methodology has several advantages in comparison to the univariate analysis applied in the empirical literature and used also in this study.

Also it could be noticed that the described situation could change due to the advance in deepening the CEE / Baltic fiscal systems and in their harmonization with old European Union ones, the consequences of the European constitution project failure and also as a result of the global financial instability. Thus, a further development of the proposed analysis should as a minimal requirement:
1) Apply alternative methodologies for a proper study of co-integration status of budget deficits in an environment of financial and fiscal instability;
2) Propose a sound conceptual model able to capture the determinants of the fiscal co-integration and to explain the discriminant factors for the existence of the mentioned sub-groups;
3) To estimate the consequences of the current financial volatility for the public revenues.
Despite these *caveats* (and many others not specified) we consider that such type of analysis could highlight the long-run process of fiscal harmonization between the old European Union member countries as a part of the economic integration deepening process.

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ANNEXES

Table 1: **The main characteristics of the budget deficits data**

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxemburg	Netherlands	Spain	Sweden	United Kingdom
Mean	-1.52	-0.50	2.39	3.97	-2.81	-2.48	-5.03	1.27	-3.07	1.98	-0.76	-0.51	0.37	1.22
Median	-1.42	-0.12	2.05	3.65	-2.68	-3.31	-4.81	1.17	-3.37	1.37	-0.50	0.26	-0.30	1.74
Maximum	0.10	0.65	5.34	6.93	-1.23	1.31	-3.09	4.71	-0.86	6.17	2.00	6.46	2.85	3.75
Minimum	-3.91	-3.34	-0.23	2.18	-4.19	-4.22	-8.84	-0.95	-4.40	-1.27	-3.32	-9.44	-1.02	-1.62
Std. Dev.	1.10	1.08	2.02	1.49	0.90	1.74	1.52	1.45	0.87	2.53	1.57	4.24	1.23	1.73
Skewness	-1.04	-1.60	0.20	0.49	0.13	0.98	-0.91	0.44	0.76	0.42	-0.06	-0.71	0.71	-0.23
Kurtosis	3.37	4.27	1.49	2.00	1.88	2.54	3.15	2.85	2.88	1.80	1.95	2.65	1.95	1.70
Jarque-Bera	5.38	14.38	2.94	2.35	1.59	4.87	4.07	0.98	2.85	2.60	1.35	2.56	3.77	2.30
Probability	0.07	0.00	0.23	0.31	0.45	0.09	0.13	0.61	0.24	0.27	0.51	0.28	0.15	0.32
Sum	-43.97	-14.50	69.45	115.24	-81.63	-71.87	-145.92	36.88	-89.09	57.50	-22.12	-14.67	10.72	35.41
Sum Sq. Dev.	33.99	32.70	114.59	62.14	22.86	84.88	64.34	58.51	21.23	178.56	68.73	503.58	42.33	84.08
Observations	29	29	29	29	29	29	29	29	29	29	29	29	29	29

Table 2: **Correlation coefficients of quarterly budget deficit series**

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxemburg	Netherlands	Spain	Sweden	United Kingdom
Austria	1.00	0.69	-0.16	0.63	0.52	0.31	0.51	-0.10	0.43	0.73	0.24	-0.35	-0.02	0.09
Belgium	0.69	1.00	-0.22	0.45	0.35	0.27	0.24	0.08	0.36	0.53	0.12	-0.28	-0.06	-0.01
Denmark	-0.16	-0.22	1.00	0.09	0.32	0.48	0.45	0.50	-0.03	-0.13	0.65	0.49	0.86	0.76
Finland	0.63	0.45	0.09	1.00	0.90	0.79	0.63	0.39	0.76	0.92	0.74	-0.62	-0.06	0.62
France	0.52	0.35	0.32	0.90	1.00	0.72	0.63	0.54	0.52	0.86	0.87	-0.54	0.05	0.73
Germany	0.31	0.27	0.48	0.79	0.72	1.00	0.61	0.68	0.74	0.55	0.85	-0.25	0.32	0.84
Greece	0.51	0.24	0.45	0.63	0.63	0.61	1.00	0.21	0.47	0.56	0.62	-0.01	0.46	0.51
Ireland	-0.10	0.08	0.50	0.39	0.54	0.68	0.21	1.00	0.35	0.20	0.77	-0.25	0.17	0.71
Italy	0.43	0.36	-0.03	0.76	0.52	0.74	0.47	0.35	1.00	0.60	0.50	-0.50	-0.09	0.44
Luxemburg	0.73	0.53	-0.13	0.92	0.86	0.55	0.56	0.20	0.60	1.00	0.56	-0.72	-0.25	0.38
Netherlands	0.24	0.12	0.65	0.74	0.87	0.85	0.62	0.77	0.50	0.56	1.00	-0.28	0.35	0.93
Spain	-0.35	-0.28	0.49	-0.62	-0.54	-0.25	-0.01	-0.25	-0.50	-0.72	-0.28	1.00	0.76	-0.09
Sweden	-0.02	-0.06	0.86	-0.06	0.05	0.32	0.46	0.17	-0.09	-0.25	0.35	0.76	1.00	0.49
United Kingdom	0.09	-0.01	0.76	0.62	0.73	0.84	0.51	0.71	0.44	0.38	0.93	-0.09	0.49	1.00

Table 3: **Principal components analysis of the budget deficits**

Computed using: Ordinary correlations

Extracting 14 of 14 possible components

Eigenvalues: (Sum = 14, Average = 1)

Number	**Value**	**Difference**	**Proportion**	**Cumulative Value**	**Cumulative Proportion**
1.000	6.922	3.423	0.494	6.922	0.494
2.000	3.498	1.917	0.250	10.420	0.744
3.000	1.581	0.869	0.113	12.001	0.857
4.000	0.712	0.061	0.051	12.713	0.908
5.000	0.651	0.396	0.047	13.363	0.955
6.000	0.255	0.086	0.018	13.618	0.973
7.000	0.169	0.075	0.012	13.787	0.985
8.000	0.094	0.052	0.007	13.881	0.992
9.000	0.042	0.018	0.003	13.923	0.995
10.000	0.024	0.001	0.002	13.946	0.996
11.000	0.022	0.005	0.002	13.969	0.998
12.000	0.017	0.008	0.001	13.986	0.999
13.000	0.009	0.004	0.001	13.995	1.000
14.000	0.005	---	0.000	14.000	1.000

Eigenvectors (loadings):

Variable	**PC 1**	**PC 2**	**PC 3**	**PC 4**	**PC 5**	**PC 6**	**PC 7**	**PC 8**	**PC 9**	**PC 10**	**PC 11**	**PC 12**	**PC 13**	**PC 14**
Austria	0.206	-0.258	0.472	0.004	0.142	0.156	0.768	0.107	0.005	-0.066	0.125	0.037	-0.008	0.037
Belgium	0.155	-0.248	0.362	0.663	0.319	-0.053	-0.399	-0.185	-0.146	-0.117	0.096	0.014	-0.029	0.015
Denmark	0.146	0.481	0.057	-0.055	0.150	0.068	0.086	-0.339	-0.202	-0.348	-0.194	0.093	0.568	0.247
Finland	0.354	-0.154	0.008	-0.110	-0.085	0.197	-0.203	0.256	0.237	-0.249	-0.004	-0.714	0.195	0.143
France	0.354	-0.045	-0.050	-0.240	0.318	0.022	-0.135	-0.089	0.461	-0.093	0.060	0.303	0.143	-0.589
Germany	0.341	0.113	-0.067	0.224	-0.298	0.140	-0.061	0.621	-0.290	-0.175	-0.217	0.361	0.012	-0.158
Greece	0.273	0.096	0.365	-0.328	-0.210	-0.711	-0.120	0.035	-0.222	0.002	0.240	-0.041	-0.014	-0.033
Ireland	0.233	0.186	-0.410	0.424	0.229	-0.458	0.302	0.171	0.205	0.292	0.018	-0.146	0.162	0.079
Italy	0.275	-0.143	-0.049	0.248	-0.714	0.028	0.100	-0.484	0.258	0.059	-0.004	0.104	0.068	0.007
Luxemburg	0.306	-0.276	0.074	-0.250	0.139	0.082	-0.193	0.021	-0.008	0.566	-0.331	0.241	0.118	0.443
Netherlands	0.345	0.176	-0.153	-0.078	0.151	-0.040	0.043	-0.171	0.097	-0.322	-0.181	0.045	-0.731	0.288
United Kingdom	-0.174	0.392	0.366	0.103	-0.086	0.058	-0.149	0.267	0.584	0.015	0.234	0.235	-0.006	0.340
Spain	0.072	0.452	0.379	0.090	-0.023	0.144	0.019	-0.090	-0.003	0.397	-0.413	-0.328	-0.179	-0.377
Sweden	0.305	0.271	-0.158	-0.035	0.036	0.402	-0.054	-0.084	-0.276	0.298	0.679	-0.029	-0.083	0.020

Ordinary correlations:

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxemburg	Netherlands	United Kingdom	Spain	Sweden
Austria	1.000													
Belgium	0.691	1.000												
Denmark	-0.158	-0.222	1.000											
Finland	0.626	0.454	0.088	1.000										
France	0.520	0.350	0.316	0.896	1.000									
Germany	0.312	0.267	0.477	0.791	0.716	1.000								

Greece	0.513	0.240	0.448	0.627	0.632	0.612	1.000							
Ireland	-0.096	0.082	0.505	0.393	0.540	0.676	0.212	1.000						
Italy	0.429	0.359	-0.032	0.757	0.516	0.745	0.472	0.346	1.000					
Luxemburg	0.730	0.530	-0.129	0.917	0.861	0.545	0.555	0.195	0.603	1.000				
Netherlands	0.236	0.125	0.653	0.740	0.874	0.847	0.624	0.770	0.504	0.564	1.000			
United Kingdom	-0.350	-0.285	0.489	-0.619	-0.538	-0.250	-0.009	-0.250	-0.505	-0.724	-0.281	1.000		
Spain	-0.018	-0.063	0.863	-0.063	0.055	0.325	0.460	0.174	-0.086	-0.250	0.350	0.755	1.000	
Sweden	0.086	-0.005	0.760	0.616	0.729	0.840	0.514	0.714	0.437	0.384	0.930	-0.090	0.495	1.000

Table 4: **Unit root tests for budget deficits**

	ADF	PP	KPSS
Austria	-0.635693	-1.778833	0.869672
Belgium	-2.312359	-2.313734	0.366086
Denmark	-1.933882	-2.546872	0.785872
Finland	0.191058	-0.867101	4.372407
France	-1.526999	-1.574816	2.187663
Germany	-2.041683	-2.271259	1.492133
Greece	-1.319081	-2.100976	0.946071
Ireland	-2.604207	-2.565583	1.949515
Italy	-0.220636	-1.753521	0.948248
Luxemburg	-0.490754	-1.927535	0.978770
Netherlands	-2.939341	-2.095233	1.794515
Spain	-1.573853	-1.675745	3.157598
Sweden	-2.653885	-2.186183	1.475573
United Kingdom	-1.018890	-1.235180	0.640207

Notes:

ADF, PP and KPSS are the *Augmented Dickey-Fuller*, the *Phillips-Perron* and the *Kwiatkowski-Phillips-Schmidt-Shin* unit root tests, respectively. The lag length is chosen using the *Modified Hannan-Quinn* information criterion.

The spectral estimation method is *AR spectral-GLS detrended* for the PP and KPSS tests. For the ADF and PP tests, the null hypothesis is the *presence of a unit root*, whereas for the KPSS tests, the null hypothesis is *stationarity*.

For all the tests there is a constant and a linear trend as exogenous variables. The ADF critical values for 1%,5% and 10% significance levels are -4.323979, -3.580623 and -3.225334, the PP critical values are -4.323979, -3.580623and -3.225334, the KPSS critical values are 0.216, 0146 and respectively 0.119.

Table 5: **The pairs Johansen co-integration test**

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxemburg	Netherlands	Spain	Sweden	United Kingdom
Austria		No	No	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes/No	No
Belgium			No	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	No
Denmark				Yes	Yes/No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
Finland					No/Yes	Yes	Yes	Yes	Yes	Yes/No	Yes	Yes	Yes	Yes
France						Yes	No	Yes	No	Yes/No	Yes	No	Yes	Yes
Germany							Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Greece								No	No	No	Yes	Yes	Yes/No	No
Ireland									No	Yes/No	No	Yes	Yes	Yes
Italy										No	No	Yes	No	No
Luxemburg											Yes	No	No	Yes
Netherlands												Yes	Yes	Yes/No
Spain													Yes	No
Sweden														Yes
United Kingdom														

Table 6: **The co-integration equations**

GREDEF(-1)	1.000000	SWEDEF(-1)	1.000000
SPADEF(-1)	-3.459386 (0.14274) [-24.2355]	FRADEF(-1)	-2.986802 (0.25529) [-11.6997]
DANDEF(-1)	-1.057636 (0.08869) [-11.9254]	UKDEF(-1)	-0.526759 (0.18183) [-2.89696]
FINDEF(-1)	-1.433974 (0.06241) [-22.9759]	IRLDEF(-1)	0.397196 (0.13916) [2.85426]
AUSDEF(-1)	1.153520 (0.07168) [16.0928]	@TREND(00Q4)	0.212532 (0.08804) [2.41414]
NETHEF(-1)	2.448402 (0.10096) [24.2523]	C	-13.37523
GERDEF(-1)	-0.064492 (0.04194) [-1.53776]		
@TREND(00Q4)	0.550511		
C	9.810692		

Figure 1: **The sub-groups of "fiscal families"**