CONVERGENCE OF FISCAL PRESSURE IN THE EU: A TIME SERIES APPROACH [*]

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ABSTRACT

The study of fiscal convergence in the European Union is an interesting issue in the context of economic integration and fiscal harmonization and we report new empirical evidence on this topic through the time series approach. We use unit root and stationarity tests with an endogenous break for the study of long run, deterministic and stochastic convergence of the national fiscal pressure taking Germany, the United Kingdom and the European average as benchmarks. Only the United Kingdom and Germany present long run convergence and few countries converge with them despite harmonization efforts and fiscal competition.

Keywords: fiscal pressure, convergence, unit root, stationarity, structural break.

JEL classification: C22, E62, H87.

1. INTRODUCTION

Convergence of per capita income has received much attention since the relevant works of Baumol (1986), Barro and Sala-i-Martin (1992) and Mankiw *et al.* (1992) to test the predictions of the Solow neoclassical model (1956). Nevertheless, there have been few studies on fiscal convergence in the European Union, an interesting issue in the framework of economic integration and fiscal harmonization.

Fiscal differences among the Member States can alter the free movement of goods, capital and workers. However, the existence of some divergences is clearly explained by the different views of the role and scope of the public sector in the economy –market failures, redistribution and stabilization– and the extent of the welfare state. As it is well known, the two opposite public sector models in Europe are the British and the Nordic views, the former with a fiscal pressure significantly below the average and a very low social security contributions share, and the latter with fiscal pressure around 50 per cent and great relevance given to income and profits taxation.

Convergence can be studied from two perspectives, cross section analysis and the time series approach. Within the first group, the analysis is carried out for the group of countries and beta and sigma convergence are widely applied. Beta convergence means that the poorer countries grow faster than the richer and the so-called convergence speed or rate is estimated. Sigma convergence needs the dispersion of the variables to diminish throughout time. In the time series setting, the study is for pairs of countries. Long run convergence requires that the difference between the country and the benchmark is stationary around a zero level, deterministic convergence that the difference is stationary around a non-zero level, and stochastic convergence or catching up that the difference is stationary around a trend that diminishes the gap between them (beta convergence condition).

In the review of the literature about convergence of fiscal pressure in the EU[1] with time series tests, Esteve *et al.* (1999), using unit root tests with a break and taking Germany as benchmark, reject the long run convergence for the six OECD main tax subdivisions but they find catching up for some countries in the period 1967-1994. For that same period and for the total fiscal pressure, Esteve *et al.* (2000) only find long run convergence between Austria and Germany, and catching up for a group of countries –Belgium, Italy, Portugal, Spain, Sweden and the United Kingdom–.

Within the cross section studies, Esteve *et al.* (2000) find evidence of convergence of total fiscal pressure for the period 1967-1994. They use sigma and beta

[1] Another perspective is the study of the convergence of fiscal policies –see De Bandt and Mongelli (2000) and Blot and Serranito (2006)– or the convergence of the Maastricht criteria such as deficit and debt ratios to GDP.

convergence with a convergence rate of 2.4% for that period. Sosvilla *et al.* (2001) analyse the EU tax burden for the period 1967-1995 and they observe that the sigma convergence has not been continuous and took place in the periods 1967-1974 and 1984-1995. Gemmell and Kneller (2003) study the fiscal convergence for a ten European countries sample in 1970-1995. They find sigma convergence through Gini coefficient for the total fiscal pressure and the distortionary component, whereas not for the non-distortionary taxation. Delgado (2006) studies the convergence of the tax mix and the fiscal pressure. The beta, sigma and gamma convergence results show convergence in the overall period 1965-2004, but centred approximately between 1975 and 1990, and since then fiscal convergence in the EU has hardly progressed.

The main objective of this paper is to test if there is convergence of fiscal pressure in the EU-15 through the time series techniques. This paper attempts to contribute to the debate about fiscal approximation with empirical evidence. With this aim, we study fiscal pressure with respect to the European average, Germany as a leader country and the United Kingdom as the origin of the fiscal changes in Europe from the seventies. We employ data from the OECD for the period 1965-2004. Data are total tax revenues as a percentage of GDP or total fiscal pressure. With respect to the above mentioned works about convergence with time series tests, Esteve *et al.* (1999, 2000), in this paper unit root and stationarity tests are employed jointly as a means to confirm the results derived from both kinds of tests, and more notions of convergence, including the deterministic convergence and the β-convergence condition for the stochastic convergence, are researched. Also, a wide range of countries, which include Germany, the United Kingdom and the European average, are considered as benchmarks and all of them for a wider period which finishes in 2004, the last year available at the moment.

The structure of the paper is as follows. Fiscal harmonization in the EU is briefly revised in Section 2. Section 3 describes the notions of convergence in the time series framework. Section 4 includes the methodology of unit root and stationarity tests, and of the β-convergence condition for the catching up. The empirical results are presented in Section 5. Section 6 concludes. The appendix contains the detailed results from tests applied for the analysis.

2. FISCAL HARMONIZATION AND EVOLUTION OF THE TAX SYSTEM IN THE EU

Fiscal harmonization in the EU is integrated in the Treaty of European Union in its article 93, which establishes that process in the indirect tax framework.

However, the text of article 94 refers to direct tax –although in a non explicit way– in the functioning of the single market.

Tax harmonization has been and will continue to be a matter of interest in the EU[2]. Some of the main questions to solve are: is tax harmonization useful? is tax coordination necessary?, is tax competition harmful? These topics have been studied by a large number of authors with differing conclusions (see Wilson, 1999; Eggert and Genser, 2001; Sorensen, 2004). Recently Auerbach (2006), in his study on capital income taxation[3] and international coordination, concludes that "countries are likely to have different interests in the formulation of international tax agreements; the motivation for existing agreements is not always evident; and their application may serve to limit the adoption of generally beneficial tax policies".

Fiscal approximation in the EU is also confronted with the unanimity[4] and subsidiariety principles and the difficult balance between the EU as a supranational organization and the sovereignty of the states. The countries are averse to losing the short margin in the fiscal policy, the only one stabilization instrument in the Euro zone after giving up the monetary competences and the limitations from the Stability and Growth Pact.

Major advances have taken place in indirect taxation, Value Added Tax (VAT) and excises. With respect to VAT, the major agreements were achieved with the Sixth VAT Directive (1977) and the agreements on rates after the elimination of the frontier controls (1992). The Member States must have a standard rate not inferior to 15 per cent, one or two reduced rates and the suppression of the higher rate applied to luxury goods[5]. Today, the politics of the EU are directed towards improving the performance of the destination based system, although the objective is an origin based VAT system. This transition is complicated because of the differences on the actual rates (from the 15 per cent of Luxembourg to the 25 per cent of Denmark and Sweden) and it needs a greater

[2] Tax harmonization can be interpreted as an instrument to reach the objective of a well-performing single market or a fundamental key towards European political union. For that harmonization, there are two main strategies: the competitive, based on fiscal competition, and the institutional, based on agreements of the Member States. Due to the difficulties of the agreement, the former has been the predominant strategy, especially in the capital case.

[3] Conventional view holds that capital tax competition leads to a "race to the bottom", but the empirical evidence does not reflect that conclusion. See Baldwin and Krugman (2004).

[4] Obviously, the unanimity criterion slows down the fiscal harmonization process. Although this principle was justified when the number of members was low, we think that with the last EU enlargements up to the EU-27 it must be revised to a less restrictive one such as the qualified majority. Another option is reinforced cooperation (at least 8 Member States).

[5] As well the agreement included the status quo of some special features: Luxembourg and Spain with their reduced rates not below the 3 per cent; Ireland and the United Kingdom with their zero rates; and rates not inferior to 5 per cent in other countries.

uniformity in order to minimize the effects on intra commerce –efficiency–. One possible solution can consist of a smaller interval for the standard rate and the progressive simplification of the remaining rates, for example with only one reduced for necessary goods.

In the case of excise duties, the advances have been less significant and there can be noted only the agreements of minimum rates for alcohol, tobacco and energy –fuels–[6] (1992). The internal system is based on a duty-suspension until the product reaches the consumption country.

In direct taxation, it is necessary to point out that the powers are national and the EU is limited to guaranteeing the performance of the single market. Community legislation is centred on company taxation and the taxation of savings income.

The "tax package" (1997) consisted of a political code of conduct to eliminate harmful business tax regimes, and two legislative measures to ensure an effective minimum level of taxation of savings income and to eliminate source taxes on cross-border payments of interest and royalties between associated companies (then the Directive 2003/49/EC).

The Directive 2003/48/EC on taxation of savings income in the form of interest payments has been applicable since 1 July 2005. Some countries, Austria, Belgium and Luxembourg, levy a withholding tax at an initial rate of 15 per cent and they transfer 75 per cent of the revenue to the investor's state of residence. The rest of Member States introduced a system of exchange information.

Finally, the European Commission has created a work group for the study of a common base in the company taxation. This project, *Common Consolidated Corporate Tax Base* (CCCTB), has as its aim the establishment of a common tax base for the groups that act in several Member States and its distribution among them.

The recent incorporation of new Member States with lower tax rates will have an important impact on income and benefits taxation. Some recent studies on company taxation harmonization are Devereux *et al.* (2002), Cnossen (2004), Mintz (2004) and Sorensen (2004).

3. CONVERGENCE: THE TIME SERIES APPROACH

The empirical study of convergence can be analysed from two perspectives: the cross-section and the time series approaches. The first one is based on the

[6] An important advance was produced with the Directive 2003/96/EC that restructures the Community framework for the taxation of energy products and electricity. This Directive extends the system of minimum rates to coal, natural gas and electricity.

negative relation between the growth rate and the initial values of the magnitude, the so-called β-convergence[7]. Nevertheless, the cross-section approach has been criticized by Friedman (1992) and Quah (1993) because of its biased estimations, so the time series approach has acquired more prominence. The latter focuses on the temporal properties of the series and was first introduced by Carlino and Mills (1993), Quah (1993), Bernard and Durlauf (1995 and 1996), Oxley and Greasley (1995), Loewy and Papell (1996) and Quah (1996) among others. Cheung and García (2004) show an interesting comparative view of the several methodologies.

Contrary to the case of cross-section, there is no a unique definition of convergence in the time series setting. Several notions have been proposed and hence several strategies for its empirical testing.

Among these approaches, the absolute, unconditional or long run convergence is the most demanding because it requires equality in the long run.

Absolute, unconditional or long run convergence[8]. This is a very strong concept which requires the equality of the long run predictions of the fiscal pressures for countries *i, j* with the actual information I_t. In other words, it needs the difference to be a stationary with a zero mean variable.

$$\lim_{T\to\infty} E(y_{i,t+T} - y_{j,t+T} | I_t) \quad 0 \qquad (1)$$

Stochastic convergence or catching-up. Carlino and Mills (1993) proposed stochastic convergence as the case in which the difference of two series is stationary around a trend. That is, under stochastic convergence, shocks are temporary. This definition is open to criticism because the presence of the trend permits the existence of permanent differences (see for instance Li and Papell, 1999). So, Carlino and Mills (1993) state that for actual convergence both stochastic convergence –as trend stationarity– and the β-convergence condition –as the need for difference between the initial series to be reduced– become necessary. Furthermore, we refer to stochastic convergence or catching up when both requisites are verified.

Deterministic convergence. Li and Papell (1999) proposed an intermediate notion between the long run and the stochastic convergence. This approach occurs when the difference is stationary around a non-zero level and it is equivalent to the *asymptotically relative convergence* in Hobijn and Franses (2000)[9].

[7] Sigma convergence refers to the decline of the dispersion of the series measured as the coefficient of variation or an inequality index such as Gini or Theil.

[8] It is the same concept as the *asymptotically perfect convergence* in Hobijn and Franses (2000).

[9] Hobijn and Franses (2000) add the *growth rate convergence* when the result from the lag operator to the difference is a stationary time series with zero mean.

These notions of convergence can be implemented through unit root and stationarity tests, which allow us to carry out the analysis of the stationarity of the series; and they can be complemented by the application of β-convergence tests in order to make complete statements on stochastic convergence. The methodologies we apply to research the existence of convergence are described in the next section.

4. METHODOLOGY

We carried out our stationarity analysis applying joint unit root and stationarity tests as a means to reinforce the conclusions derived from both kinds of tests. Concretely, Cheung and Chinn (1996) summarize the results of this confirmatory[10] analysis in Table 1:

Table 1

SUMMARY OF JOINT RESULTS FROM UNIT ROOT AND STATIONARITY TESTS

	Stationarity test: No rejects	**Stationarity test: Rejects**
Unit root test: No rejects	CASE I (?)	CASE II
Unit root test: Rejects	CASE III	CASE IV (?)

Source: Cheung and Chinn (1996).

Cases II and III are not problematic, since they lead to coincidental conclusions (no stationarity and stationarity, –or convergence and no convergence– respectively). Contradictions are present in cases I and IV, and can be imputed to the low power of the tests and to the existence of more complex data generating processes, respectively.

Our analysis began with the application of the tests that do not take into account the presence of structural breaks in the series. However, the period that we considered in our study includes years where events of high impact on fiscal terms have taken place in the European Union. In addition, there is the strong evidence -pointed out by Perron (1989, 1990) and Lee *et al.* (1997) of the low power of the Dickey-Fuller unit root test and the strong distortions in the size of LM stationarity test which favour the hypothesis of non stationarity when variables suffer a structural break which is ignored. Both factors led us to the

[10] Another proposal consists in applying joint confirmation analysis of unit root and stationarity tests, as proposed by Charemza and Syczewska (1998) and Carrión *et al.* (2001).

application of unit root and stationarity tests that allow a change occurring at *a priori* unknown time.

In the case of the unit root tests, the methodology behind the class of modified tests (*M-tests*) was applied, while for the stationarity tests, the LM test was considered. Otherwise, for the β-convergence analysis, the framework based on Tomljanovich and Vogelsang (2002) methodology was followed.

Unit root test

In order to increase power and avoid size distortions, Ng and Perron (2001) studied a new class of modified tests, the so called *M-tests*. One of these tests is the MZ_{α}^{GLS} test, which we applied paying attention to its properties in processes with characteristics such as the ones researched in this paper.

In the analysis of the *M-tests,* the data generating process considered is of the form:

$$\begin{aligned} y_t &= d_t + u_t \\ & \qquad\qquad t = 0,\ldots,T \\ u_t &= \alpha u_t + v_t \end{aligned} \tag{2}$$

where $E(u_0^2) < \infty$, $v_t = \delta(L)e_t = \sum_{j=0}^{\infty} \delta_j e_{t-j}$ with $\sum_{j=0}^{\infty} j|\delta_j| < \infty$ and $\{e_t\} \approx iid(0, \sigma_e^2)$. $d_t = \psi' z_t$, z_t being a set of deterministic components to be referred below. The hypothesis to be tested is $\alpha = 1$ against $\alpha < 1$.

The MZ_{α}^{GLS} statistic is defined by:

$$MZ_{\alpha}^{GLS} = \left(T^{-1}\tilde{y}_t - s^2\right)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \tag{3}$$

y being the detrended series which is obtained using local-to-unity GLS detrending, $s^2 = s_{ek}^2 / (1 - \hat{b}(1))^2$ is an autoregressive spectral density estimator, with $s_{ek}^2 = (T-k)^{-1} \sum_{t=k+1}^{T} \hat{e}_{tk}^2$, $\hat{b}(1) = \sum_{j=1}^{k} \hat{b}_j$. Finally, $\hat{b}_j$ and $\{\hat{e}_{tk}\}$ are obtained from the following regression:

$$\Delta\tilde{y}_t = b_0\tilde{y}_{t-1} + \sum_{j=1}^{k} b_j \Delta\tilde{y}_{t-j} + e_{tk} \tag{4}$$

where, as advocated by Ng and Perron (2001), in order to improve properties of the test, the Modified Akaike Information Criterion[11] (MAIC) can be considered to select *k*.

11 In our application, given the limited number of observations, we chose $k_{max} = 5$.

Ng and Perron (2001) focused on two alternatives for the deterministic component, z_t: $z_t = \{1\}$ for the case of a constant and $z_t = \{1, t\}$ for the case of a constant and a linear trend.

When the analysis is extended to series which suffer a structural break, four models can be distinguished: Model Level (series without trend and with a level shift; $z_t = \{1, 1\,(t > T_b)\}$), Model A (series with a trend and a level shift; $z_t = \{1, 1\,(t > T_b), t\}$), Model B (series with a change in slope; $z_t = \{1, t, 1(t > T_b)\,(t - T_b)\}$), and Model C (series with both a change in intercept and slope; $z_t = \{1, 1(t > T_b), t, 1(t > T_b)\,(t - T_b)\}$), where 1(.) is the indicator function and T_b is the time of the change.

Perron and Rodríguez (2003) extended the class of *M-tests* to the analysis of this kind of series which suffer a change, considering that the break point is unknown *a priori*. However, they just focused on and provided critical values for cases where a change in the trend function is allowed (Models B and C), since Models Level and A are a special case of what Elliott *et al.* (1996) referred to as a *slowly evolving determinist component*, and tests have the same asymptotic distribution as in the case where the determinist components include a constant and a time trend respectively. Rodríguez (2006a) analysed case A in finite samples and concluded that, although differences were reduced as sample size increased, in small samples there were big differences with respect to the asymptotic behaviour; so, in our applications we used Rodríguez (2006a) finite sample critical values. Otherwise, as expected the same behaviour in Model Level, we generated finite sample critical values[12] adapted to our data sample size, adjusted for the effect of using the data-dependent method to select k and for the procedure used for estimating the break point fraction, as advised by Perron and Rodríguez (2003).

Finally, in order to estimate the break point, we followed the *Infimum* method and estimated it as the date that yielded the minimal value of the statistic.

Stationarity test

For the stationarity analysis we applied the LM stationarity test. Following Kurozumi (2002), the error-components model is considered:

$$\begin{array}{l} y_t \quad d_t + \mu_t + u_t \\ \qquad\qquad\qquad\qquad t \quad 1,\ldots,T \\ \mu_t \quad \mu_{t-1} + \varepsilon_t \end{array} \qquad (5)$$

[12] We carried out Monte Carlo experiments and generated series under the null hypothesis. We considered $T = 50$, adopted $\bar{c} \quad -7$ as advocated by Elliot *et al.* (1996), applied the MAIC criterion to select k ($k_{max} = 5$), and used the *Infimum* method to estimate the break fraction. We did 5,000 replications. Following a similar procedure, we also generated finite sample critical values for the case of a constant, without a break.

where $u_t = \sum_{j=0}^{\infty} \alpha_j v_{t-j}$, $\{v_t, \varepsilon_t\}'$ are jointly independently and identically distributed with $E[v_t^2] = \sigma_v^2 > 0$ and $E[\varepsilon_t^2] = \sigma_\varepsilon^2 \geq 0$, and $\{u_t\}$ and $\{\varepsilon_t\}$ independent. Also, $\{v_t, \varepsilon_t\}'$ has finite $2+\delta$th moment for $\delta > 0$, and $\sum_{j=1}^{\infty} j|\alpha_j| < \infty$, $\alpha = \sum_{j=0}^{\infty} \alpha_j \neq 0$. Finally, as previously, $d_t = \psi' z_t$, z_t being the deterministic component, and $\mu_0 = 0$ without loss of generality as z_t includes a constant term.

As in the unit root analysis, a number of specifications for the deterministic component has been studied. Kwiatkowski *et al.* (1992) (hereafter KPSS) and Leybourne and McCabe (1994) considered $z_t = \{1\}$ and $z_t = \{1, t\}$ for the analysis of stationarity around a level and around a linear trend respectively. Lee and Strazicich (2001), Busetti and Harvey (2001), Kurozumi (2002) or Presno and López (2003a) extended the analysis to series with a structural break, considering as previously four patterns of the break shift.

The LM statistic to test stationarity, $H_0 : \rho = \frac{\sigma_\varepsilon^2}{\sigma_v^2} = 0$, against $H_1 : \rho > 0$ is:

$$\hat{\eta} = \frac{\sum_{t=1}^{T} S_t^2}{T^2 \hat{\sigma}^2} \tag{6}$$

where $S_t = \sum_{i=1}^{t} \hat{u}_i$ denotes the partial sum process, $\{\hat{u}_t\}$ is the OLS estimated residuals which are obtained when the series is regressed against the deterministic components, and $\hat{\sigma}^2$ represents a kernel estimator of the long-run variance:

$$\hat{\sigma}^2 = T^{-1} \sum_{t=1}^{T} \hat{u}_t^2 + 2T^{-1} \sum_{s=1}^{l} w(s,l) \sum_{t=s+1}^{T} \hat{u}_t \hat{u}_{t-s} \tag{7}$$

where $w(s,l)$ is a spectral window and l the spectral bandwidth, whose correct selection turns out to be determinant in order to prevent inconsistency of the test. Carrión-i-Silvestre and Sansó (2006) compared via Monte Carlo simulation some alternatives which were proposed in order to solve this problem, and concluded that the best choice is the Sul *et al.* (2005) proposal. So in this paper we followed their method, which improves the size and the power properties of the test using a prewhitened Heteroskedasticity and Autocorrelation Consistent (HAC) estimator for the long-run variance and a boundary condition rule[13].

[13] The procedure we followed can be summarized in this way. In a first stage an AR(p) structure is estimated for the residuals of the regression of the series on the corresponding deterministic components. In our application, p is selected using AIC criterion, with $p_{max} = 6$. Then an estimate of the long-run variance is obtained from the residuals of the AR model,

In order to estimate the break date, we adopted the selection rule proposed by Kurozumi (2002) and Busetti and Harvey (2002) who estimate the relevant regression for all possible break dates, and use a break point which minimizes the residual sum of squares. This procedure estimates the true break fraction highly consistently, and leads to using critical values associated with tests involving a break at a known date. In this sense, we applied the response surface proposed by Presno and López (2003b).

Finally, as stressed by Montañés *et al.* (2005) for the unit root case, a relevant issue in order to correctly infer the time properties of the series is the suitable selection of the type of break, so they advised the use of some information criteria, such as Akaike or Schwarz. In our analysis we estimated the three trended models, and we opted for the one selected using the Schwarz criteria, although AIC provided similar conclusions.

β-convergence analysis

To carry out the β-convergence study in the stochastic convergence notion, we followed Tomljanovich and Vogelsang's (2002) proposal, which is based on two regressions that are estimated by OLS.

The first regression is given by:

$$y_t \quad \mu_1 DU_{1t} + \beta_1 DT_{1t} + \mu_2 DU_{2t} + \beta_2 DT_{2t} + u_t \qquad (8)$$

where $DU_{1t} = 1(t \leq T_b)$, $DU_{2t} = 1(t > T_b)$, $DT_{1t} = 1(t \leq T_b)\,(t)$, and $DT_{2t} = 1(t > T_b)\,(t - T_b)$, with 1(.) denoting a indicator function. The parameters μ_1 and μ_2 indicate whether the fiscal pressure is above ($\mu_1 > 0$) or below ($\mu_1 < 0$) the average/benchmark at times 1 and T_b respectively, while the parameters β_1 and β_2 are growth rates before and after the break.

The second regression is obtained by computing partial sums of y_t.

$$z_t \quad \mu_1 DT_{1t} + \beta_1 SDT_{1t} + \mu_2 DT_{2t} + \beta_2 SDT_{2t} + S_t \qquad (9)$$

Where $z_t \quad \sum_{i\ 1}^{t} y_i$, $SDT_{jt} \quad \sum_{i\ 1}^{t} DT_{ji}$, j=1, 2 and $S_t \quad \sum_{i\ 1}^{t} u_i$.

In our application we assumed that the break point was unknown[14] *a priori*, so it had to be estimated from the data. In this sense, the same method applied by Tomljanovich and Vogelsang (2002) was followed, which consists in estimating

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through the application of an HAC estimator (we opted for the quadratic spectral window). Finally, the estimated long-run variance is recoloured, and the boundary condition rule proposed by Sul *et al.* (2005) is applied.

[14] The consideration of an unknown break date implies that there are fewer statistically significant point estimates, and so weakens slightly the β-convergence.

regression (8) for break data in the interval [0.1*T*, 0.9*T*], with *T* as the sample size, computing T^{1} multiplied by the Wald statistic for testing the joint hypothesis that $\mu_1 = \mu_2$ and $\beta_1 = \beta_2$ (so, the hypothesis that there is no break in the trend function of y_t) for each regression, and selecting the break date that results in the largest normalized Wald statistic.

As stressed by Tomljanovich and Vogelsang (2002), studying convergence involves testing that the parameters μ_1, μ_2, β_1 and β_2 are different from zero and present signs consistent with convergence. To do that, Vogelsang (1997) provides statistics which allow a clearer interpretation of the point estimates of the trend function parameters without the need of distinguishing if u_t has a unit root or not. These statistics are modifications of the standard t-statistics computed by OLS and, concretely, in this paper we used the $T^{1/2}t_y$ and the $T^{1/2}t_z$ statistics, where t_y and t_z denote the t-statistics for testing the null that the individual parameters in (8) and (9) regressions respectively are zero. We chose these statistics since the former has well-defined asymptotic distributions when u_t is I(1), but remains robust in the presence of I(0) disturbances[15]; while the latter was designed to have power and is more appropriate if the errors are known to be I(0), issue which was analysed from the unit root and stationarity tests results.

Critical values are reported in Vogelsang (1997) and Tomljanovich and Vogelsang (2002).

5. DATA AND RESULTS

The analysis of fiscal pressure convergence for the EU-15 is implemented by studying the pairs of States and it is frequent to consider a leader country as the benchmark. As was justified in the introduction, in this work we considered Germany, the United Kingdom and the European average as benchmarks.

We employed data from the OECD (2006) for the period 1965-2004. Data are tax revenues as percentage of GDP or total fiscal pressure and are presented in Table 2. Sigma convergence can be observed from the variation coefficient (it drops from 0.23 to 0.14).

Detailed results of the analysis are reported in the Appendix[16] and summarized in Tables 3-5. In these tables, for the sake of brevity, we just report the results derived from tests which consider a break because in the sample several fiscal facts which can have affected the series have taken place as we reviewed in Section 2.

[15] In this case the statistic converges to zero and the test is conservative.

[16] Tables A.1 to A.6 for the tests without break, and Tables A.7 to A.11 for the tests with an endogenous break.

Table 2

DESCRIPTIVE STATISTICS. TOTAL TAX REVENUE AS PERCENTAGE OF GDP

Country	1965	2004	Variation 1965-2004
Austria	33.9	42.6	8.7
Belgium	31.1	45.0	13.9
Denmark	29.9	48.8	18.9
Finland	30.4	44.2	13.8
France	34.5	43.4	8.9
Germany	31.6	34.7	3.1
Greece	19.5	35.0	15.5
Ireland	24.9	30.1	5.2
Italy	25.5	41.1	15.6
Luxembourg	27.7	37.8	10.1
Netherlands	32.8	37.5	4.7
Portugal	15.8	34.5	18.7
Spain	14.7	34.8	20.1
Sweden	35.0	50.4	15.4
United Kingdom	30.4	36.0	5.6
EU15	27.9	39.7	11.8
Min	14.7	30.1	15.4
Max	35.0	50.4	15.4
Range	20.3	20.3	0.0
Standard deviation	26.33	5.67	-0.66
Variation coefficient	20.23	0.14	-0.08

Source: OECD (2006).

As a general comment for all the studied cases, we observe that if we compare the results obtained applying tests with and without change, a great number of series are relocated in tables from quadrant II (no stationarity, no convergence) to quadrants I and III (cases of doubt about the nature of the series owing to the low power of the tests and of stationarity, respectively). This behaviour is not surprising if we take into account that, as stressed previously, these tests favour the hypothesis of non stationarity when variables suffer a structural break which is ignored by the researcher in the applications. Also, and according to the results of Burke (1994) about confirmatory analysis[17], in our tables case I is quite common, while case IV results relatively infrequent.

[17] Burke (1994) also stresses the convenience of analysing the results using the 10% significance level, instead the 5% which is usual in the applications.

We analysed the results of the study distinguishing long run (stationarity around a zero level), deterministic (stationarity around a non-zero level), and stochastic (stationarity around a trend and the confirmation of the catching-up by the β-convergence condition) convergence respect to the two benchmarks (Germany and the United Kingdom) and the European average, and we focused our comments mainly on the results derived from tests which allow the presence of a break.

Deterministic convergence

Compared with the conclusions of the tests without change (Tables A.2, A.4 and A.6 in the Appendix), results related to the differences with respect to Germany (Table 3A) confirm the deterministic convergence of the United Kingdom, but not of Ireland. Furthermore, there exists long run convergence between these countries since the stationary is produced around the zero level. To the group of deterministic convergent countries with non-zero level countries, the cases of Spain and the Netherlands can be joined when a break in the tests is included.

When the benchmark is the United Kingdom (Table 3B), convergence of fiscal pressure is clearly observed with respect to the other country of reference, Germany. And again we have to mention the Netherlands in this group. However, none of these countries shows convergence with respect to the European average (Table 3C). In this last category we can mention the cases of Finland, Greece and Sweden.

As stressed previously, a large number of countries are located in quadrant I of contradictory conclusions owing to the rejection of the unit root test with a break.

Table 3

SUMMARY OF UNIT ROOT AND STATIONARITY TESTS WITH BREAK (LEVEL CASE)

3A. *BENCHMARK: GERMANY*

	Stationarity test: No rejects	**Stationarity test: Rejects**
Unit root test: No rejects	Belgium France Greece Ireland Italy Luxembourg Portugal	Austria[b] Denmark[a] Finland[a] Sweden[b]
Unit root test: Rejects	Netherlands[c] Spain[c] United Kingdom[b]	

[a], [b], [c] significance at 1%, 5% and 10% levels, respectively.

(*Keep.*)

(*Continuation*.)

3B. *BENCHMARK: UNITED KINGDOM*

	Stationarity test: No rejects	Stationarity test: Rejects
Unit root test: No rejects	Austria Belgium Finland France Ireland Italy Luxembourg Spain Sweden	Denmark[a] Greece[c] Portugal[b]
Unit root test: Rejects	Germany[b] Netherlands[b]	

[a], [b], [c] significance at 1%, 5% and 10% levels, respectively.

3C. *BENCHMARK: EUROPEAN AVERAGE*

	Stationarity test: No rejects	Stationarity test: Rejects
Unit root test: No rejects	Austria Denmark France Ireland Italy Luxembourg Netherlands Portugal United Kingdom	Germany[c] Belgium[c] Spain[b]
Unit root test: Rejects	Finland[c] Greece[b] Sweden[a]	

[a], [b], [c] significance at 1%, 5% and 10% levels, respectively.

Stochastic convergence or catching-up

Again, the composition of the tables changes completely if we compare it with the results derived from tests which do not allow a change (Tables A.2, A.4 and A.6 in the Appendix, where all the countries were placed in quadrants I and II) and is quite different to the tables where we summarized results for deterministic convergence, where a large number of countries were settled in other quadrants. As a rule, in this case we observe a greater number of stationary results, especially with respect to the United Kingdom.

Results are summarized in Table 4. First, taking Germany as a benchmark (Table 4A), the tests confirm the stationarity around a trend with a break for the series of Belgium, Greece and Sweden[18]. With respect to the United Kingdom (Table 4B), the list is longer, and includes Austria, Belgium, Denmark, Ireland, the Netherlands and Sweden. If the European average is the reference (Table 4C), the condition is fulfilled for the series of Denmark, Greece, Ireland and Portugal.

Table 4

SUMMARY OF UNIT ROOT AND STATIONARITY TESTS WITH BREAK (TREND CASE)

4A. *BENCHMARK: GERMANY*

	Stationarity test: No rejects	Stationarity test: Rejects
Unit root test: No rejects	Ireland Luxembourg United Kingdom	Austria[c] Finland[b] Italy[a]
Unit root test: Rejects	Belgium[a] Greece[c] Sweden[a]	Denmark[b,c] France[c,a] Netherlands[a,a] Portugal[a,b] Spain[a,c]

[a], [b], [c] significance at 1%, 5% and 10% levels, respectively.

4B. *BENCHMARK: UNITED KINGDOM*

	Stationarity test: No rejects	Stationarity test: Rejects
Unit root test: No rejects	Germany Finland France Portugal	Spain[a] Greece[c] Italy[a] Luxembourg[b]
Unit root test: Rejects	Austria[a] Belgium[a] Denmark[a] Ireland[a] Netherlands[b] Sweden[b]	

[a], [b], [c] significance at 1%, 5% and 10% levels, respectively.

(*Keep.*)

[18] With respect to the results from Esteve *et al.* (1999, 2000), although they were derived using other techniques and another period, it must be noted that two countries coincide with our results related to the convergence respect to Germany: Belgium and Sweden; however, we identify divergent paths in the β-convergence analysis for these countries. For the rest of the countries –Italy, Portugal, Spain and the United Kingdom– the conclusions are different too.

(*Continuation*.)

4C. BENCHMARK: EUROPEAN AVERAGE

	Stationarity test: No rejects	Stationarity test: Rejects
Unit root test: No rejects	Belgium Spain Finland France Italy Luxembourg Netherlands	
Unit root test: Rejects	Denmark[b] Greece[b] Ireland[c] Portugal[b]	Austria[a,c] Germany[c,a] United Kingdom[b,b] Sweden[a,a]

[a], [b], [c] significance at 1%, 5% and 10% levels, respectively.

However, stationarity around a trend does not mean stochastic convergence everyway and we need to check the β-convergence condition introduced in the previous section. The joint study of both requirements is synthesized in Table 5 with the detailed results of the regressions at the Appendix (Tables A.10 and A.11). Figure 1 represents the cases of long run and stochastic convergence.

As a first remark, we observe that when conclusions derived from the $T^{1/2}t_y$ statistic are analysed, there appear a great amount of cases where no results can be inferred. This fact could be explained by the conservative characteristics of the test in the presence of I(0) disturbances, as the ones that both unit root and stationarity tests confirm for the series which are analysed for the catching up analysis. In these cases, the $T^{1/2}t_z$ statistic could offer more accurate results and be more appropriate.

Otherwise, the break point[19] was estimated mainly at the beginning of the nineties due to the great impact of the preparation for the Euro and the Maastricht conditions, and to a lesser extent the VAT agreements.

Estimates of μ_1 are not statistically different from zero for the series of fiscal pressure of Belgium with respect to Germany, Sweden with respect to the United Kingdom, and Denmark with respect to the European average; however, for all these countries, large divergences are observed, and they do not seem to show a trend to the correction after the break data. A similar remark can be made for the cases of Austria and Denmark with respect to the United Kingdom, although there seems to be a glimpse of hesitant and incipient convergence after the break point.

[19] The break points estimated for the β-convergence analysis do not coincide in some cases with the change data obtained from the unit root and stationarity tests. This fact is emphasized also by Rodríguez (2006b) in his study on income convergence, and can be explained by the different methods used to select the break data.

Table 5

SUMMARY OF RESULTS OF β-CONVERGENCE CONDITION FOR THE TREND STATIONARY CASES

5A. *BENCHMARK: GERMANY*

	$T^{-1/2}t_y$ (T_b unknown)		$T^{-1/2}t_z$ (T_b unknown)		$\hat{T}_b$
	Pre-break	Post-break	Pre-break	Post-break	
Belgium	d	u	d	D	1988
Greece	c	u	C	u	1995
Sweden	D	u	D	D	1991

5B. *BENCHMARK: UNITED KINGDOM*

	$T^{-1/2}t_y$ (T_b unknown)		$T^{-1/2}t_z$ (T_b unknown)		$\hat{T}_b$
	Pre-break	Post-break	Pre-break	Post-break	
Austria	u	u	d	c	1991
Belgium	u	u	d	u	1992
Denmark	d	u	d	c	1992
Ireland	c	u	C	d	1991
Netherlands	u	u	d	c	1990
Sweden	u	d	d	d	1986

5C. *BENCHMARK: EUROPEAN AVERAGE*

	$T^{-1/2}t_y$ (T_b unknown)		$T^{-1/2}t_z$ (T_b unknown)		$\hat{T}_b$
	Pre-break	Post-break	Pre-break	Post-break	
Denmark	u	d	d	D	1974
Greece	d	c	D	C	1987
Ireland	d	u	D	d	1994
Portugal	c	C	c	C	1988

C: estimates consistent with β-convergence that are statistically significant at least at the 10% level.

c: estimates consistent with β-convergence with only one estimate statistically significant at least at the 10% level.

D: estimates consistent with divergence that are statistically significant at least at the 10% level.

d: estimates consistent with divergence with only one estimate statistically significant at least at the 10% level.

u: no result inferred.

Taking Germany as a benchmark, results confirm the catching up for Greece in the pre-break period, 1965-1995, and after the break point the fiscal pressure of both countries is almost identical. Belgium and Sweden present divergence both before and after the break.

If the United Kingdom is the reference, only two countries stochastically converge: Ireland, in the pre-break period, 1965-1991, and the Netherlands, but only after the break estimated in 1990. As remarked previously, Austria and Denmark present a divergent path more intense in the pre-break period, but a smooth trend to the convergence afterwards.

Finally, with respect to the European average, Denmark and Ireland clearly diverge and on the other hand Greece and Portugal catch up, the former in the second sub-sample, 1987-2004, and the latter in the overall period, but more intensely after the break, 1988.

As De Juan and Tomljanovich (2005) remark, we have to take into account two issues when we analyse the conclusions derived from this kind of β-convergence study. One, this methodology does not offer predictive power about the future path of the variables; and two, unlike cross-section studies of convergence, no speed of convergence parameter is estimated, so we cannot know at what point convergence will be attained.

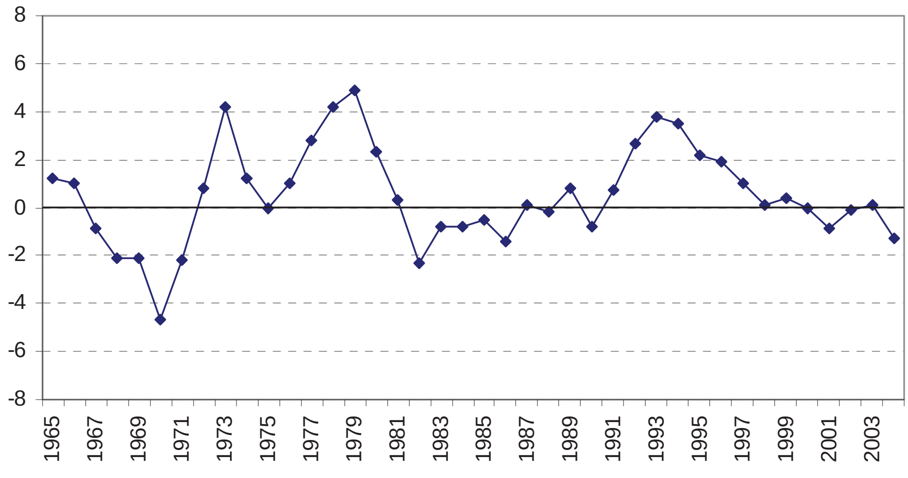
If we compare the results from deterministic and stochastic convergence, we can observe that there are two cases which are classified as convergent applying both concepts: the Netherlands with respect to the United Kingdom and Greece with respect to the European average. However, after a further analysis of the statistics jointly with the graphs, we opted for the more general model and established the stochastic convergence.

As a final remark, we conclude that the results show the lack of an authentic political agreement on fiscal equalization and hence somewhat for the European political union. In the short and medium run a substantial change in these conclusions is not expected and even less, since the incorporation of countries with fiscal systems so different from the analysed EU-15.

Figure 1

LONG RUN AND STOCHASTIC CONVERGENCE RESULTS

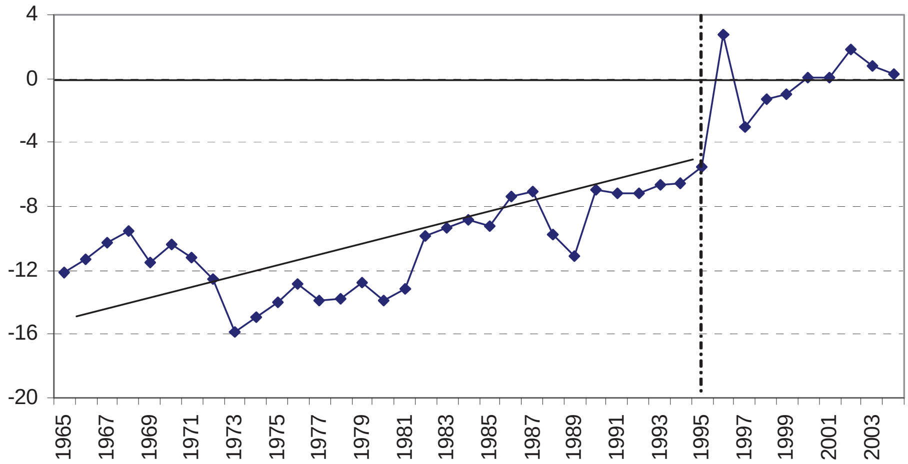
Germany *Vs* United Kingdom



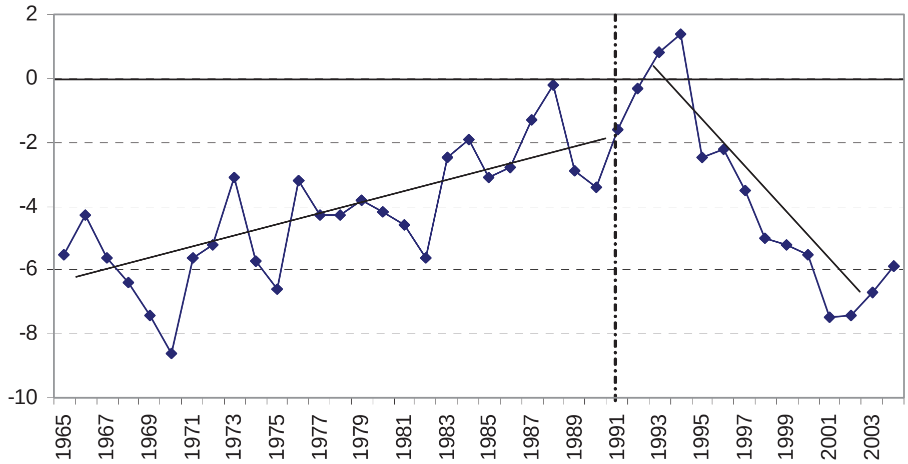
(*Keep.*)

(*Continuation.*)

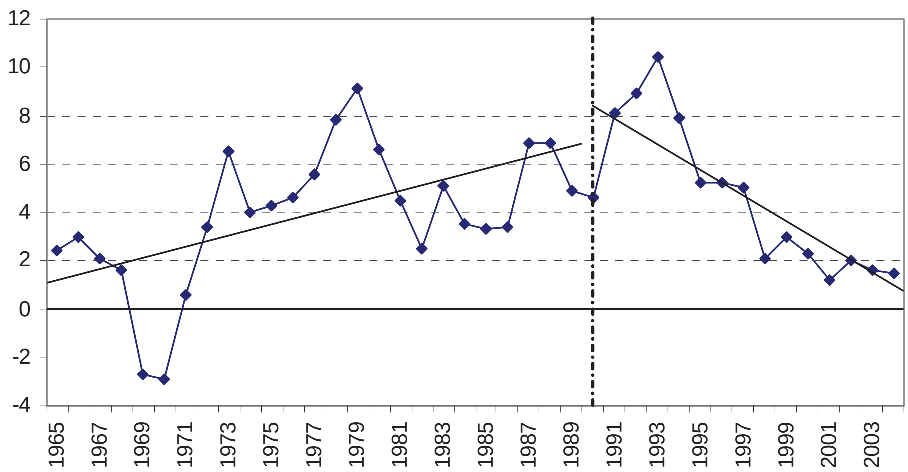
Greece *Vs* Germany



Ireland *Vs* United Kingdom



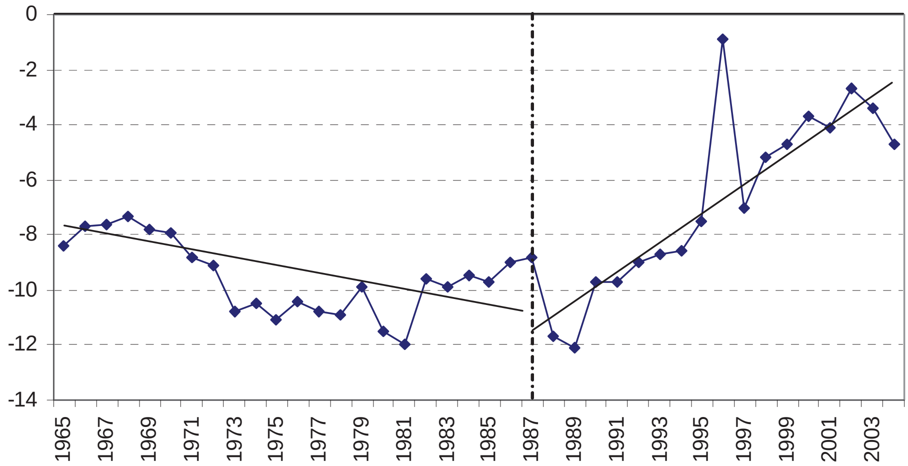
Netherlands *Vs* United Kingdom



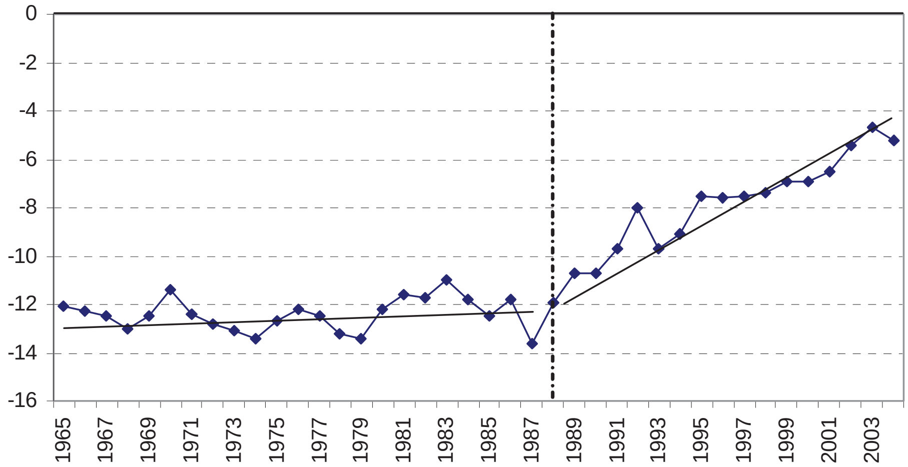
(*Keep.*)

(*Continuation.*)

Greece *Vs* European average



Portugal *Vs* European average



6. CONCLUDING REMARKS

In this work we have analysed the convergence of fiscal pressure for the EU-15 with respect to Germany, the United Kingdom and the European average, through the time series approach. The convergence notions employed are deterministic convergence, when the difference is stationary around a non-zero level, long run convergence if that level is zero, and stochastic convergence or catching up, when the difference is stationary around a trend and a β-convergence condition is satisfied. We use the stationarity and unit root tests with an endogenous break because of the large sample, 1965-2004, period in which relevant events which have produced effects on fiscal pressure have taken place.

The results reported in this paper suggest the existence of few convergences of fiscal pressure among the EU-15 Member States. Only the United Kingdom presents long run convergence with Germany. A small group of countries converge deterministically with the benchmarks: the Netherlands and Spain with Germany and Finland and Sweden with the European average. The catching-up process is confirmed for Greece when Germany is the benchmark, Ireland and the Netherlands with respect to the United Kingdom and, finally, Greece and Portugal taking the European average as reference. These results evidence the slow process of approximation of the European fiscal systems despite the increasing integration due to the different tax (social) models and the obstacles raised by Member States that prevent progress in the common taxation field.

As future extensions of this paper, we can anticipate at least two directions. Firstly, a variety of panel unit roots tests has been proposed which increases power relative to previous tests. This issue could be relevant in this context where we work with relatively short series -40 years-. Secondly, we are interested in the study of convergence clubs because of the absence of a unique stationary state for the series of fiscal pressure. Several algorithms have been applied for that purpose, e.g. Hobijn and Franses (2000).

APPENDIX. UNIT ROOT AND STATIONARY TESTS RESULTS

Table A.1

RESULTS FROM UNIT ROOT AND STATIONARITY TESTS WITHOUT BREAK

BENCHMARK: GERMANY

	Constant mean		Linear trend	
	MZ_α^{GLS}	LM	MZ_α^{GLS}	LM
Austria	0.640(2)	0.538(3)[b]	-4.101(2)	0.139(1)[c]
Belgium	-0.097(0)	0.614(1)[b]	-8.411(2)	0.067(1)
Denmark	-0.211(0)	0.791(1)[a]	-9.591(0)	0.282(6)[a]
Spain	-2.268(3)	6.446(4)[a]	-4.714(0)	0.129(4)[c]
Finland	-1.154(0)	0.821(1)[a]	-10.750(0)	0.075(1)
France	-0.536(0)	0.844(1)[a]	-5.168(0)	0.122(4)[c]
Greece	-0.355(1)	0.684(1)[b]	-5.232(2)	0.132(1)[c]
Ireland	-6.919(0)[c]	0.081(1)	-7.847(0)	0.059(1)
Italy	0.0401(0)	1.476(1)[a]	-4.394(0)	0.061(1)
Luxembourg	-2.897(0)	0.361(1)[c]	-8.593(0)	0.039(1)
Netherlands	-2.722(2)	0.146(6)	-3.606(2)	0.108(6)
Portugal	1.368(0)	2.051(1)[a]	-4.027(3)	0.092(1)
United Kingdom	-9.784(0)[b]	0.189(6)	-9.766(0)	0.129(6)[c]
Sweden	-2.748(1)	0.703(2)[b]	-8.433(0)	0.113(2)

[a, b, c] denote significance at the 1%, 5% and 10% levels, respectively.

Between parenthesis: lag length for MZ_α^{GLS} test using MAIC ($k_{max}=5$); order of the autoregressive correction for LM test using AIC ($p_{max}=6$).

Critical values from: MZ_α^{GLS} test, constant mean (own elaboration*); MZ_α^{GLS} test, linear trend (Rodriguez, 2006a); LM test (Sephton, 1995).

* Critical values: -11.845; -8.245; -6.230 at the 1%, 5% and 10% significance level, respectively.

Table A.2

SUMMARY OF UNIT ROOT AND STATIONARITY TESTS WITHOUT BREAK: STATIONARY RESULTS

BENCHMARK: GERMANY

Level case	Trend case
Ireland United Kingdom	—

Table A.3

RESULTS FROM UNIT ROOT AND STATIONARITY TESTS WITHOUT BREAK

BENCHMARK: UNITED KINGDOM

	Constant mean		Linear trend	
	MZ_{α}^{GLS}	LM	MZ_{α}^{GLS}	LM
Germany	-9.784(0)[b]	0.1888(6)	-9.766(0)	0.129(6)[c]
Austria	-3.349(3)	0.427(6)[c]	-10.273(0)	0.092(2)
Belgium	-1.204(3)	0.306(1)	-10.367(0)	0.168(6)[b]
Denmark	-0.015(4)	1.405(6)[a]	-7.605(4)	0.206(6)[b]
Spain	-0.189(0)	1.502(1)[a]	-7.703(0)	0.045(1)
Finland	-1.967(0)	0.665(1)[b]	-7.539(0)	0.025(1)
France	-2.848(0)	0.516(1)[b]	-7.998(0)	0.042(1)
Greece	-1.324(1)	0.659(1)[b]	-6.986(2)	0.150(1)[b]
Ireland	-7.242(0)[c]	0.101(1)	-7.909(0)	0.064(1)
Italy	-0.264(2)	1.463(1)[a]	-4.113(2)	0.065(1)
Luxembourg	-4.237(0)	1.493(6)[a]	-8.457(0)	0.230(6)[a]
Netherlands	-7.019(0)[c]	0.214(5)	-7.547(0)	0.093(2)
Portugal	0.381(0)	1.627(1)[a]	-7.122(0)	0.078(1)
Sweden	-1.803(0)	0.468(1)[c]	-8.222(0)	0.087(2)

[a, b, c] denote significance at the 1%, 5% and 10% levels, respectively.

Between parenthesis: lag length for MZ_{α}^{GLS} test using MAIC ($k_{max}=5$); order of the autoregressive correction for LM test using AIC ($p_{max}=6$).

Critical values from: MZ_{α}^{GLS} test, constant mean (own elaboration*); MZ_{α}^{GLS} test, linear trend (Rodriguez, 2006a); LM test (Sephton, 1995).

* Critical values: -11.845; -8.245; -6.230 at the 1%, 5% and 10% significance level, respectively.

Table A.4

SUMMARY OF UNIT ROOT AND STATIONARITY TESTS WITHOUT BREAK: STATIONARY RESULTS

BENCHMARK: UNITED KINGDOM

Level case	Trend case
Germany Ireland Netherlands	—

Table A.5

RESULTS FROM UNIT ROOT AND STATIONARITY TESTS WITHOUT BREAK

BENCHMARK: EUROPEAN AVERAGE

	Constant mean		Linear trend	
	MZ_{α}^{GLS}	LM	MZ_{α}^{GLS}	LM
Germany	0.567(0)	1.395(1)[a]	-9.891(0)	0.048(1)
Austria	-1.228(3)	0.379(3)[c]	-1.649(5)	0.112(1)
Belgium	-5.355(0)	0.106(1)	-6.416(0)	0.083(1)
Denmark	-0.507(5)	0.881(6)[a]	-7.043(0)	0.229(6)[a]
Spain	-0.039(0)	1.903(4)[a]	-6.959(0)	0.090(4)
Finland	-6.235(0)[c]	0.171(1)	-9.136(0)	0.043(1)
France	-3.785(0)	0.875(6)[a]	-7.586(0)	0.061(1)
Greece	-1.979(2)	0.127(2)	-3.753(2)	0.087(2)
Ireland	-1.253(0)	0.554(1)[b]	-7.145(0)	0.090(1)
Italy	-1.415(0)	0.763(1)[a]	-3.979(0)	0.078(1)
Luxembourg	-7.523(0)[c]	0.047(1)	-7.753(0)	0.047(1)
Netherlands	-0.737(0)	0.678(1)[b]	-5.745(0)	0.084(1)
Portugal	0.235(0)	0.906(1)[a]	-2.945(2)	0.110(1)
United Kingdom	-1.678(0)	0.635(1)[b]	-9.376(0)	0.066(2)
Sweden	-4.431(0)	0.217(2)	-6.385(0)	0.126(2)[c]

[a, b, c] denote significance at the 1%, 5% and 10% levels, respectively.

Between parenthesis: lag length for MZ_{α}^{GLS} test using MAIC ($k_{max}=5$); order of the autoregressive correction for LM test using AIC ($p_{max}=6$).

Critical values from: MZ_{α}^{GLS} test, constant mean (own elaboration*); MZ_{α}^{GLS} test, linear trend (Rodriguez, 2006a); LM test (Sephton, 1995).

* Critical values: -11.845; -8.245; -6.230 at the 1%, 5% and 10% significance level, respectively.

Table A.6

SUMMARY OF UNIT ROOT AND STATIONARITY TESTS WITHOUT BREAK: STATIONARY RESULTS

BENCHMARK: EUROPEAN AVERAGE

Level case	Trend case
Finland Luxembourg	—

Table A.7

RESULTS FROM UNIT ROOT AND STATIONARITY TESTS WITH AN ENDOGENOUS BREAK

BENCHMARK: GERMANY

	Model Level				Model A				Model B				Model C			
	Unit root		Stationarity		Unit root		Stationarity		Unit root		Stationarity		Unit root		Stationarity	
	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM
Austria	2000	-2.326(2)	1994	0.285(1)^b	1975	-6.661(4)	1971	0.059(1)	1978	-13.089(4)	1974	0.101(2)^c	1979	-14.648(4)	1977	0.106(2)^b
Belgium	1989	-3.018(1)	1976	0.185(1)	1988	-23.534(2)^a	1987	0.052(1)	1981	-12.690(2)	1983	0.038(1)	1988	-26.689(2)^b	1987	0.038(1)
Denmark	1969	-2.740(3)	1982	0.381(6)^a	1967	-18.910(1)^b	1969	0.637(6)^a	1968	-16.751(1)	1970	0.145(6)^b	1968	-17.205(1)	1971	0.104(6)^c
Spain	1966	-11.656(5)^c	1982	0.131(1)	1989	-40.280(3)^a	1982	0.643(6)^a	1997	-39.804(3)^a	1974	0.097(4)^c	1998	-40.098(3)^a	1981	0.059(1)^c
Finland	1981	-4.965(5)	1987	0.367(2)^a	1987	-9.627(4)	1987	0.149(6)^b	1974	-10.631(4)	1980	0051(1)	1987	-30.413(4)^b	1987	0.244(6)^a
France	1973	-5.258(3)	1980	0.134(1)	1968	-10.122(2)	1969	0.360(1)^a	1970	-13.951(2)	1972	0.047(1)	1978	-24.022(1)^c	1978	0.147(4)^a
Greece	1995	-5.141(2)	1994	0.142(2)	1995	-12.687(1)	1971	0.425(1)^a	1977	-22.032(1)^c	1977	0.043(1)	1977	-21.884(1)	1971	0.088(1)
Ireland	1975	-10.199(1)	1980	0.129(1)	1994	-14.776(1)	1980	0.069(1)	1990	-14.583(1)	1991	0.037(1)	1983	-22.025(1)	1980	0.067(1)^c
Italy	1985	-3.144(1)	1987	0.075(1)	1968	-10.794(1)	1971	0.078(1)	1970	-12.651(1)	1974	0.047(1)	1982	-17.487(1)	1979	0.103(2)^a
Luxembourg	1982	-6.730(1)	1974	0.098(1)	1976	-13.511(1)	1973	0.040(1)	1981	-11.414(1)	1983	0.034(1)	1976	-16.848(1)	1973	0.056(1)
Netherlands	1990	-11.734(5)^c	1973	0.117(6)	1988	-19.927(4)^b	1993	0.080(6)	1988	-12.673(4)	1991	0.064(5)	1993	-64.443(1)^a	1993	0.376(6)^a
Portugal	1985	-2.959(1)	1988	0.115(1)	1977	-7.787(1)	1971	0.163(3)^a	1976	-42.832(1)^a	1974	0.182(6)^a	1975	-41.125(1)^a	1971	0.123(3)^b
U. K.	1976	-13.542(3)^b	1972	0.117(2)	1976	-20.387(1)^b	1971	0.089(3)	1998	-15.747(3)	1995	0.093(6)^c	1970	-17.698(2)	1970	0.053(2)
Sweden	1976	-5.925(1)	1975	0.353(4)^b	1990	-34.935(1)^a	1990	0.055(2)	1985	-32.797(1)^a	1987	0.046(2)	1990	-36.094(1)^a	1990	0.214(5)^a

$^{a, b, c}$ denote significance at the 1%, 5% and 10% levels, respectively.

Between parenthesis: lag length for MZ_α^{GLS} test using MAIC (k_{max}=5; following Perron and Rodriguez, 2003, k_{min}=1); order of the autoregressive correction for LM test using AIC (p_{max}=6).

Critical values from: MZ_α^{GLS} test: Model Level (own elaboration*); Model A (Rodriguez, 2006a); Models B and C (Perron and Rodriguez, 2003).

Critical values for LM test: Presno and Lopez (2003b).

* Critical values: -20.771; -13.070; -11.043 at the 1%, 5% and 10% significance level, respectively.

The model selected according to the Schwarz criterion shaded for emphasis.

Table A.8

Results from unit root and stationarity tests with an endogenous break

Benchmark: United Kingdom

	Model Level				Model A				Model B				Model C			
	Unit root		Stationarity		Unit root		Stationarity		Unit root		Stationarity		Unit root		Stationarity	
	$\hat{T}_b$	MZ_{α}^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_{α}^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_{α}^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_{α}^{GLS}	$\hat{T}_b$	LM
Germany	1976	-13.542(3)^{b}	1972	0.117(2)	1976	-20.387(1)^{b}	1971	0.089(3)	1998	-15.747(3)	1995	0.093(6)^{c}	1970	-17.698(2)	1970	0.053(2)
Austria	1983	-6.921(3)	1990	0.158(2)	1973	-24.287(1)^{a}	1990	0.066(2)	1977	-28.854(1)^{b}	1968	0.061(2)	1989	-33.014(1)^{a}	1970	0.069(2)
Belgium	1976	-9.892(1)	1974	0.168(6)	1972	-28.946(1)^{a}	1971	0.074(3)	1977	-23.247(1)^{c}	1978	0.098(6)^{b}	1974	-35.022(1)^{a}	1978	0.097(6)^{b}
Denmark	1977	-5.924(1)	1984	0.673(6)^{a}	1967	-30.885(1)^{a}	1969	0.086(2)	1996	-32.793(1)^{a}	1995	0.116(5)^{b}	1996	-33.157(1)^{a}	1966	0.124(5)^{c}
Spain	1982	-4.179(1)	1985	0.149(1)	1982	-14.221(1)	1985	0.072(5)	1999	-9.761(4)	1994	0.192(3)^{a}	1982	-15.695(1)	1986	0.130(3)^{a}
Finland	1987	-7.823(1)	1987	0.051(1)	1987	-15.261(1)	1987	0.021(1)	2000	-11.961(1)	1997	0.043(1)	1987	-17.505(1)	1966	0.023(1)
France	1982	-7.288(1)	1977	0.178(6)	1969	-13.362(1)	1969	0.041(1)	1967	-18.295(1)	1969	0.057(1)	1974	-23.326(1)^{c}	1970	0.053(1)
Greece	1995	-7.321(2)	1990	0.217(1)^{c}	1973	-12.115(1)	1991	0.108(2)^{c}	1983	-20.095(1)	1982	0.041(1)	1995	-21.575(1)	1990	0.052(1)
Ireland	1975	-10.812(1)	1974	0.059(1)	1994	-12.507(2)	1996	0.108(2)^{b}	1994	-32.065(1)^{a}	1994	0.073(2)	1996	-36.165(1)^{a}	1993	0.075(2)^{c}
Italy	1995	-2.570(1)	1987	0.123(1)	1967	-8.470(4)	1988	0.115(2)^{c}	2002	-7.590(4)	1970	0.025(1)	1985	-12.211(2)	1990	0.144(3)^{a}
Luxembourg	1976	-9.117(1)	1974	0.149(6)	1972	-12.663(1)	1974	0.130(6)^{b}	1981	-13.142(1)	1979	0.177(6)^{a}	1972	-20.773(1)	1966	0.232(6)^{a}
Netherlands	1970	-15.847(1)^{b}	1971	0.066(1)	1993	-17.820(1)^{b}	1996	0.062(2)	1991	-28.050(1)^{b}	1993	0.083(5)	1995	-28.684(1)^{b}	1966	0.116(5)^{c}
Portugal	1982	-3.860(1)	1989	0.230(1)^{b}	1969	-13.352(1)	1990	0.037(1)	1972	-16.084(1)	1969	0.039(1)	1988	-19.749(1)	1990	0.036(1)
Sweden	1982	-10.122(1)	1975	0.110(1)	1975	-22.202(1)^{b}	1975	0.018(1)	1981	-24.599(1)^{b}	1978	0.047(2)	1974	-27.431(1)^{b}	1975	0.039(2)

$^{a, b, c}$ denote significance levels at the 1%, 5% and 10% levels, respectively.

Between parenthesis: lag length for MZ_{α}^{GLS} test using MAIC (k_{max}=5; following Perron and Rodriguez, 2003, k_{min}=1); order of the autoregressive correction for LM test using AIC (p_{max}=6).

Critical values from: MZ_{α}^{GLS} test: Model Level (own elaboration*); Model A (Rodriguez, 2006a); Models B and C (Perron and Rodriguez, 2003).

Critical values for LM test: Presno and Lopez (2003b).

* Critical values: -20.771; -13.070; -11.043 at the 1%, 5% and 10% significance level, respectively.

The model selected according to the Schwarz criterion shaded for emphasis.

Table A.9

RESULTS FROM UNIT ROOT AND STATIONARITY TESTS WITH AN ENDOGENOUS BREAK

BENCHMARK: EUROPEAN AVERAGE

	Model Level				Model A				Model B				Model C			
	Unit root		Stationarity		Unit root		Stationarity		Unit root		Stationarity		Unit root		Stationarity	
	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM	$\hat{T}_b$	MZ_α^{GLS}	$\hat{T}_b$	LM
Germany	1989	-4.179(5)	1981	0.192(1)^c	1968	-17.158(2)^b	1981	0.109(1)^c	1970	-13.554(2)	1973	0.062(1)	1980	-24.477(2)^c	1980	0.214(6)^a
Austria	1975	-5.817(3)	1981	0.133(1)	2000	-10.123(2)	1995	0.099(2)^c	1989	-58.232(1)^a	1989	0.079(2)^c	1986	-59.661(1)^a	1991	0.084(2)^b
Belgium	1970	-6.327(1)	1987	0.174(1)^c	1985	-9.264(1)	1987	0.076(1)	1975	-10.288(1)	1977	0.051(1)	1985	-16.343(1)	1978	0.054(1)
Denmark	1969	-7.579(4)	1968	0.092(6)	1967	-31.273(1)^a	1968	0.060(6)	1968	-30.259(1)^a	1971	0.078(6)	1974	-29.653(1)^b	1973	0.042(1)
Spain	1970	-5.570(5)	1985	0.246(3)^b	1982	-13.611(4)	1985	0.086(3)	1966	-13.806(4)	1974	0.088(4)	1970	-10.165(2)	1985	0.085(3)^a
Finland	1993	-11.503(1)^c	1987	0.042(1)	1990	-15.318(1)	1987	0.066(2)	1982	-12.703(1)	1983	0.030(1)	1988	-15.110(1)	1987	0.060(2)^c
France	1966	-7.749(1)	1968	0.099(6)	1966	-11.397(1)	1969	0.071(1)	1968	-19.398(1)	1971	0.067(1)	1968	-19.437(1)	1977	0.040(1)
Greece	1995	-13.549(1)^b	1995	0.108(1)	1995	-17.663(1)^b	1995	0.081(1)	1986	-17.277(1)	1988	0.071(1)	1995	-17.586(1)	1995	0.081(1)^c
Ireland	1994	-6.456(1)	1994	0.126(1)	1994	-16.018(1)	1994	0.035(1)	1990	-21.406(1)^c	1988	0.035(1)	1983	-23.123(1)^c	1981	0.047(1)
Italy	1985	-3.556(1)	1988	0.061(1)	1972	-8.281(1)	1971	0.064(1)	1975	-11.299(1)	1976	0.046(1)	1982	-13.108(1)	1979	0.040(1)
Luxembourg	1987	-7.152(1)	1974	0.157(1)	1974	-9.445(1)	1974	0.055(1)	1980	-8.370(1)	1980	0.041(1)	1974	-11.769(1)	1973	0.078(1)
Netherlands	1988	-4.101(1)	1993	0.101(1)	1997	-9.684(5)	1994	0.226(6)^a	1977	-20.627(1)	1979	0.034(1)	1976	-20.864(1)	1993	0.053(1)
Portugal	1987	-5.140(5)	1990	0.109(1)	1994	-10.160(1)	1990	0.113(1)^b	1984	-25.902(2)^b	1987	0.050(1)	1991	-29.765(1)^b	1986	0.047(1)
U. K.	1982	-10.229(1)	1985	0.084(1)	1986	-21.109(1)^b	1997	0.076(2)	1996	-25.159(1)^b	1996	0.077(2)	1990	-27.753(1)^b	1991	0.104(6)^b
Sweden	1971	-21.781(1)^a	1975	0.154(2)	1973	-26.307(1)^a	1990	0.271(6)^a	1981	-30.207(1)^a	1978	0.246(5)^a	1973	-34.221(1)^a	1990	0.242(6)^a

$^{a, b, c}$ denote significance at the 1%, 5% and 10% levels, respectively.

Between parenthesis: lag length for MZ_α^{GLS} test using MAIC (k_{max}=5; following Perron and Rodriguez, 2003, k_{min}=1); order of the autoregressive correction for LM test using AIC (p_{max}=6).

Critical values from: MZ_α^{GLS} test: Model Level (own elaboration*); Model A (Rodriguez, 2006a); Models B and C (Perron and Rodriguez, 2003).

Critical values for LM test: Presno and Lopez (2003b).

* Critical values: -20.771; -13.070; -11.043 at the 1%, 5% and 10% significance level, respectively.

The model selected according to the Schwarz criterion shaded for emphasis.

Table A.10

β- CONVERGENCE EMPIRICAL RESULTS (ONLY CASES FROM QUADRANT OF STATIONARITY IN STOCHASTIC ANALYSIS)

$T^{-1/2}t_y$ statistic. Regression: $y_t \quad \mu_1 DU_{1t} + \beta_1 DT_{1t} + \mu_2 DU_{2t} + \beta_2 DT_{2t} + u_t$

	$\hat{\mu}_1$	$\hat{\beta}_1$	$\hat{\mu}_2$	$\hat{\beta}_2$	$\hat{T}_b$
Benchmark: Germany					
Belgium	0.404 (0.164)	0.340[c] (1.977)	4.620 (1.511)	0.332 (1.051)	1988
Greece	-13.852[b] (-2.851)	0.207 (0.779)	-0.658 (-0.069)	0.145 (0.085)	1995
Sweden	2.656[c] (0.742)	0.477[b] (2.137)	9.965 (1.874)	0.506 (0.756)	1991
Benchmark: United Kingdom					
Austria	0.817 (0.192)	0.108 (0.405)	7.792 (1.229)	-0.057 (-0.072)	1991
Belgium	0.240 (0.049)	0.287 (0.972)	9.552 (1.228)	-0.084 (-0.079)	1992
Denmark	0.057 (0.011)	0.447[c] (1.472)	14.923 (1.830)	0.257 (-0.232)	1992
Ireland	-6.773[b] (-2.064)	0.183 (0.893)	1.177 (0.241)	-0.712 (-1.159)	1991
Netherlands	1.379 (0.252)	0.187 (0.529)	9.753 (1.276)	-0.687 (-0.766)	1990
Sweden	2.991 (0.500)	0.455 (1.000)	15.054[c] (2.380)	0.024 (0.040)	1986
Benchmark: European average					
Denmark	0.113 (0.020)	1.170 (1.304)	7.101[c] (2.377)	0.074 (0.429)	1974
Greece	-8.310[b] (-2.108)	-0.101 (-0.351)	-11.687[c] (-2.518)	0.557 (1.231)	1987
Ireland	-1.771[c] (-0.691)	-0.091 (-0.631)	-7.033 (-1.505)	-0.427 (-0.566)	1994
Portugal	-12.605[b] (-7.370)	0.016 (0.137)	-10.873[b] (-5.108)	0.371[c] (1.686)	1988

[b, c] denote significance at the 5% and 10% levels, respectively. Values in parenthesis are the *$T^{-1/2}t_y$ statistics.*

Table A.11

β- CONVERGENCE EMPIRICAL RESULTS (ONLY CASES FROM QUADRANT OF STATIONARITY IN STOCHASTIC ANALYSIS)

$T^{-1/2}t_z$ statistic. Regression: $z_t \quad \mu_1 DU_{1t} + \beta_1 SDT_{1t} + \mu_2 DT_{2t} + \beta_2 SDT_{2t} + S_t$

	$\hat{\mu}_1$	$\hat{\beta}_1$	$\hat{\mu}_2$	$\hat{\beta}_2$	$\hat{T}_b$
Benchmark: Germany					
Belgium	0.463 (0.884)	0.344[b] (6.812)	4.662[b] (3.177)	0.328[b] (1.819)	1988
Greece	-13.597[b] (-8.070)	0.176[c] (1.345)	2.441 (0.171)	-0.348 (-0.113)	1995
Sweden	2.776[b] (4.158)	0.463[b] (7.933)	10.253[b] (3.564)	0.514[c] (1.184)	1991
Benchmark: United Kingdom					
Austria	0.696 (0.826)	0.118[c] (1.605)	7.624[b] (2.100)	-0.040 (-0.073)	1991
Belgium	0.230 (0.162)	0.337[b] (2.802)	7.414 (1.040)	0.165 (0.141)	1992
Denmark	0.043 (0.036)	0.451[b] (4.503)	14.477[b] (2.435)	-0.221 (-0.227)	1992
Ireland	-6.828[b] (-13.615)	0.186[b] (4.251)	-1.724 (-0.798)	-0.816[b] (-2.450)	1991
Netherlands	1.025 (0.729)	0.227[b] (1.786)	8.823[b] (1.688)	-0.619 (-0.844)	1990
Sweden	2.284 (1.361)	0.541[b] (3.104)	13.579[b] (3.780)	0.104 (0.265)	1986
Benchmark: European average					
Denmark	0.411 (0.122)	1.066[c] (1.581)	7.230[b] (5.898)	0.080[c] (1.020)	1974
Greece	-7.896[b] (-8.257)	-0.153[c] (-1.600)	-10.931[b] (-4.670)	0.520[b] (1.928)	1987
Ireland	-1.813[b] (-3.470)	-0.088[b] (-2.097)	-6.921[b] (-1.882)	-0.477 (-0.665)	1994
Portugal	-12.623[b] (-38.350)	0.017 (0.526)	-10.752[b] (-11.650)	0.358[b] (3.164)	1988

[b, c] denote significance at the 5% and 10% levels, respectively. Values in parenthesis are the *$T^{-1/2}t_z$ statistics.*

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SÍNTESIS

PRINCIPALES IMPLICACIONES DE POLÍTICA ECONÓMICA

La evolución de los sistemas fiscales europeos está condicionada por un amplio conjunto de factores. Así, tanto la estructura tributaria como el nivel de presión fiscal serán el resultado de la interacción de variables como el gasto público y el nivel de estado de bienestar de cada país, la armonización fiscal, la competencia fiscal, etc. Las posibles diferencias fiscales pueden tener su impacto en los requisitos de libertad de movimientos de mercancías, capitales y trabajadores. Por tanto, reviste gran interés el estudio de la aproximación fiscal en los países de la UE a través de su principal agregado, la presión fiscal.

En este trabajo se realiza un contraste empírico de la hipótesis de convergencia de la presión fiscal en los países de la UE-15 con un enfoque de series temporales. Con datos de la OCDE para el periodo 1965-2004, se contrastan los conceptos de convergencia a largo plazo (diferencia estacionaria en torno a cero), determinística (diferencia estacionaria en torno a media no nula) y estocástica (diferencia estacionaria en torno a una tendencia con condición adicional de beta convergencia) tomando como referencia Alemania, Reino Unido y la media europea. Con este fin se emplean conjuntamente *test* de raíces unitarias y de estacionariedad con cambio estructural endógeno.

Los resultados evidencian un número muy reducido de convergencias. Tan sólo Alemania y Reino Unido presentan convergencia absoluta, mientras que la convergencia estocástica o *catching-up* se concluye para Grecia *vs* Alemania, Irlanda y Países Bajos *vs* Reino Unido, y Grecia y Portugal *vs* la media europea. Finalmente, la convergencia determinística, es decir, diferencias estacionarias no nulas, aparecen en las comparaciones de Países Bajos y España con Alemania, y Finlandia y Suecia con la media.

En síntesis, la presión fiscal de los países de la UE-15 mantiene importantes diferenciales a pesar de la creciente integración económica, la armonización fiscal y los espacios de competencia fiscal, poniendo de manifiesto la ausencia de un único modelo tributario europeo como consecuencia de la diversidad de estados del bienestar y las dificultades de superar los requisitos de unanimidad y subsidiariedad establecidos en la normativa comunitaria para avanzar en la aproximación tributaria.

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