ISSN: 1576-0162

Tax Policy Convergence In EU: An Empirical Analysis.

Convergencia de la política impositiva en la Unión Europea: un análisis empírico.

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Recibido: marzo de 2009; aceptado: septiembre de 2009.

Abstract

This paper examines the tax policy convergence in the EU-15 during the period 1965-2005 using a time series approach. The main purpose is to assess the convergence of the main components of tax revenue -income and profits, social security contributions, property, general taxes on goods and services, taxes on specific goods and services- taking as references Germany, the United Kingdom and the European average. The analysis is carried out from two complementary perspectives: the tax burden and the tax structure. Using unit roots and stationarity tests with a structural change, and also analyzing β-convergence, the results show little evidence of tax convergence. Convergence appears with similar intensity with respect to the three benchmarks, and in the years previous to the structural break which, in general, was situated endogenously at the end of the 1980s or at the beginning of the 1990s. Moreover, tax convergence is basically centred on income and profits, and goods and services taxation. The empirical evidence shows that the autonomy of the countries, their different economic structures and political preferences regarding the degree of public intervention, prevail over the idea of fiscal equalization in the EU.

Keywords: Convergence; European Union; Tax Policy; Time Series Analysis.

Resumen

En este trabajo se analiza la convergencia de la política impositiva en la UE-15 en el periodo 1965-2005 mediante un enfoque de series temporales. El principal objetivo es contrastar la convergencia de los principales componentes de los ingresos tributarios –renta y beneficios, contribuciones a la seguridad social, propiedad, impuestos generales sobre bienes y servicios, impuestos específicos sobre bienes y servicios- tomando como referencias Alemania, Reino Unido y la media europea. El análisis se realiza desde dos perspectivas complementarias: la presión fiscal y la estructura impositiva. Mediante contrastes de raíz unitaria y de estacionariedad con cambio estructural, y analizando la condición de beta convergencia, los resultados muestran poca evidencia de convergencia fiscal. La convergencia se presenta con similar intensidad con respecto a las tres referencias y en los años previos a la ruptura endógena que, en general, se sitúa a finales de los 80 y comienzos de los 90. Además, la convergencia se centra básicamente en la imposición sobre renta y beneficios y bienes y servicios. La evidencia empírica muestra por tanto que la autonomía de los países, sus estructuras económicas diferenciadas y las preferencias políticas sobre el grado de intervención pública prevalecen sobre la idea de igualdad fiscal en la UE.

Palabras clave: Convergencia; Unión Europea; Política impositiva; Series temporales.

JEL Classification: C22, E62, H87.

1. Introduction[1]

In the context of the progressive economic integration in the European Union, the study of the convergence has been the focus of a broad empirical literature in the last two decades by analysing per capita income, productivity or price indexes. In this integration process the Maastricht criteria refer only to nominal requisites, including prices and interest rates. About the measures of the public sector, only deficit and debt are contemplated among the criteria[2]. However, the convergence of the fiscal systems deserves a specific analysis in light of the existence of policies of fiscal harmonization and some degree of tax competition, especially in capital income. This convergence can be addressed from several perspectives, and we focus on two: the convergence of the tax burden (total tax revenue as a percentage of GDP) and the convergence of the tax structure (the components of tax structure as a percentage of total tax revenue). We carry this out with a disaggregated analysis of the main tax components using time series techniques.

In a single market it is debatable from a theoretical point of view whether there should be equalization of the tax burden among Member States (Emerson *et al*., 1992). Tax-coordination as tool for avoiding very distinct policies, and tax-harmonization in the sense of an equalization of effective tax rates, have been debated since the beginning of the process of European integration. Due to the existence of differences in economic structures and political preferences, along with national fiscal autonomy, European tax systems are far from uniform. Our aim is to investigate the issue of tax convergence from an empirical perspective.

Though a large literature exists on the convergence of public expenditure, both in terms of its size as its composition[3], the available literature on the topic

[1] An earlier version was presented at the XVIth Meeting on Public Economics (Granada, 2009). The authors thank the comments and suggestions from Miguel Sánchez Villalba, Alan Wall and two anonymous referees.

[2] Alonso and Cendejas (2006) study the role of the business cycle in the convergence process of both ratios in the EMU.

[3] See for example Kautto and Kvist (2002), Bouget (2003) and Ganghof (2006) for welfare systems; and Sanz and Velázquez (2004 and 2006) and Skidmore *et al.* (2004) for expenditure composition.

of tax convergence in EU is relatively small[4]. Using a cross-section approach, Esteve *et al.* (1999) and Sosvilla *et al.* (2001) study beta and sigma convergence and Delgado (2009) analyses gamma convergence[5]. In the present study, however, we use a time series setting which permits an individualized study of every country. Previous studies using time series analysis are Esteve *et al.* (1999 and 2000) and Delgado and Presno (2007). Esteve *et al.* (1999) study the tax burden using the six main subdivisions of the OECD tax classification for 1967-1994. By using unit root tests with a change, and taking Germany as the benchmark, they reject the hypothesis of long-run convergence but they find *catching-up* for some countries and tax categories. Esteve *et al.* (2000) repeat the exercise for the total tax burden, finding long-run convergence for Austria and *catching-up* for Belgium, Italy, Portugal, Spain, Sweden and the United Kingdom. Finally, Delgado and Presno (2007) study the total tax burden over the period 1965-2004 taking several benchmarks and their results suggest a reduced number of convergence paths.

Our main objective in this research is to study the disaggregated tax burden and to include the tax mix in the analysis in order to achieve a more complete vision of the process of fiscal convergence in the EU-15. We employ OECD data for the period 1965-2005, with Germany, the United Kingdom and the European average as benchmarks.[6] The following tax components are considered: income, profits and capital gains; social security contributions; taxes on property; general taxes on goods and services; and taxes on specific goods and services. Taken together, these represent at present about 90 per cent of EU-15 tax revenue.

The remainder of the paper is organized as follows. Section 2 contains the theoretical framework and the methodology, describing the definitions of convergence and the tests employed in the paper. The data and general results are presented in Section 3. Section 4 exhibits the detailed results and policy implications. Finally, Section 5 concludes. An Appendix contains a summary of test results.

[4] Slemrod (2004) analyses the corporate tax rates convergence and Boscá et al. (2005) study the convergence of the effective tax rates on consumption, capital and labour for the OECD countries.
[5] Delgado (2009) also carries out a cluster analysis within the EU-15 with regard to the tax burden and tax structure to determine groups of countries with similar characteristics. In his study for 2005, Germany appears in the most numerous cluster, and the other four groups are formed by (i) Belgium, Finland and Sweden, (ii) Greece and Portugal, (iii) Ireland and the United Kingdom and (iv) Denmark.
[6] While Germany is an obvious choice given its status as the EU largest economy, we also study the differences with respect to the United Kingdom due to its importance in the European economy and the peculiarities of its tax system.

2. Theoretical Framework and Methodology.

2.1. Some Issues about Taxation in EU.

The increasing economic integration of the EU countries, epitomized by the constitution of the Single Market after 1992, provides an important framework for both theoretical and empirical study in the area of Public Economics, and more precisely in the Fiscal Federalism and Public Policy theories[7].

Theoretically, countries compete for mobile factors in an integrated area with free movement of goods, services, capital and labour. Thus, in a convergence scenario, tax competition (for reviews, see Wilson, 1999 or Zodrow, 2003) could tend to equalize the tax burden and the tax mix. Another result from the globalization theory of taxation is that, as labour is less mobile than capital, it is expected that effective tax rates on labour increase, whereas effective tax rates on capital decrease, i.e. convergence towards the bottom[8]. The net result is that the tax structure will be more based on labour income, implying a shift in the tax burden from mobile to immobile tax bases. However, in the real world the pressures of unemployment rates and other factors constrain the potential rise of labour taxation.

Fiscal harmonization policies have been geared towards the convergence of tax systems in EU. However, relatively little harmonization has been achieved because the unanimity criterion requires a lot of effort and time to achieve agreements, slowing down tax integration. Swank and Steinmo (2002) argue that changes in tax burdens are constrained by three factors –internationalization, domestic economic change and budgetary forces– and they explain the complexity of tax policy outcomes in the framework of a "new political economy of taxation"[9].

Another issue is that the Member States do not have the same economic structures or public welfare systems. It is well-known that the Nordic welfare model is the most generous, with Denmark and Sweden facing a tax burden of over 50 per cent of GDP. On the other extreme, the tax to GDP ratios of Greece and Ireland are much lower than the EU average. Moreover, the introduction of the single currency in the euro zone has left national fiscal policy as the key stabilization tool for individual countries.

In the context of EU integration, fiscal magnitudes are not the central task of the process. The harmonization rules in indirect taxation, based on minimum rates, and the slight agreement on capital incomes approved in recent years do

[7] For an exhaustive review of the literature on policy convergence, see Heichel *et al.* (2005). Holzinger (2006) contains an interesting discussion of the methodological problems of policy convergence studies.
[8] This can be seen as the result of the classic prisoner's dilemma (Tanzi, 1995). In an extreme case of fully mobile capital in open economies, the optimal tax rate on capital income tends to be zero. However, real world data show that they are far from zero. On the other hand, Hays (2003) concludes that globalization will lead to partial capital tax convergence but not convergence to the bottom.
[9] For a more detailed discussion about internationalization and its effects on national policies, see for example Radaelli (1997), Hallerberg and Basinger (1998) and Drezner (2003).

not constitute a "hard" and unique Union tax policy. Furthermore, the Maastricht criteria of entry into the EMU refer only to the public deficit and national debt, which must be below 3 per cent and 60 per cent of GDP respectively.

Finally, insofar as both the level of the tax burden and the tax mix have effects on economic growth and productivity, there is a need to study the differentials between the fiscal systems of the European countries, as well as their paths of convergence and divergence[10].

2.2. Definitions of Convergence.

The literature on convergence from a time series perspective (Carlino and Mills, 1993; Quah, 1993; Bernard and Durlauf, 1995; Evans and Karras, 1996; Li and Papell, 1999) has given rise to three concepts –*long run*, *deterministic* and *stochastic convergence* or *catching-up*– which we briefly summarize below.

Long run or *absolute convergence* requires the equality of the long run predictions of the fiscal magnitudes, so the difference between the country and the benchmark must be a zero-mean stationary series. The strength of this restriction has meant that this kind of convergence, called "asymptotically perfect convergence" by Hobijn and Franses (2000), is not frequently confirmed.

Stochastic convergence or *catching-up* version refers to when the difference is stationary around a trend. However, this concept is compatible with permanent differences (Li and Papell, 1999), so we will label this "preliminary" stochastic convergence. Carlino and Mills (1993) point out that a condition of β-convergence must be confirmed as well to ensure the strengthening of the difference. Thus, "confirmed" stochastic convergence or simply stochastic convergence is attained when both preliminary stochastic convergence and β-convergence are verified.

Third, Li and Papell (1999) propose *deterministic convergence* as an intermediate concept between the previous two when the difference is stationary around a non-zero level, which is the same idea behind the "asymptotically relative convergence" of Hobijn and Franses (2000). Nevertheless, this is a weak concept of convergence as it permits important, though constant, differences between the series.

[10] For instance, see Mendoza *et al*. (1997) for a theoretical and empirical study on the relationship between tax policy and long-run growth, Tosun and Abizadeh (2005) for an empirical study of the relation between tax mix and economic growth, and Wang (2007) on the tax burden and growth, all of which are studies for the OECD countries. Lee and Gordon (2005) study the influence of tax structure on economic growth with a worldwide sample of 70 countries and they find a negative effect of the corporate tax rate on growth. In a more specific framework, Pintus (2008) analyses the relationship between the progressiveness of income tax and the speed of convergence, finding that income convergence and tax progressiveness are positively correlated both for a US sample and a sample of six OECD countries (Italy, France, Germany, Spain, the United Kingdom and United States). Joumard (2002) contains an interesting review of tax policies in EU countries.

2.3. Methodological Issues.

As seen above, convergence analysis from a time series approach rests on the concept of stationarity, that is, on the idea that shocks only have a temporary effect due to the non-existence of a unit root in the process. With the aim of studying this stochastic time series property, in this paper we apply both unit root and stationarity tests as a means to reinforce the conclusions of both kinds of tests and to obtain robust results. The confirmatory analysis is summarized in Table 1 (Cheung and Chinn, 1996). While cases II and III lead to coincidental conclusions (no stationarity or "no convergence" and stationarity or "convergence", respectively), the conclusions of the tests are contradictory in cases I and IV, imputable, respectively, to the deficient power of the tests under some circumstances and to the existence of more complex data generating processes.

Table 1: Summary of Joint Results from Unit Root and Stationarity Tests.

	Stationarity test: Does not reject	Stationarity test: Rejects
Unit root test: Does not reject	CASE I (?)	CASE II
Unit root test: Rejects	CASE III	CASE IV (?)

Source: Cheung and Chinn (1996).

As the period that we consider in our convergence analysis contains events of great relevance in fiscal terms (such as the adhesion of new Member States, the introduction of harmonization measures, the single market, the Maastricht criteria), we apply tests which allow a structural break taking place at a time unknown *a priori*[11]. Also, we consider four models. For the analysis of *deterministic convergence*, we use the *Level Model* (series without trend but with a change in level). When we extend our study to *stochastic convergence*, we consider three models with trend: *Model A* (series with a level shift), *Model B* (series with a change in the slope), and *Model C* (series with both a change in intercept and slope). Since the election of the model is relevant in order to correctly infer the properties of the time series, we estimated the three trended models and, following Montañés *et al.* (2005), opted for the one selected using the Schwarz criteria.

To perform the analysis, we applied the unit root statistic proposed by Perron and Rodríguez (2003). They extended the class of modified tests (*M-tests*) of Elliott *et al.* (1996) and Ng and Perron (2001) to the analysis of series which suffer a structural change in the trend function (Models *B* and *C*) at a time unknown *a priori*. Concretely, and paying attention to the properties

[11] It has been demonstrated in the unit root and stationarity tests literature (e.g. Perron, 1989, 1990 and Lee *et al.*, 1997) that the existence of breaks which are ignored carries low power in the Dickey-Fuller test and strong distortions in the size of the LM stationarity test.

of the time series, we applied the $MZ_{\alpha}^{GLS}(\delta)$ statistic:

$$MZ_{\alpha}^{GLS}(\delta) = \left(T^{-1}\tilde{y}_T^2 - s^2\right)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \quad (1)$$

where $\tilde{y}_t$ represents the detrended series which is obtained using local-to-unity GLS detrending[12], $\delta = T_b/T$ ($\delta \in (0,1)$) is the relative position of the timing of the break, $s^2 = s_{ek}^2 / \left(1-\hat{b}(1)\right)^2$ is an autoregressive spectral density estimator, with $s_{ek}^2 = (T-k)^{-1}\sum^{T}\hat{e}_{tk}^2$, and $\hat{b}(1) = \sum^{k}\hat{b}_j$. $\hat{b}_j$ and $\{\hat{e}_{tk}\}$ are obtained from the regression $\Delta\tilde{y}_t = b_0\tilde{y}_{t-1} + \sum_{j=1}^{k} b_j\Delta\tilde{y}_{t-j} + e_{tk}$ where k was selected according to the Modified Akaike Information Criterion (MAIC) considering $k_{max}=5$. As we treat the break point as unknown *a priori*, we applied the *Infimum* method to estimate it.

Finally, for the trending models (*A*, *B* and *C*) we used finite sample critical values provided by Rodríguez (2006a) and Perron and Rodríguez (2003). For the *Level Model*, we generated finite sample critical values adapted to our data sample size and adjusted for the effect of the method used to select k and for the procedure applied for estimating the change date[13].

To complement this, we applied the LM stationarity test with a structural break, which was studied by Lee and Strazicich (2001), Busetti and Harvey (2001), Kurozumi (2002) or Presno and López (2003a).

The LM statistic is given by:

$$\hat{\eta} = \frac{\sum_{t=1}^{T} S_t^2}{T^2\hat{\sigma}^2} \quad (2)$$

[12] For the unit root and stationarity tests, we considered the following set of deterministic components, z_t, depending on the model: $z_t = \{1, 1(t>T_b)\}$ (*Model Level*), $z_t = \{1, 1(t>T_b), t\}$ (*Model A*), $z_t = \{1, t, 1(t>T_b)(t-T_b)\}$ (*Model B*), and $z_t = \{1, 1(t>T_b), t, 1(t>T_b)(t-T_b)\}$ (*Model C*), where 1(.) is the indicator function and T_b is the break date.

[13] Perron and Rodríguez (2003) stress that the *Level Model* and *Model A* are special cases of the *slowly evolving deterministic component* (Elliott *et al*., 1996) and the asymptotic distributions of the tests coincide with the case whose deterministic components include a constant and a time trend respectively. However, for case A, Rodríguez (2006a) checks that in small samples there are big differences with respect to the asymptotic behaviour and generates finite sample critical values. For the *Level Model* we generated them according to the following specifications: we did Monte Carlo experiments (5,000 replications) and generated series under the null hypothesis with $T=50$. We considered $c=-7$, applied the MAIC criterion to select k, and estimated the break point using the *Infimum* method.

where $S_t = \sum_{i=1}^{t} \hat{u}_i$ is the partial sum process of the OLS estimated residuals, obtained when the series is regressed against the deterministic components.

$\hat{\sigma}^2$ is a consistent estimator of the long-run variance, $\hat{\sigma}^2 = T^{-1}\sum_{t=1}^{T}\hat{u}_t^2 + 2T^{-1}\sum_{s=1}^{l} w(s,l)\sum_{t=s+1}^{T}\hat{u}_t\hat{u}_{t-s}$, where in our application $w(s,l)$ is the Quadratic Spectral window depending on a bandwidth parameter *l*. Since a suitable selection of these elements turns out to be determinant in order to prevent inconsistency of the test, we followed the Sul *et al.* (2005) proposal[14].

Finally, following Kurozumi (2002) and Busetti and Harvey (2002), we selected the break point which minimizes the residual sum of squares, and used the critical values provided by the response surface of Presno and López (2003b).

As stated above, the study of stochastic convergence was completed with the analysis of the notion of β-convergence. For that, we followed the Tomljanovich and Vogelsang (2002) approach. The analysis is based on two regressions that are both estimated by OLS.

The first regression is given by:

$$y_t = \mu_1 DU_{1t} + \beta_1 DT_{1t} + \mu_2 DU_{2t} + \beta_2 DT_{2t} + u_t \quad (3)$$

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. μ_1 and μ_2 indicate whether the fiscal variable is above or below the average/benchmark at times 1 and T_b respectively, and β_1 and β_2 are growth rates before and after the break.

The second regression is based on computing partial sums of y_t.

$$z_t = \mu_1 DT_{1t} + \beta_1 SDT_{1t} + \mu_2 DT_{2t} + \beta_2 SDT_{2t} + S_t \quad (4)$$

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

β-convergence involves testing that the parameters μ_i and β_i, i = 1,2, are different from zero and their signs are consistent with convergence, that is, are negatively related ($\mu_i > 0$ and $\beta_i < 0$ or vice versa). This can be carried out using the statistics provided by Vogelsang (1997, 1998), which are robust to the case

[14] Carrión-i-Silvestre and Sansó (2006) analyzed this method via Monte Carlo simulations, showing its good properties in terms of size and power.

where u_t is either an $I(0)$ or $I(1)$ process. In our application we opted for 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 regressions (3) and (4) respectively are zero, and T is the sample size. The election of these statistics is based on the fact that the former has well-defined asymptotic distributions when u_t is $I(1)$, but remains robust in the presence of $I(0)$ disturbances, while the latter was designed to have power and is more appropriate if the errors are known to be $I(0)$, which in our study was confirmed from the prior unit root and stationarity tests results.

The critical values are reported in Vogelsang (1997) and Tomljanovich and Vogelsang (2002), and depend on whether the break date is assumed known or unknown *a priori*. We assumed this last case and followed the method applied by Tomljanovich and Vogelsang (2002) to estimate the break point from the data. This consists of estimating regression (3) sequentially for each break year with 10 percent trimming ($0.1T < T_b < 0.9T$), computing for each regression T^{-1} multiplied by the Wald statistic for testing the joint hypothesis that $\mu_1 = \mu_2$ and $\beta_1 = \beta_2$, and selecting the break date that results in the largest normalized Wald statistic.

We complete our research with the study of the strongest concept of convergence, *long run convergence*. This kind of convergence was analysed via the LM procedure to test the null hypothesis of zero mean stationarity. Concretely, once stationarity around a constant or deterministic convergence was detected, we applied the stationarity around zero mean test to the pre- and post-break periods. In order to confirm long run convergence, we used the critical values reported in Hobijn *et al.* (2004).

3. Data and General Results.

3.1. Data.

Our data are from the Revenue Statistics of the OECD and refer to the tax burden and the tax structure or tax mix of the main tax components: income, profits and capital gains (IP); social security contributions (SS); taxes on property (PR); general taxes on goods and services (GSG); and taxes on specific goods and services (GSS)[15]. Jointly, they represent 90 per cent approximately of the tax revenue in the EU-15 in 2005. The sample period is from 1965 to 2005.

Descriptive statistics are reported in Tables 2 and 3. For illustrative purposes, Figures 1 and 3 represent the evolution of the tax burden and the tax mix for the European average, and Figures 2 and 4 the evolution of σ-convergence measured by the coefficient of variation.

[15] These components are the 1000, 2000, 4000, 5110 and 5120 subdivisions of the OECD tax classification. We concentrate on the above and do not study the other two main subdivisions -3000-Taxes on payroll and workforce and 6000-Other taxes- which only represent the 0.43 and 0.33 per cent of total tax revenue respectively in 2005.

With respect to the tax burden, from Table 2 and Figure 1 we can see the rise in the average of all components except for specific consumption taxes, as well the σ-convergence process (Figure 2), especially in social security contributions and general consumption taxes. IP and SS account for the majority of tax revenue, amounting to 24.81% of GDP in 2005 when total tax burden was 39.67%. The tax-to-GDP ratio increased notably from 27.56% in 1965 because of the extension of welfare and protection systems combined with an ageing population, but it has stabilized near 40% since the beginning of the 1990s. The Maastricht convergence criteria, the Stability and Growth Pact and the extension of the hypothesis of oversized public sectors in Europe are some explanations for this change in the trend.

Table 2: Tax Burden (% of GDP) in the EU-15, 1965-2005.

	IP		SS		PR		GSG		GSS	
	1965	2005	1965	2005	1965	2005	1965	2005	1965	2005
Mean	8.80	13.72	6.16	11.09	1.76	2.07	3.83	7.47	5.97	3.81
Min	1.41	6.96	1.13	1.10	0.62	0.56	0.31	6.00	2.71	2.54
Max	19.21	30.71	11.63	16.33	4.42	4.38	7.92	9.99	10.82	5.36
SD	4.55	5.62	3.31	3.94	1.02	1.05	2.07	1.20	2.07	0.79
CV	0.517	0.410	0.538	0.355	0.578	0.507	0.541	0.161	0.347	0.206

With regard to the tax mix (Table 3), the decline of the taxes on specific goods and services, from 23.07% in 1965 to only 9.74% in 2005, was absorbed by the remaining categories, except for the taxes on property, which decreased slightly. In addition, there is σ-convergence with similar characteristics to the tax burden.

Table 3: Tax Mix (% of total revenue) in the EU-15, 1965-2005.

	IP		SS		PR		GSG		GSS	
	1965	2005	1965	2005	1965	2005	1965	2005	1965	2005
Mean	30.43	33.81	22.72	28.41	6.67	5.34	13.35	19.04	23.07	9.74
Min	9.12	23.52	3.78	2.19	1.78	1.33	0.10	14.61	11.10	6.79
Max	54.89	61.04	34.17	39.93	15.13	12.00	23.26	25.06	44.01	14.82
SD	11.68	9.07	10.54	9.46	3.71	2.86	6.44	2.76	10.11	2.02
CV	0.384	0.268	0.464	0.333	0.557	0.536	0.482	0.145	0.438	0.208

FIGURE 1: TAX BURDEN FOR AVERAGE EU-15, 1965-2005.

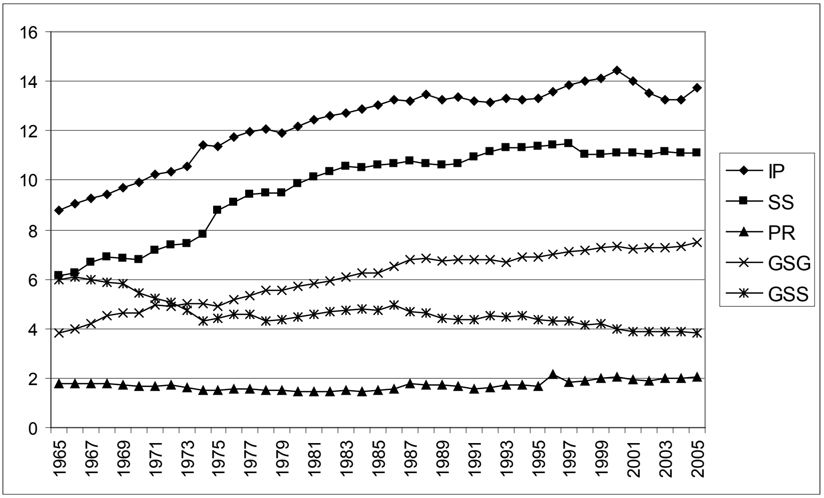


FIGURE 2: σ- CONVERGENCE OF TAX BURDEN, 1965-2005.

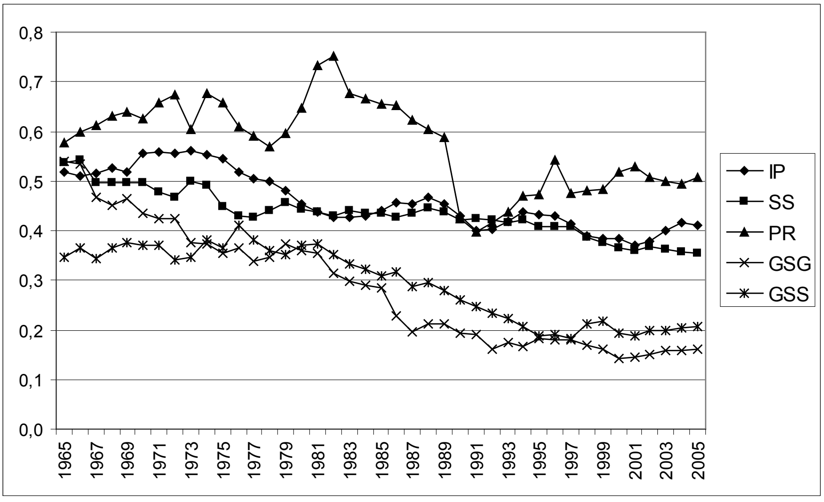


Figure 3: Tax Mix for Average EU-15, 1965-2005.

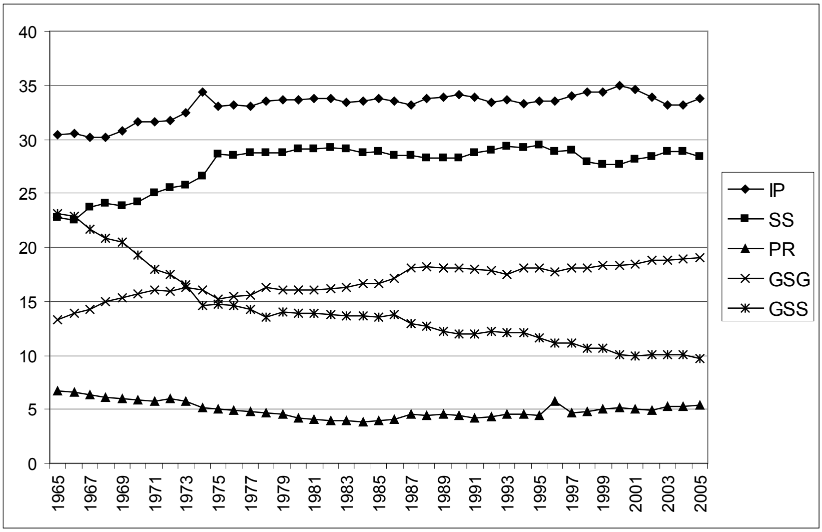
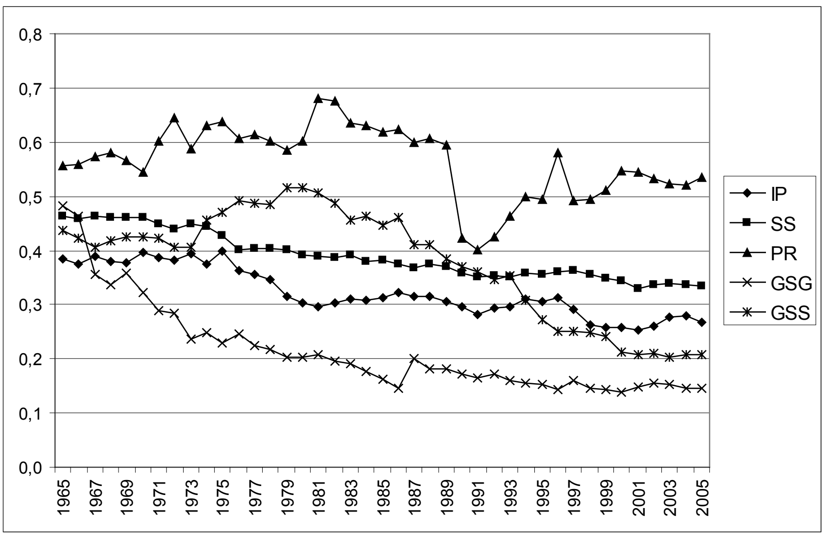


Figure 4: σ- convergence of Tax Mix, 1965-2005.



In short, the dynamics of both the tax burden and the tax composition in the EU-15 reveal an increasing common trend, but with a decreasing dispersion, so time series analysis will be capable of offering individual paths of convergence or divergence[16].

3.2. Some General Remarks of the Empirical Results.

For each of the concepts of convergence that we analyse, Tables 4 and 6, which refer to the tax burden and tax mix respectively, summarize the series that turned out to be stationary around a level (deterministic convergence) or a trend with a break on the basis of the confirmatory analysis using unit root and stationarity tests jointly. For series which were confirmed as stationarity around a trend (series with "preliminary" stochastic convergence), we analyzed the β-convergence condition. This analysis permits the differentiating of paths before and after the break, as well as confirming convergence or divergence in the preliminary stochastic convergence cases. In Tables 5 and 7 we report the conclusions of the β-convergence study following the classification used by Tomljanovich and Vogelsang (2002). Thus, from the analysis of the sign and significance of the coefficients μ_i and β_i, *C* denotes convergence with both parameters statistically significant, *c* denotes convergence but with only one parameter statistically significant, *D* means divergence with both parameters statistically significant, *d* means divergence but with only one parameter statistically significant, and finally *u* denotes that no conclusion could be reached as no coefficient is statistically significant. The series which converge stochastically respect to the benchmark ("confirmed" stochastic convergence) for the tax burden and the tax mix are reported in the last column of Tables 4 and 6. Detailed results of the tests are reported in Tables A.1-A.3 in the Appendix.

In the next sections, we comment separately on the results for the tax burden and the tax mix as they address two different perspectives of tax policy, the former how much to collect and the latter how to obtain the revenue from the several taxable sources. Before doing so, we offer some general remarks about the tests and the results.

From Tables A.1-A.3 in the Appendix, we observe that the break in the data estimated for the unit root and stationarity tests and that estimated in the β-convergence analysis does not coincide in some series. This issue has been emphasized in previous studies which employ these methodologies (for instance, Rodríguez, 2006b) and is due to the different methods applied to locate the break point.

Results deriving from the $T^{-1/2}t_y$ statistic lead in many cases to situations where making inferences about convergence or divergence is difficult (cases

[16] In addition, the coefficient of correlation between the measure of σ-convergence of the tax burden and tax mix for each tax category is always above 0.9.

u in Tables 5 and 7). This fact could be explained by the conservative nature of the test in the presence of *I*(0) processes, confirmed by the unit root and stationarity tests. In Tables 4 and 6 we include the conclusions about convergence from a joint examination of $T^{-1/2}t_y$ and $T^{-1/2}t_z$ statistics.

The estimates of μ_1 are statistically different from zero for most series. The only exceptions are the GSG component - tax burden perspective- of Ireland when the United Kingdom is the benchmark, and the IP component -tax mix perspective- of Luxembourg with respect to the United Kingdom and Portugal with respect to the EU-15[17]. This means that, in general, the tax magnitudes in the European Union did not match with the benchmark in the initial period of our study, 1965.

Tables A.2 and A.3 show more cases of estimates of μ_2 significantly different from zero, even when the results were derived from the less conservative $T^{-1/2}t_y$ statistic. However, all these countries attained stochastic convergence with the benchmark before the break but they did not maintain it in the post break years.

Moreover, the results show that the bulk of the convergence process has taken place mainly in the period before the break point, and in very few cases did the process continue after the break. This fact seems to indicate that in the latter years no significant advances in the field of tax policy convergence have occurred.

Finally, as remarked by De Juan and Tomljanovich (2005), two caveats have to be taken into account when β-convergence analysis is carried out. The first is that this methodology does not offer predictive power about the future behaviour of the variables. The second rests on the fact that no speed of convergence parameter is estimated, so it is not possible to know at what moment convergence will be reached.

4. Detailed Results and Policy Implications.

4.1. Results for the Tax Burden.

The summary in Table 4 shows that very few cases of long run convergence can be observed: Luxembourg with the United Kingdom in IP and Sweden with Germany in SS, both in the post break period[18]. This was as expected due to the strong restrictions associated with this type of convergence.

[17] However, it should be highlighted that long run convergence was not attained in these cases, and we only observe stochastic convergence in the period posterior to the break.

[18] Due to the small number of countries with long run convergence, in Table A.1 we do not report the values of the LM statistic to test stationarity around zero mean. These values are 0.77 for the case of the IP component of Luxembourg with respect to the United Kingdom, and 0.948 for the SS of Sweden when Germany is the benchmark.

The results reveal several cases of deterministic convergence where the difference has stabilized around a non-zero constant. The most numerous group appears with the United Kingdom in PR.

As we would expect given its weaker restrictions, there are relatively more cases of stochastic convergence. Still, few instances of convergence exist and they are mainly concentrated in property and consumption taxes.

A case which deserves a special mention is taxes on property when the United Kingdom is the benchmark. For all these series, both kinds of analysis (stationarity-unit root tests and β-convergence analysis) coincide in detecting a break date located in the year 1989. The justification is that the United Kingdom abolished domestic property taxation based on rates in 1989 (Scotland) and 1990 (England and Wales), and approved the replacement by the controversial poll tax or Community Charge.

With respect to consumption taxes, a group of six nations converge to the EU-15 average. This fact could be expected because of the agreements on minimum tax rates on alcohol, tobacco and fuel, but it is striking that the convergence paths concentrate in the pre break period –which is located mainly at the end of the 1980s and at the beginning of the 1990s- but not in the post break years.

A closer examination of the results from Table 5 highlights some clear divergences that reinforce the main finding of the paper, that is, there has been no advance in the field of tax policy convergence in the last fifteen or twenty years.

Table 4: Results from Convergence Analysis of the Tax Burden.

Series	*Benchmark*	*Long run convergence*	*Deterministic convergence*	*Preliminary Stochastic convergence*	*Stochastic convergence*
IP	Germany	-	Luxembourg Netherlands Sweden United K.	-	-
	United K.	Luxembourg (Post-1975)	Germany Sweden	Austria Finland Greece Netherlands	Greece (Pre & Post-90)
	EU-15	-	-	Finland Germany Ireland Portugal Sweden	Germany (Pre-95) Ireland (Pre-91) Portugal (Post-78) Sweden (Pre-90)
SS	Germany	Sweden (Post-1975)	-	Ireland Italy Netherlands Portugal	Ireland (Post-95) Netherlands (Post-88) Portugal (Post-91)

	United K.	-	-	Italy Spain Sweden	Italy (Post-91)
	EU-15	-	Italy	Austria Belgium Netherlands Sweden	Belgium (Pre & Post-83) Netherlands (Post-86)
PR	Germany	-	Ireland	Denmark France Italy Luxembourg Portugal Spain United K.	Denmark (Post-69) Portugal (Pre & Post-89) Spain (Pre-95)
	United K.	-	Austria Belgium Denmark Finland Ireland	France Germany Greece Italy Luxembourg Netherlands Spain	France (Pre-89) Luxembourg (Pre-89) Netherlands (Pre-89) Spain (Pre-89)
	EU-15	-	Italy Portugal	Belgium Denmark France Greece Luxembourg United K.	Belgium (Pre-95) France (Pre-91)
GSG	Germany	-	Austria Finland Netherlands	Greece Portugal Sweden	Greece (Pre-86) Portugal (Pre & Post-85) Sweden (Pre-79)
	United K.	-	Greece	Ireland Luxembourg Netherlands Spain	Ireland (Post-78) Luxembourg (Pre-90) Netherlands (Post-79) Spain (Pre & Post-79)
	EU-15	-	Finland Luxembourg Netherlands	Austria Greece Ireland	Austria (Post-86) Ireland (Pre & Post-81)
GSS	Germany	-	Sweden	Austria Denmark United K.	Austria (Pre-93) Denmark (Pre-88) United K. (Pre & post-95)
	United K.	-	Austria Denmark	Finland France Germany Greece	France (Pre & Post-90) Germany (Pre & Post-95) Greece (Pre-78)
	EU-15	-	-	Denmark Finland France Ireland Luxembourg Spain	Denmark (Pre-89) Finland (Pre & Post-74) France (Pre-94) Ireland (Pre-91) Luxembourg (Pre & Post-87) Spain (Pre-84)

Notes: Pre-year: convergence attained in the period previous to the break, and break date. Post-year: convergence attained in the period posterior to the break year, and break date.

Table 5: Results for b-convergence Condition for the Stochastic Convergence of the Tax Burden.

Series	Benchmark	Country	$T^{1/2}t_y$ (T_b unknown)		$T^{1/2}t_z$ (T_b unkown)		$\hat{T}_b$
			Pre-break	Post- break	Pre-break	Post- break	
IP	Germany	-					
	United K.	Austria	d	u	d	u	1990
		Finland	u	u	D	c	1990
		Greece	c	c	c	c	1990
		Netherlands	u	u	u	c	1990
	EU-15	Finland	d	u	d	D	1977
		Germany	C	u	C	d	1995
		Ireland	c	u	C	c	1991
		Portugal	d	c	D	C	1978
		Sweden	C	u	C	c	1990
SS	Germany	Ireland	D	u	D	u	1995
		Italy	u	u	d	u	1997
		Netherlands	D	c	D	C	1988
		Portugal	D	C	D	C	1991
	United K.	Italy	d	c	D	C	1991
		Spain	u	d	c	D	1977
		Sweden	u	d	u	D	1976
	EU-15	Austria	d	d	d	d	1992
		Belgium	c	c	C	C	1983
		Netherlands	d	C	D	C	1986
		Sweden	u	u	u	c	1975
PR	Germany	Denmark	u	c	u	C	1969
		France	D	d	D	D	1991
		Italy	u	u	u	d	1991
		Luxembourg	d	u	D	u	1998
		Portugal	c	u	C	C	1989
		Spain	C	u	C	u	1995
		United K.	D	d	D	D	1989
	United K.	France	c	u	C	c	1989
		Germany	d	d	D	D	1989
		Greece	c	u	d	u	1995
		Italy	d	u	D	D	1989
		Luxembourg	c	u	C	d	1989
		Netherlands	c	u	c	D	1989
		Spain	C	u	c	d	1989
	EU-15	Belgium	c	u	C	u	1995
		Denmark	d	u	d	c	1988
		France	C	u	C	c	1991
		Greece	u	u	c	u	1995
		Luxembourg	d	u	D	c	1998
		United K.	D	u	d	D	1989
GSG	Germany	Greece	c	u	c	u	1986
		Portugal	c	u	C	C	1985
		Sweden	c	u	C	d	1979

	United K.	Ireland	u	u	c	C	1978
		Luxembourg	C	u	C	c	1990
		Netherlands	d	u	d	C	1979
		Spain	C	u	C	C	1979
	EU-15	Austria	d	u	d	C	1986
		Greece	d	u	D	c	1986
		Ireland	C	u	C	C	1981
GSS	Germany	Austria	c	u	C	u	1993
		Denmark	c	u	c	c	1988
		United K.	C	c	C	c	1995
	United K.	Finland	u	u	u	c	1974
		France	c	c	C	c	1990
		Germany	c	c	C	c	1995
		Greece	C	u	c	c	1978
	EU-15	Denmark	c	u	C	u	1989
		Finland	c	c	c	C	1974
		France	c	u	C	u	1994
		Ireland	C	u	C	D	1991
		Luxembourg	C	u	C	C	1987
		Spain	C	u	C	c	1984

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

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

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

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

u means that no conclusion is possible to be advanced using the available information.

Although our results are not directly comparable with those of Esteve *et al.* (1999) due to differences in methodology (they just apply unit root tests with a break and do not take into account the β-convergence condition) and differences in the sample periods used (they study 1967-1994), it is worth noting that we find less evidence of stochastic convergence. The reason is that we use more demanding criteria to confirm the results, which are thus more robust.

4.2. Results for the Tax Mix.

Using the same methodology, the tax mix results are summarized in Table 6. Long run convergence is confirmed in just one case: the PR component of Italy with respect to the EU-15 average in the post-break period[19].

With regard to deterministic convergence, the empirical results again show that the biggest group of convergent countries appears in the case of PR when

[19] The value of the LM statistic to test stationarity around zero mean is 0.279.

the United Kingdom is the benchmark. Concretely, five countries converge with the United Kingdom, three of which coincide with the tax burden study: Austria, Belgium and Denmark. Again, in all cases the stationarity test detects a break around 1989. One must bear in mind that the taxation of the UK is heavily based on property, representing about 12 per cent of the tax revenue today whereas the EU-15 average is only 5.34 per cent.

Again, from the preliminary stochastic convergence cases, the Tomljanovich and Vogelsang (2002) methodology allows us to isolate the stochastic convergence cases (Table 7). If we apply this filter to the preliminary results on stochastic convergence, then convergence turns out to be limited to a small group of countries. Now, the main cases of convergences are found in the IP component, where two countries (Greece and Ireland) converge with the three benchmarks, and on the taxes on goods and services, both general and excise. It is worth mentioning that five countries converge with Germany in GSS, but essentially in the pre-break sample. Finally, as with the tax burden, we conclude that there has been some divergence from the benchmarks.

Table 6: Results from Convergence Analysis of the Tax Mix.

Series	Benchmark	Long run convergence	Deterministic convergence	Preliminary Stochastic convergence	Stochastic convergence
IP	Germany	-	Austria Luxembourg Netherlands	Greece Ireland Sweden	Greece (Pre & Post-93) Ireland (Pre-92) Sweden (Pre-76)
	United K.	-	Netherlands Spain	Denmark Greece Ireland Luxembourg Sweden	Greece (Pre & Post-92) Ireland (Pre-91) Luxembourg (Post-85) Sweden (Pre&Post-77)
	EU-15	-	-	Greece Ireland Luxembourg Portugal	Greece (Pre & Post-97) Ireland (Pre-1992) Luxembourg (Post-79) Portugal (Post-78)
SS	Germany	-	Sweden	Ireland Netherlands	Ireland (Post-95)
	United K.	-	Denmark	Ireland Luxembourg	Ireland (Pre-78) Luxembourg (Pre-82)
	EU-15	-	Belgium United K.	Ireland Italy Sweden	Ireland (Pre & Post-94) Italy (Post-76) Sweden (Pre-76)
PR	Germany	-	Denmark Portugal United K.	Belgium France Italy Luxembourg	Belgium (Pre-97) France (Pre-74) Italy (Pre-87)
	United K.	-	Austria Belgium Denmark Germany Italy	Finland Portugal Spain	Finland (Pre-89)

	EU-15	Italy (Post-92)	Portugal Spain	Belgium France Luxembourg United K. Sweden	Belgium (Pre-94) France (Pre-88) Sweden (Pre-86)
GSG	Germany	-	Finland Netherlands	Ireland Sweden	Ireland (Pre-78) Sweden (Pre-94)
	United K.	-	Greece Portugal	Belgium Finland Ireland Luxembourg	Belgium (Pre-91) Finland (Pre-91) Luxembourg (Pre-91)
	EU-15	-	Germany Netherlands	Austria Greece Ireland Portugal	Austria (Post-85) Ireland (Pre-86) Portugal (Pre-93)
GSS	Germany	-	-	Austria Finland Greece Luxembourg Sweden	Austria (Pre-93) Finland (Pre&Post-88) Greece (Pre-94) Luxembourg (Pre-79) Sweden (Pre-94)
	United K.	-	Denmark Italy Sweden	-	-
	EU-15	-	Finland Sweden	France Luxembourg	France (Pre-94) Luxembourg (Pre-92)

Notes: Pre-year: convergence attained in the period previous to the break, and break date. Post-year: convergence attained in the period posterior to the break year, and break date.

Table 7: Results of the β-convergence Condition for the Stochastic Convergence of the Tax Mix.

Series	Benchmark	Country	$T^{1/2}t_y$ (T_b unknown)		$T^{1/2}t_z$ (T_b unkown)		$\hat{T}_b$
			Pre-break	Post-break	Pre-break	Post-break	
IP	Germany	Greece Ireland Sweden	C C C	u u u	C C C	C d d	1993 1992 1976
	United K.	Denmark Greece Ireland Luxembourg Sweden	D C C u C	u u u u u	D C C c C	c C u C C	1991 1992 1991 1985 1977
	EU-15	Greece Ireland Luxembourg Portugal	C C d u	u u c u	C C D d	C c C C	1997 1992 1979 1978
SS	Germany	Ireland Netherlands	d D	c u	D d	c c	1995 1989
	United K.	Ireland Luxembourg	c C	u d	C C	d c	1978 1982

	EU-15	Ireland Italy Sweden	C d C	c C u	C D c	C C c	1994 1976 1976
PR	Germany	Belgium France Italy Luxembourg	C C c D	u u u u	C C C d	u D c c	1997 1974 1987 1998
	United K.	Finland Portugal Spain	c d D	d d u	C D d	D D d	1989 1989 1989
	EU-15	Belgium France Luxembourg Sweden United K.	C C d c D	u u u u u	C C d C D	c c c d D	1994 1988 1998 1986 1989
GSG	Germany	Ireland Sweden	C C	u u	C C	D u	1978 1994
	United K.	Belgium Finland Ireland Luxembourg	C C u C	u u u u	C C c C	u u c d	1991 1991 1978 1991
	EU-15	Austria Greece Ireland Portugal	d u C C	u u u u	d u C C	C c d u	1985 1986 1986 1993
GSS	Germany	Austria Finland Greece Luxembourg Sweden	c c c c C	u c u u u	C c C c C	u c u d u	1993 1988 1994 1979 1994
	United K.	-					
	EU-15	France Luxembourg	C C	u u	C C	u u	1994 1992

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

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

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

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

u means that no conclusion is possible to be advanced using the available information.

4.3. Discussion and Policy Implications.

Within the heterogeneous field of cross-national policy convergence (see e.g. Knill, 2005), the task of tax convergence is of great importance for European integration. The EU must face the trade off between national sovereignty and the single market requisites, and even the prospect of a real political union within the new scenario created after the Treaty of the European Union. This can be addressed within the framework of classical integration theory or multi-level governance theory (Jachtenfuchs, 2001). Clearly, the EU is a federation of nations and traditional fiscal federalism is not directly valid. As pointed out by Alesina *et al.* (2005), this is due to the lower individual mobility, the fact that the transfers within EU countries are much larger than that among them, and the higher heterogeneity of preferences.

In accordance with the results from our approach to tax convergence, the empirical evidence reveals that tax policies remain largely national and the vaguely designed harmonization measures and other factors such as tax competition are not equalizing the tax burden or the tax structure in the EU. Thus, policy makers, in the search for an equilibrium between the theoretical results from increasing economic integration and the need to maintain the current welfare states with increased demands for social protection from citizens, seem to have opted for deviating from an hypothetical common path in the tax topics.

A final issue is whether this absence of policy convergence can affect the future of the EU integration. Asymmetries in tax systems must be sufficiently bounded to guarantee the performance and benefits from the single market and single currency. The recent entry of new Member States with economic, fiscal and hence tax differences with respect to the countries that formed the EU-15, means that this is a good time to rethink tax policy to avoid a rise in tax competition, harmful or not (Halkos and Kyriazis, 2006), which could put at risk welfare states and market unity, and by extension the future steps towards integration.

5. Concluding Remarks.

In the framework of European integration, the convergence analysis has been applied to income, productivity and prices, but this literature deserved little attention to the public sector measures. In this paper we concentrate on the fiscal perspective to study the convergence of the disaggregated tax burden and the tax structure in the EU-15 over the period 1965-2005 using a time series approach. Concretely, we jointly use unit root and stationarity tests with a break, and the Tomljanovich and Vogelsang (2002) approach as a complementary tool, to evaluate three concepts of convergence: long run, deterministic and stochastic, corresponding to stationarity around a zero mean, stationarity around a non-zero level and stationarity around a trend with β-convergence condition. Germany, the United Kingdom and the EU-15 average are the benchmarks.

Has there been tax policy convergence in the EU during the last decades? As a general conclusion, we have found little empirical evidence of convergence to the benchmarks either in the tax burden or in the tax mix in spite of harmonization policy or tax competition. The demanding concept of long run convergence is hardly detected and both deterministic and stochastic convergence appear with similar frequencies with respect to the three benchmarks. Moreover, convergences are more frequent in the pre-break period -mainly in the 1980s and the beginning of the 1990s- and rarely occur in the post-break years, confirming that convergence has stopped in the last two decades. Thus, much of the convergence process occurred at the end of the1980s and at the beginning of the 1990s before the establishment of the Maastricht convergence criteria and the Single Market, but from then the intensity of the process is weaker. Moreover, the finding of a relatively high number of divergences reinforces the main conclusions of the paper.

If we investigate the convergence on a more detailed level, it was asserted that the weak *catching up* process is slightly more frequent in property and consumption taxes –general and specific- in the tax burden analysis, whereas in the study of the tax mix it is found that the taxes on income and profits account for the majority of cases of stochastic convergence.

These conclusions confirm that the autonomy of countries and the differentiated economic structures and political preferences with regard to the degree of public intervention prevail over the idea of hard harmonization in the fiscal field in the European Union, which lacks a unique fiscal policy beyond a soft harmonization in taxation on goods and services and capital income in the form of interest and dividends.

As future extensions of this research, the application of panel-data-based unit root and stationarity tests allowing for structural breaks could offer new insights through the combination of the information in the cross-section and time dimensions. In other direction, we are investigating the existence of fiscal convergence clubs, which in turn can be further compared with income convergence clubs or with social (protection) models established in the European Union. The combination of several perspectives -income, government expenditure and tax revenue- could help to understand better both diversity and clustering inside the EU.

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Appendix. Results from tests[20]

Table A.1 Detailed results of deterministic convergence of tax burden and tax mix

		Tax Burden			Tax Mix		
Series	Benchmark	Country	$MZ_{\alpha}^{GLS}(\delta)$	$\hat{\eta}$	Country	$MZ_{\alpha}^{GLS}(\delta)$	$\hat{\eta}$
IP	Germany	Luxembourg	-12.966^{c}(1977)	0.044 (1974)	Austria	-11.087^{c} (1977)	0.194(1994)
		Netherlands	-12.602^{c}(1997)	0.048(1992)	Luxembourg	-15.321^{b} (1969)	0.193(1969)
		Sweden	-29.510^{a}(1998)	0.045(1991)	Netherlands	-11.792^{c} (1976)	0.044(1972)
		United K.	-13.429^{b}(1993)	0.194(1996)			
	United K.	Germany	-13.429^{b} 1993)	0.194(1996)	Netherlands	-12.233^{c} (1969)	0.117(1992)
		Sweden	-17.669^{b} 1969)	0.104(2000)	Spain	-5.503^{c} (1983)	0.108(1978)
	EU-15	-	-	-	-	-	-
SS	Germany	-	-	-	Sweden	-12.694^{c} (1973)	0.116(1975)
	United K.	-	-	-	Denmark	-12.093^{c} (1969)	0.075(1971)
	EU-15	Italy	-27.482^{a}(1975)	0.064(1975)	Belgium	-18.106^{b} (1968)	0.144(1972)
					United K.	-12.515^{c} (1974)	0.086(1966)
PR	Germany	Ireland	-13.980^{b}(1974)	0.130(1975)	Denmark	-17.468^{b} (1983)	0.083(1983)
					Portugal	-11.552^{c} (1989)	0.084(1996)
					United K.	-18.626^{b} (1981)	0.053(1989)
	United K.	Austria	-20.901^{a}(1999)	0.068(1991)	Austria	-13.465^{b} (1968)	0.094(1990)
		Belgium	-13.950^{b}(1982)	0.100(1989)	Belgium	-12.513^{c} (1983)	0.145(1989)
		Denmark	-17.052^{b}(1999)	0.028(1991)	Denmark	-20.501^{b} (1999)	0.032(1991)
		Finland	-14.237^{b}(1987)	0.031(1989)	Germany	-18.626^{b} (1981)	0.053(1989)
		Ireland	-11.734^{c}(1974)	0.100(1976)	Italy	-13.276^{b} (1991)	0.122(1988)
	EU-15	Italy	-12.461^{c}(1996)	0.164(1992)	Portugal	-18.684^{b} (1971)	0.132(1973)
		Portugal	-20.480^{b}(1994)	0.075(1995)	Spain	-12.719^{c} (1996)	0.243(2000)
GSG	Germany	Austria	-11.950^{c}(1972)	0.157(1972)	Finland	-19.163^{b} (1993)	0.031(1991)
		Finland	-17.448^{b}(1980)	0.072(1984)	Netherlands	-109.17^{a} (1973)	0.150(1970)
		Netherlands	-106.45^{a}(1967)	0.152(1970)			
	United K.	Greece	-12.995^{c}(1974)	0.151(1978)	Greece	-11.377^{c} (1995)	0.056(1978)
					Portugal	-20.231^{b} (1966)	0.116(1984)
	EU-15	Finland	-13.935^{b}(1975)	0.072(1973)	Germany	-18.706^{b} (1971)	0.113(1972)
		Luxembourg	-11.157^{c}(1966)	0.054(1966)	Netherlands	-184565^{a} (1976)	0.105(1999)
		Netherlands	-18.524^{b}(1999)	0.137(1990)			
GSS	Germany	Sweden	-16.080^{b}(1985)	0.165(1993)		-	-
	United K.	Austria	-12.759^{c}(1966)	0.092(1973)	Denmark	-14.223^{b}(1967)	0.103(1967)
		Denmark	-15.287^{b}(1982)	0.163(1973)	Italy	-11.762^{c} (1975)	0.095(1972)
					Sweden	-11.762^{c} (1974)	0.090(1994)
	EU-15	-	-	-	Finland	-17.843^{b} (1981)	0.157(1977)
					Sweden	-11.687^{c} (1984)	0.044(1984)

^{a,b,c} denote significance at the 1%, 5% and 10% levels, respectively. Between parentheses, selected break date.

Critical values: $MZ_{\alpha}^{GLS}(\delta)$ test (own elaboration: -20.771; -13.070; -11.043 at the 1%, 5% and 10% significance level respectively).

$\hat{\eta}$ test. Presno and López (2003b).

[20] Only selected models. Other results are available upon request from authors.

TABLE A.2 DETAILED RESULTS OF (CONFIRMED) STOCHASTIC CONVERGENCE WITH β-CONVERGENCE ANALYSIS FOR TAX BURDEN

			Stationarity analysis		β-convergence analysis								
Series	Benchmark	Stochastic convergence	$MZ_{\alpha}^{GLS}(\delta)$	$\hat{\eta}$	Empirical results using the y_t regression and $T^{-1/2}t_y$ statistic				Empirical results using the z_t regression and $T^{-1/2}t_z$ statistic				$\hat{T}_b$
					$\hat{\mu}_1$	$\hat{\beta}_1$	$\hat{\mu}_2$	$\hat{\beta}_2$	$\hat{\mu}_1$	$\hat{\beta}_1$	$\hat{\mu}_2$	$\hat{\beta}_2$	
IP	Germany	-											
	United K.	Greece	-34.523[a] (B,1972)	0.062(B, 1970)	-11.73[b] (-5.38)	0.06 (0.43)	-7.68[c] (-2.62)	0.08 (0.24)	-11.70[b] (-20.29)	0.05 (1.04)	-7.24[b] (-3.70)	0.04 (0.15)	1990
	EU-15	Germany	-32.714[a](A,1971)	0.057(C,1972)	2.18[b](1.92)	-0.14[b](-2.1.9)	-3.13(-1.49)	-0.06(-0.19)	2.15[b](9.13)	-0.13[b](-7.24)	-3.47[b](-2.00)	-0.01(-0.03)	1995
		Ireland	-23.911[c](C,1987)	0.085(B, 1994)	-2.86[b] (-1.97)	0.09 (1.01)	0.54 (0.26)	-0.20 (-0.81)	-2.89[b] (-7.93)	0.09[b] (2.94)	0.75 (0.53)	-0.23[c] (-1.15)	1991
		Portugal	-22.128[c](B,1976)	0.020(B,1976)	-4.40[b] (-2.03)	-0.28 (-1.10)	-7.51[b] (-4.94)	0.11 (1.19)	-4.37[b] (-5.27)	-0.28[b] (-2.24)	-7.68[b] (-13.60)	0.13[b] (3.21)	1978
		Sweden	-37.961[a](B,1987)	0.090(A,1990)	10.45[b] (4.84)	-0.09 (-0.68)	5.88 (2.03)	-0.01 (-0.04)	10.67[b] (27.47)	-0.12[b] (-3.40)	6.60[b] (5.01)	-0.08 (-0.47)	1990
SS	Germany	Netherlands	-44.140[a](C,1982)	0.033(C,1981)	1.73[b] (1.05)	0.18[c] (1.56)	4.53 (2.28)	-0.34[c] (-1.75)	1.77[b] (5.76)	0.18[b] (5.97)	4.74[b] (5.97)	-0.36[b] (-3.96)	1988
		Portugal	-45.146[a](C,1990)	0.065(C,1994)	-4.97[b] (-5.83)	-0.05 (-0.91)	-6.69[b] (-5.50)	0.28[c] (1.99)	-4.90[b] (-38.93)	-0.06[b] (-5.04)	-6.47[b] (-13.14)	0.26[b] (3.74)	1991
	United K.	Italy	-26.132[b](C,1992)	0.070(B,1997)	4.12[b](2.88)	0.06(0.67)	7.36[b](3.61)	-0.12(-0.51)	4.24[b](19.72)	0.05[b](2.53)	7.84[b](9.33)	-0.18[b](-1.49)	1991
	EU-15	Belgium	-18.912[b](A,1986)	0.027(C,1983)	3.80[b] (5.15)	-0.09 (-1.39)	3.57[b] (5.22)	-0.03 (-0.57)	3.81[b] (20.58)	-0.09[b] (-4.17)	3.60[b] (14.39)	-0.03[b] (-1.48)	1992
		Netherlands	-33.116[a](B,1985)	0.047(B,1985)	4.40[b] (2.31)	0.18 (1.27)	8.36[b] (4.05)	-0.34[c] (-1.86)	4.41[b] (10.71)	0.19[b] (4.35)	8.23[b] (10.03)	-0.32[b] (-3.81)	1986
PR	Germany	Portugal	-19.638[b](A,1975)	0.085(A,1974)	-0.99[b] (-2.61)	0.01 (0.54)	-0.46 (-0.95)	0.05 (0.94)	-0.98[b] (-10.61)	0.01[c] (1.43)	-0.47[b] (-1.72)	0.05[b] (1.50)	1989
		Spain	-27.645[b](C,1979)	0.050(B,1996)	-0.96[b] (-2.52)	0.05[b] (2.61)	0.61 (0.86)	0.14 (1.24)	-0.93[b] (-9.11)	0.05[b] (6.51)	0.82 (1.10)	0.11 (0.74)	1995
	United K.	France	-23.785[c](C,1989)	0.031(C,1989)	-3.37[b] (-3.96)	0.05 (0.95)	0.09 (0.08)	-0.08 (-0.75)	-3.38[b] (-25.68)	0.06[b] (4.54)	0.14 (0.37)	-0.10[b] (-1.98)	1989
		Luxembourg	-34.889[a](C,1989)	0.031(C,1988)	-3.00[b] (-3.64)	0.04 (0.68)	0.04 (0.03)	-0.07 (-0.65)	-2.99[b] (-18.93)	0.04[b] (2.51)	-0.01 (-0.02)	-0.06[c] (-1.08)	1989
		Netherlands	-28.932[b](C,1989)	0.053(C,1989)	-3.40[b] (-4.23)	0.02 (0.30)	-1.09 (-1.07)	-0.09 (0.82)	-3.46[b] (-18.54)	0.02 (1.25)	-1.18[b] (-2.13)	-0.08[c] (-1.20)	1989
		Spain	-23.670[c](C,1987)	0.046(A,1988)	-3.61[b] (-4.24)	0.01 (0.23)	-1.29 (-1.19)	-0.04 (-0.35)	-3.62 (-16.63)	0.02 (0.72)	-1.26[b] (-1.96)	-0.05 (-0.65)	1989
	EU-15	Belgium	-38.611[a](C,1981)	0.092(A,1980)	-0.52[b] (-1.89)	0.01 (0.70)	-0.35 (-0.69)	0.05 (0.57)	-0.52[b] (-6.97)	0.01[b] (1.77)	-0.35 (-0.65)	0.05 (0.44)	1995
		France	-24.479[b](B,1990)	0.053(B,1992)	-0.55[b] (-1.24)	0.06[b] (2.28)	1.25 (1.97)	-0.003 (-0.04)	-0.58[b] (-10.19)	0.06[b] (13.29)	1.21[b] (5.48)	-0.001 (-0.05)	1991
GSG	Germany	Greece	-20.702[b](A,1986)	0.055(A,1986)	-2.69[b] (-1.64)	0.02 (0.14)	-0.07 (-0.04)	-0.01 (-0.08)	-2.67[b] (-5.64)	0.02 (0.35)	-0.15 (-0.16)	-0.01 (-0.13)	1986
		Portugal	-26.969[a](A,1987)	0.042(A,1984)	-4.38[b] (-3.86)	0.12 (1.30)	-0.81 (-0.69)	0.13 (1.35)	-4.51[b] (-18.66)	0.14[b] (5.18)	-1.07[b] (-2.53)	0.15[b] (3.62)	1985
		Sweden	-36.852[a](C,1979)	0.087(A,1967)	-0.88[c](-0.76)	0.09(1.36)	2.18(1.10)	0.06(0.22)	-0.94[b](-4.90)	0.10[b](6.20)	1.80[b](1.51)	0.11(0.51)	1979
	United K.	Ireland	-28.614[b](C,1978)	0.081(B,1972)	-0.47(-0.23)	0.22(0.92)	1.03(0.74)	-0.03(-0.32)	-0.35(-0.44)	0.19[c](1.59)	1.29[b](2.41)	-0.05[c](-1.23)	1978
		Luxembourg	-32.246[a](B,1993)	0.065(B,1992)	1.51[b] (1.54)	-0.11[c] (-1.71)	1.73 (-1.31)	0.06 (0.42)	1.50[b] (7.41)	-0.11[b] (-5.88)	-1.76[b] (-2.55)	0.06 (0.69)	1990
		Netherlands	-192.26[a](B,1971)	0.044(C,1978)	2.39[b] (1.55)	0.07 (0.42)	1.38(1.21)	-0.06 (-0.74)	2.28[b] (3.87)	0.09 (1.08)	1.43[b] (3.07)	-0.07[b] (-1.92)	1979
		Spain	-32.217[a](C,1985)	0.029(C,1979)	1.74[b] (1.23)	-0.16 (-1.01)	-2.0 (1.96)	0.054 (0.79)	1.90[b] (2.97)	-0.19[b] (-2.07)	-1.83[b] (-3.64)	0.04[c] (1.10)	1979
	EU-15	Austria	-27.757[b](C,1974)	0.031(C,1974)	1.97[b] (2.78)	0.01 (0.22)	1.72 (2.24)	-0.06 (-0.90)	1.94[b] (12.89)	0.02 (0.97)	1.68[b] (5.59)	-0.06[b] (-1.80)	1986
		Ireland	-31.211[b](C,1988)	0.055(B,1984)	-2.31[b] (-1.63)	0.13 (0.97)	0.89 (0.76)	-0.05 (-0.64)	-2.49[b] (-5.06)	0.16[b] (2.59)	0.74[c] (1.44)	-0.05[c] (-1.18)	1981
GSS	Germany	Austria	-26.346[b](C,1974)	0.052(C,1974)	1.83[b] (2.24)	-0.06 (-1.17)	0.02 (0.02)	-0.01 (-0.08)	1.88[b] (9.19)	-0.06[b] (-3.53)	0.19 (0.17)	-0.03 (-0.18)	1993
		Denmark	-26.286[a](A,1966)	0.067(C,1974)	2.99[b] (1.91)	-0.01 (-0.13)	1.97 (1.04)	0.01 (0.04)	3.13[b] (5.91)	-0.03 (-0.63)	2.36[b] (1.72)	-0.02 (-0.12)	1988
		United K.	-31.030[a](A,1972)	0.060(C,1980)	2.86[b] (3.29)	-0.06(-1.19)	1.99(1.23)	-0.17[c](-1.76)	2.88[b] (12.13)	-0.06[b] (-3.21)	2.28[c] (1..31)	-0.22(-0.63)	1995
	United K.	France	-17.246[b](A,1977)	0.083(A,1973)	-3.48[b] (-4.29)	0.10[c] (1.86)	-1.22 (-1.12)	0.04[c] (1.74)	-3.51[b] (-20.37)	0.10[b] (6.43)	-1.21[b] (-2.06)	0.04 (0.46	1990
		Germany	-31.030[a](A,1972)	0.060(C,1980)	2.86[b] (3.29)	-0.06(-1.19)	1.99(1.23)	-0.17[c](-1.76)	2.88[b] (12.13)	-0.06[b] (-3.21)	2.28[c] (1..31)	-0.22(-0.63)	1995
		Greece	-21.856[c](B,1984)	0.028(C,1978)	-2.60[b] (-1.75)	0.07 (0.40)	0.11 (0.10)	-0.06 (-0.89)	-2.57[b] (-4.97)	0.06 (0.81)	0.12 (0.34)	-0.06[b] (-2.32)	1978
	EU-15	Denmark	-24.627[a](A,1966)	0.069(A,1994)	2.07[b] (1.93)	-0.04 (-0.49)	0.61 (0.45)	0.08 (0.53)	2.12[b] (7.48)	-0.04[c] (-1.58)	0.79 (0.94)	0.07 (0.63)	1989
		Finland	-17.813[b](A,1974)	0.058(A,1974)	1.34[b] (1.24)	-0.04 (-0.25)	1.72[c] (2.95)	-0.02 (-0.66)	1.30[b] (2.21)	-0.03 (-0.28)	1.68[b] (8.17)	-0.02[b] (-1.49)	1974
		France	-21.068[b](A,1967)	0.096(B,1968)	-1.58[b] (-3.19)	0.03 (0.91)	-0.48 (-0.55)	0.01 (0.07)	-1.57[b] (-19.68)	0.02[b] (3.81)	-0.41 (-0.83)	0.002 (0.02)	1994
		Ireland	-26.548[a](A,1975)	0.096(A,1979)	5.69[b] (5.47)	-0.13[c] (-1.96)	1.56 (1.05)	-0.16 (-0.90)	5.66[b] (34.091)	-0.12[b] (-8.57)	1.48[b] (2.28)	0.15[b] (-1.66)	1991
		Luxembourg	-20.311[b](A,1974)	0.028(A,1979)	-3.52[b] (-3.22)	0.14[c] (1.78)	-0.89 (-0.71)	0.12 (1.04)	-3.57[b] (-11.29)	0.15[b] (4.60)	-0.90[c](-1.25)	0.12[b] (1.60)	1987
		Spain	-37.682[a](C,1982)	0.034(C,1983)	-3.50[b] (-5.57)	0.08[c] (1.50)	-1.08 (-1.77)	0.02 (0.31)	-3.46[b] (-19.30)	0.07[b] (3.69)	-1.03[b] (-3.71)	0.01 (0.37)	1984

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

Stationarity analysis. Between parentheses, model selected according to the Schwarz criterion and break date.

β-convergence analysis. Values in parentheses are the $T^{-1/2}t_y$ and $T^{-1/2}t_z$ statistics. Column $\hat{T}_b$: estimated break point

Table A.3 Detailed results of (confirmed) stochastic convergence with β-convergence analysis for tax mix

Series	Benchmark	Stochastic convergence	Stationarity analysis $MZ_{\alpha}^{GLS}(\delta)$	Stationarity analysis $\hat{\eta}$	β-convergence: y_t regression and $T^{1/2}t_y$ statistic $\hat{\mu}_1$	$\hat{\beta}_1$	$\hat{\mu}_2$	$\hat{\beta}_2$	β-convergence: z_t regression and $T^{1/2}t_z$ statistic $\hat{\mu}_1$	$\hat{\beta}_1$	$\hat{\mu}_2$	$\hat{\beta}_2$	$\hat{T}_b$
IP	Germany	Greece	-23.894[a](A,1996)	0.037(B,1988)	-24.50[b] (-5.94)	0.41[c] (1.69)	-8.71 (-1.31)	0.54 (0.60)	-24.38 [b] (-44.87)	0.39[b] (8.85)	-8.49[b] (-2.96)	0.54[c] (1.16)	1993
		Ireland	-28.086[b](C,1992)	0.028(C,1992)	-9.80[b] (-2.45)	0.55[b] (2.27)	10.95 (1.80)	0.08 (0.11)	-9.76 [b] (-14.70)	0.54[b] (9.62)	11.20[b] (3.73)	0.08 (0.18)	1992
		Sweden	-33.002[a](B,1980)	0.058(B,1980)	22.01[b] (3.26)	-0.77 (-0.84)	8.54 (2.05)	0.05 (0.20	21.71 [b] (9.20)	-0.69[c] (-1.70)	8.25[b] (7.04)	0.06 (0.77)	1976
	United K.	Greece	-23.373[c](C,1977)	0.056(C,1978)	-30.41[b] (-6.05)	0.46[c] (1.51)	-16.03 (-2.11)	0.26 (0.27)	-30.53 [b] (-26.88)	0.46[b] (4.83)	-15.90[b] (-3.09)	0.25[c] (0.99)	1992
		Ireland	-28.380[b](B,1997)	0.050(C,1977)	-15.64[b] (-2.65)	0.59[c] (1.60)	4.76 (0.56)	-0.24 (-0.24)	-15.89 [b] (-10.03)	0.61[b] (4.40)	4.92 (0.79)	-0.25 (-0.29)	1991
		Luxembourg	-48.937[a](B,1981)	0.053(B,1980)	-0.91 (-0.16)	0.28 (0.64)	3.62 (0.64)	-0.33 (-0.69)	-1.09 (-0.94)	0.31[b] (2.42)	3.01[c] (1.47)	-0.27[b] (-1.33)	1985
		Sweden	-31.704[a](B,1974)	0.057(C,1977)	18.99[b] (2.98)	-1.25[c] (-1.56)	6.30 (1.50)	-0.23 (-0.89)	19.21[b] (9.85)	-1.30[b] (-4.14)	6.45[b] (5.67)	-0.23[b] (-2.92)	1977
	EU-15	Greece	-32.447[a](A,1996)	0.029(B,1990)	-20.92[b] (-7.14)	0.25[c] (1.65)	-8.98 (-1.40)	-0.04 (-0.03)	-20.89[b] (-71.23)	0.25[b] (11.52)	-8.60[b] (-2.70)	0.14[c] (1.00)	1997
		Ireland	-29.361[b](B,1999)	0.051(B,1997)	-6.20[b] (-1.96)	0.39[b] (2.05)	7.60 (1.59)	-0.14 (-0.24)	-6.28[b] (-10.57)	0.40[b] (7.87)	7.43[b] (2.76)	-0.11 (-0.26)	1992
		Luxembourg	-44.675[a](B,1974)	0.051(C,1978)	5.91[b] (1.12)	0.50 (0.86)	9.31[c] (2.37)	-0.32 (-1.27)	5.90[b] (3.99)	0.51[b] (2.39)	9.19[b] (7.90)	-0.32[b] (-3.65)	1979
		Portugal	-25.989[b](C,1980)	0.049(C,1977)	-4.12 (-0.61)	-0.84 (-1.07)	-11.05 (-2.35)	0.15 (0.52)	-3.60 (-1.34)	-0.94[b] (-2.31)	-11.17[b] (-6.11)	0.19[b] (1.43)	1978
SS	Germany	Ireland	-18.610[b] (A,1993)	0.061(C,1994)	-19.86[b] (-9.25)	-0.11(-0.92)	-27.67[b](-6.94)	0.27(0.42)	-20.05[b](-34.59)	-0.09[b](-1.99)	-29.19[b](-6.84)	0.51(0.61)	1995
	United K.	Ireland	-34.508[a](B,1980)	0.040(B,1981)	-8.01[b] (-2.56)	0.26 (0.71)	-2.85 (-1.30)	-0.03 (-0.24)	-8.02[b] (-8.39)	0.27[b] (1.85)	-2.94[b] (-4.52)	-0.03 (-0.65)	1978
		Luxembourg	-29.594[b](C,1972)	0.078(A,1971)	16.51[b] (3.98)	-0.38 (-0.98)	8.81[c] (2.43)	0.04 (0.14)	16.92[b] (13.40)	-0.44[b] (-2.84)	9.55[b] (6.37)	-0.02 (-0.13)	1982
	EU-15	Ireland	-24.747[a](A,1993)	0.066(A,1993)	-16.37 [b] (-15.11)	0.09[c] (1.53)	-15.68[b] (-8.38)	0.21 (0.74)	-16.46[b] (-105.45)	0.10[b] (8.22)	-16.24[b] (-16.79)	0.29[b] (1.68)	1994
		Italy	-25.975[b](C,1978)	0.053(C,1975)	10.62 [b] (2.36)	0.41 (0.67)	9.10[b] (3.26)	-0.31[c] (-1.93)	10.07 [b] (6.75)	0.54[b] (2.08)	8.90[b] (12.00)	-0.32[b] (-6.43)	1976
		Sweden	-21.766[b](A,1975)	0.038(A,1975)	-10.60 [b] (-2.06)	0.26 (0.37)	-2.24 (-0.70)	0.05 (0.25)	-10.56[b] (-5.11)	0.26 (0.73)	-2.39[b] (-2.32)	0.06 (0.81)	1976
PR	Germany	Belgium	-23.681[a](A,1979)	0.072(A,1980)	-1.96 [b] (-2.42)	0.09[b] (2.06)	1.54 (0.87)	0.09 (0.25)	-1.92[b] (-9.17)	0.08[b] (5.39)	1.68 (0.74)	0.06 (0.11)	1997
		France	-21.368 [c](B,1990)	0.060(B,1992)	-1.72[b](-1.38)	0.20[b](2.60)	4.01(2.27)	0.08(0.38)	-1.76[b](-8.81)	0.21[b](11.81)	3.74[b](4.79)	0.11[c] (0.96)	1974
		Italy	-42.684[a](C,1990)	0.027(C,1991)	1.52[c] (0.69)	-0.10 (-0.61)	-0.52 (-0.21)	0.25 (1.09)	1.65[b] (3.62)	-0.12[b] (-2.52)	-0.28 (-0.27)	0.25[b] (2.18)	1987
	United K.	Finland	-34.965[a](C,1987)	0.045(C,1989)	-11.26[b] (-6.35)	0.07 (0.55)	-5.60[c] (-2.48)	-0.28 (-1.22)	-11.30[b] (-34.01)	0.07[b] (2.25)	-5.51[b] (-5.60)	-0.31[b] (-2.53)	1989
	EU-15	Belgium	-31.979[a](B,1978)	0.029(B,1979)	-2.79[b] (-4.07)	0.07[c] (1.75)	-1.41 (-1.19)	0.08 (0.45)	-2.82[b] (-16.49)	0.07[b] (5.22)	-1.68[b] (-1.58)	0.12 (0.61)	1994
		France	-24.402[b](B,1988)	0.049(B,1986)	-2.76[b] (-2.14)	0.21[b] (2.29)	2.18 (1.41)	-0.00 (-0.00)	-2.78[b] (-19.05)	0.21[b] (14.81)	2.22[b] (5.88)	-0.01 (-0.18)	1988
		Sweden	-24.860[c](C,1986)	0.048(C,1986)	-5.49[b] (-3.94)	0.15 (1.44)	-0.24 (-0.16)	-0.11 (-0.82)	-5.40[b] (-13.69)	0.14[b] (3.46)	-0.07 (-0.09)	-0.12[b] (-1.51)	1986
GSG	Germany	Ireland	-21.399[c](B,1974)	0.058(B,1974)	-11.82[b] (-2.09)	1.19[c] (1.79)	1.50 (0.38)	0.18 (0.72)	-11.48[b] (-4.61)	1.11[b] (2.95)	2.33[c] (1.38)	0.12[c] (1.00)	1978
		Sweden	-33.646[a](C,1977)	0.102(B,1967)	-4.02[b] (-1.34)	0.09 (0.56)	-0.22 (-0.04)	0.04 (0.05)	-3.99[b] (-6.61)	0.09[b] (1.95)	-0.50[c] (-0.13)	0.06 (0.08)	1994
	United K.	Belgium	-29.389[b](B,1990)	0.057(C,1989)	18.04[b] (5.98)	-0.79[b] (-4.21)	-3.94 (-0.92)	0.08 (0.15)	18.45[b] (27.94)	-0.83[b] (-14.46)	-2.77 (-1.08)	-0.04 (-0.11)	1991
		Finland	-21.058[c](B,1996)	0.038(C,1991)	14.09[b] (3.84)	-0.51[b] (-2.20)	-2.69 (-0.51)	0.23 (0.37)	14.50[b] (14.04)	-0.55[b] (-6.07)	-1.32 (-0.33)	0.08 (0.14)	1991
		Luxembourg	-22.362[c](B,1993)	0.063(B,1993)	6.90[b] (2.44)	-0.43[b] (-2.44)	-5.96 (-1.48)	0.19 (0.40)	7.15[b] (10.64)	-0.45[b] (-7.75)	5.22[b] (1.99)	0.10 (0.28)	1991
	EU-15	Austria	-27.757[b](C,1974)	0.058(A,1974)	3.52[b] (1.81)	0.05 (0.31)	3.47 (1.73)	-0.21 (-1.24)	3.47[b] (8.78)	0.05 (1.22)	3.52[b] (5.07)	-0.21[b] (-3.14)	1985
		Ireland	-30.153[a](B,1975)	0.077(B,1974)	-7.72[b] (-2.05)	0.59[b] (2.07)	1.43 (0.35)	0.24 (0.66)	-7.90[b] (-7.06)	0.62[b] (5.36)	0.71 (0.32)	0.29[c] (1.26)	1986
		Portugal	-20.091[b](A,1966)	0.051(B,1967)	-9.62[b] (-2.31)	0.46[c] (1.88)	4.70 (0.70)	-0.02 (-0.02)	-9.73[b] (-10.86)	0.47[b] (6.42)	3.50 (0.74)	0.13 (0.17)	1993
GSS	Germany	Austria	-31.070[b](C,1972)	0.064(C,1974)	4.68[b] (2.00)	-0.18 (-1.33)	-0.93 (-0.25)	-0.11 (-0.22)	4.84[b] (7.90)	-0.19[b] (-3.86)	-0.51 (-0.16)	-0.16 (-0.30)	1993
		Finland	-28.990[b](B,1991)	0.076(A,1977)	7.42[b] (2.45)	-0.05 (-0.24)	4.75 (1.30)	-0.22[c] (-1.91)	7.28[b] (8.14)	-0.04 (-0.47)	4.70[b] (2.03)	-0.21 (-0.78)	1988
		Greece	-17.030[b](A,1978)	0.042(A,1978)	16.51[b] (3.04)	-0.25 (-0.81)	6.81 (0.73)	-0.77 (-0.56)	16.14[b] (13.21)	-0.22[b] (-2.24)	5.76 (0.76)	-0.66 (-0.49)	1994
		Luxembourg	-17.281[b](A,1979)	0.033(A,1979)	-3.45[b] (-1.24)	0.03 (0.09)	1.69 (0.82)	0.05 (0.40)	-3.36[b] (-4.03)	0.01 (0.10)	1.65[b] (2.50)	0.06[b] (1.32)	1979
		Sweden	-26.765[b](C,1978)	0.077(A,1982)	2.74[b] (0.98)	-0.10 (-0.65)	-0.97 (-0.20)	-0.21 (-0.29)	2.78[b] (2.80)	-0.11[c] (-1.40)	0.05 (0.01)	-0.34 (-0.31)	1994
	United K.	-											
	EU-15	France	-21.016[c](B,1975)	0.054(A,1969)	-8.64[b] (-5.18)	0.19[b] (2.02)	-2.53 (-0.88)	0.06 (0.13)	-8.65[b] (-18.28)	0.19[b] (5.11)	-3.03 (-1.04)	0.13 (0.25)	1994
		Luxembourg	-41.909[a](C,1979)	0.081(A,1979)	-11.77[b] (-5.09)	0.42[b] (3.01)	0.37 (0.11)	0.19 (0.43)	-11.96[b] (-23.32)	0.44[b] (10.12)	-0.31 (-0.13)	0.27 (0.76)	1992

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

Stationarity analysis. Between parentheses, model selected according to the Schwarz criterion and break date.

β-convergence analysis. Values in parentheses are the $T^{-1/2}t_y$ and $T^{-1/2}t_z$ statistics. Column $\hat{T}_b$: estimated break point.