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Tax Evolution in the EU: A Convergence Club Approach

Summary: This paper investigates tax convergence in 15 European Union member states using annual data from 1975 to 2011. We follow the proposal of Peter C. B. Phillips and Donggyu Sul (2007) to test the convergence club hypothesis, complemented with a preliminary sigma convergence study, and focusing on the tax burden and tax mix with the major OECD subdivisions. Our results suggest sigma convergence in all cases, but to different degrees. We identify convergence clubs, with several clusters in each tax category and differences between the whole sample and the two sub-periods analyzed, namely 1975-1994 and 1995-2011.

Key words: Taxation, Sigma convergence, Club convergence, European Union.

JEL: C33, E62, H20.

The evolution of tax systems has been a major topic of interest in the international public finance literature from several perspectives in recent decades, and the Great Recession has given a new impulse to some of these research lines. Thus, international tax competition and its mechanisms have been analyzed in order to gain a deeper understanding of the world tax system, which is increasingly important in a globalized economy (see Michael Keen and Kai A. Konrad 2013 for a review of the theory of tax competition; Pantelis Kammas 2011 and Denvil Duncan and Ed Gerrish 2014 investigate a related and interesting issue, namely tax mimicking and strategic interactions among national governments). Researchers have also focused on tax convergence, an issue especially relevant in the European Union in the context of the process of fiscal harmonization, the Single Market and the common currency.

In this paper we follow the "club convergence" approach to study tax convergence in the EU-15 member states. The contribution of the study is three-fold: i) this is the first paper devoted to taxation in the EU using this approach - despite Paulo Jose Regis, Juan Carlos Cuestas, and Yang Chen (2015) focused only on corporate tax rates; ii) there are very few applications of this methodology in the tax convergence literature to date, as stated below in Section 1, although it has been applied more extensively to the income convergence; and iii) we analyze the taxation from the double perspective of the tax burden (as a percentage of GDP) and the tax mix (as a percentage of total tax revenues), whereas most papers have addressed only one of these approaches.

The remainder of the manuscript is divided as follows. Section 1 reviews the literature, Section 2 includes the methodology, Section 3 presents the data and main results, while Section 4 concludes and points to future research.

1. Literature Review

Before introducing the tax convergence literature, it should be noted that one of the most studied areas in taxation is precisely the impact of the different types of taxes on economic growth. From a theoretical perspective, in neoclassical models fiscal policy does not play a role in long-run growth rate but in endogenous growth models its role can be decisive *via* human capital. The empirical evidence generally shows a negative association between taxation and economic growth. These results hold for total taxation, distortionary taxes and the level of progressiveness. See for example Mehmet Serkan Tosun and Sohrab Abizadeh (2005) or Francisco J. Delgado and Javier Salinas-Jimenez (2008).

From a theoretical point of view, tax convergence matters from several perspectives, and is particularly relevant within a framework of an internationally mobile capital. First, it may limit, control or identify (strategic) tax competition. Second, and related to this argument, it may be used to check the prediction from the theory of international tax competition of a shift of the tax burden from mobile to immobile tax bases, especially for small open economies, and the potential "race to the bottom" hypothesis (Markus Leibrecht and Claudia Hochgatterer 2012 survey the literature on tax competition and the decrease in corporate income tax rates). Third, it holds a strong relation with fiscal coordination (Clemens Fuest and Bernd Huber 1999) and has effects on welfare (Maurice Marchand, Pierre Pestieau, and Motohiro Sato 2003). As a consequence, the evidence gathered on tax convergence or divergence processes may contribute to a better understanding and design of tax policies to match specified objectives, particularly for the EU.

While the convergence of the public expenditure has been studied for example in Nicole Attia and Valerie Berenger (2007) or Jesús Ferreiro, Carlos Alberto Carrasco, and Carmen Gomez (2014), tax convergence has been analyzed to date using several methodologies:

a) Beta and sigma convergence. These two methodologies have been widely applied in several convergence frameworks, such as economic growth, productivity or inflation. As is well known, the beta convergence approach studies whether territories with lower indicators increase more intensely, and the sigma convergence analyzes if the dispersion reduces along time. Delgado (2009) studied convergence in the EU-15 for the sample period 1965-2005, also estimating gamma convergence. He found evidence pointing to the existence of convergence of fiscal pressure due basically to the evolution of taxation on goods and services. Silvia Bertarelli, Roberto Censolo, and Caterina Colombo (2014) analyzed convergence in the EU over the period 1991-2008, focusing on total revenue over GDP, and they found these types of convergence. They also studied the convergence of deficit, debt and expenditure (total and main components).

b) Time series convergence. Following a time series approach, Vicente Esteve, Simon Sosvilla-Rivero, and Cecilio Tamarit (2000) found evidence of convergence of the total tax burden in the EU for the period 1967-1994. Christophe Blot and Francisco Serranito (2006) rejected the convergence hypothesis for fiscal policies among eight EMU countries in 1970-2000. Evzen Kocenda, Ali M. Kutan, and Taner M. Yigit (2008) examined the fiscal convergence of ten Eastern European members with poor fiscal performance in the EU, suggesting that monetary unions

do not necessarily encourage fiscal convergence for its members. Delgado and Maria Jose Presno (2010), using unit roots and stationarity tests with a structural change, found scant evidence of tax convergence for the EU-15 in the 1965-2005 period. Furthermore, Delgado and Presno (2011), through deterministic and stochastic approaches, also reported a lack of convergence for those countries. Finally, Bertarelli, Censolo, and Colombo (2014) concluded that there was an overall pattern of stochastic convergence in the total revenue.

c) Club convergence. This methodology, proposed by Phillips and Sul (2007), has several advantages, as it does not require the existence of common stochastic trends, it can distinguish between overall convergence, overall divergence and club convergence, and it is possible to measure the speed of convergence. With this approach, Nicholas Apergis and Arusha Cooray (2014a) studied tax revenue convergence across ASEAN, Pacific and Oceania countries. They analyze four tax categories in 11 countries in 1990-2012, finding several convergence clubs. Furthermore, Chen, Cuestas, and Regis (2016) focus on corporate tax convergence in Asian and Pacific economies. Concretely, they study the statutory tax rates in 15 countries for 1980-2014 and find a significant dynamic tax convergence pattern with three convergence clubs. More recently, Regis, Cuestas, and Chen (2015) analyze the convergence in statutory corporate tax rates for the EU-25 over the period 1980-2014, identifying four clubs. In related papers, Apergis and Cooray (2014b) analyze the convergence in sovereign debt ratios among some EU countries, specifically Cyprus, Greece, Ireland, Italy, Portugal and Spain, for the period 2009-2013, concluding the lack of convergence for Greece and Portugal. Apergis, Christina Christou, and Christis Hassapis (2013) studied the convergence in public expenditures in 17 EU countries in 1990-2012, detecting several clubs in the spending categories.

2. Econometric Methodology

In this section we outline the methodology proposed by Phillips and Sul (2007) to test for convergence in a panel of countries. Assume we have panel data for a variable y_{it}, $i = 1, 2, \ldots, N$ and $t = 1, \ldots, T$ where N and T are the number of countries and the sample size respectively. The starting point of the formulation of Phillips and Sul (2007) is the single factor model:

$$y_{it} = \delta_i \mu_t + u_{it}, \tag{1}$$

where δ_i measures the idiosyncratic distance between the common factor μ_t and the systematic part of y_{it} (μ_t may represent the aggregated common behavior of y_{it} or any common variable of influence on individual behavior), and u_{it} denotes the error term. Thus, the model examines the evolution of the individual y_{it} in relation to the common factor by means of two idiosyncratic elements: the systematic element (δ_i) and the error (u_{it}). Phillips and Sul (2007) extended (1) by allowing the systematic idiosyncratic element to evolve over time through a time-varying factor loading coefficient δ_{it}. Furthermore, they allow δ_{it} to have a random component, which absorbs u_{it} in (1) and allows for possible convergence behavior in δ_{it} over time in relation to the common factor μ_t. The new model has the following time-varying factor representation:

$$y_{it} = \delta_{it}\mu_t \,. \tag{2}$$

The time varying representation in (2) can be used to separate common from idiosyncratic components in the traditional decomposition of panel data:

$$y_{it} = g_{it} + a_{it}, \tag{3}$$

where g_{it} embodies systematic components (including permanent common components that give rise to cross-section dependence), and a_{it} are the transitory components; also, no particular parametric specification is assumed for both g_{it} or a_{it}.

Phillips and Sul (2007) transform (3) into the form of (2) in the following way:

$$y_{it} = \left(\frac{g_{it}+a_{it}}{\mu_t}\right)\mu_t = \delta_{it}\mu_t\,,\ for\ all\ i,t. \tag{4}$$

Thus, the variable y_{it} is decomposed into: 1) μ_t - a common steady-state trend function which may have both deterministic and stochastic components; and 2) δ_{it} - the time-varying loadings, which measure the transition path of country i to μ_t; they represent the idiosyncratic movements in y_{it} and can be seen as a form of (economic) distance of each economy from the common trend.

The convergence of all N countries to the common trend requires that δ_{it} and δ_{jt} converge to a common constant $\delta_i = \delta_j = \delta$ as $t \to \infty$ for $i, j = 1, 2, \ldots, N$ and $i \neq j$ (or equivalently, that country-specific differences are eliminated over time). Thus, in order to formulate a null of convergence, Phillips and Sul (2009) specify the following semiparametric model for the transition coefficients:

$$\delta_{it} = \delta_i + \sigma_{it}\varepsilon_{it},\ \sigma_{it} = \frac{\sigma_i}{\log(t)t^{\alpha}},\ \sigma_i > 0\,, \tag{5}$$

where δ_i is fixed, ε_{it} is $iid(0,1)$ across i but may be weakly dependent over t, and α governs the rate at which the cross-section variation over the transitions decays to zero over time.

The hypothesis of interest is convergence among all countries (or *overall convergence*), against the alternative hypothesis of no convergence for some country or countries. The latter includes divergence of all countries (*overall divergence*) or the case of groups of countries converging to different steady states (*club convergence*) with possibly some diverging states.

The null hypothesis of overall convergence, following Phillips and Sul (2007), can be expressed as:

$$H_0\colon \delta_i = \delta\ for\ all\ i, with\ \alpha \geq 0,$$

against the alternative:

$$H_1\colon \delta_i = \delta\ for\ all\ i, with\ \alpha < 0,$$

or

$$H_1\colon \delta_i \neq \delta\ for\ some\ i, with\ \alpha \geq 0\ or\ \alpha < 0,$$

corresponding to the overall divergence and club convergence, respectively.

In order to estimate the factor loadings δ_{it} some smoothness and structural restrictions are required, but they are not well developed for fitting stochastic process-

es. So, Phillips and Sul (2009) propose the construction of the relative transition coefficient as an alternative approach:

$$h_{it} = \frac{y_{it}}{N^{-1}\sum_{i=1}^{N} y_{it}} = \frac{\delta_{it}}{N^{-1}\sum_{i=1}^{N} \delta_{it}}, \quad (6)$$

which measures the loadings δ_{it} for country i in relation to the cross section average at time t, while removing the common steady-state trend μ_t. Thus, the path h_{it} traces out an individual trajectory over time for economy i relative to the panel average (it is the "relative transition path") and measures country i's relative departure from μ_t, reflecting possible divergences from it.

Under convergence, $h_{it} \underset{p}{\to} 1$ for all i as $t \to \infty$, and the cross-sectional mean square transition differential, H_t, converges to zero asymptotically:

$$H_t = N^{-1}\sum_{i=1}^{N}(h_{it} - 1)^2 \to 0 \; as \; t \to \infty. \quad (7)$$

H_t measures the quadratic distance for the panel from the common limit. If convergence fails to hold, this distance remains positive as t goes to infinity, and several possibilities exist: it may converge to a non-zero constant (in the case of club convergence it typically converges to a positive constant), it may remain bounded above zero but not converge, or it may diverge. Based on this property, Phillips and Sul (2007) propose a testing procedure (the "log t" convergence test; note that since the log t test is based on the variance of the logarithm of the variable of interest, this test is more related to sigma than beta convergence) which involves estimating the following regression by ordinary least squares:

$$\log\left(\frac{H_1}{H_t}\right) - 2\log(\log(t)) = \mathrm{c} + b\log(t) + u_t, \quad (8)$$

where $t = [rT], [rT] + 1, \ldots, T$, for some fraction $r > 0$, being $[rT]$ the integer part of rT (Phillips and Sul 2007 suggest setting $r = 0.3$ for $T \leq 50$). Coefficient b provides a scaled estimator of the speed of convergence parameter α, since $b = 2\alpha$. This way, the null of convergence can be tested by a one-sided t test of $\alpha \geq 0$ (using the estimate $\hat{b}$ and a heteroscedasticity and autocorrelation consistent (HAC) standard error), and it is rejected at the 5% level if the t-statistic has a value below -1.65. In this case, a clustering procedure can be applied in order to detect possible subgroups or clubs which converge in the panel.

As Phillips and Sul (2009) remark, not only is the sign of $b = 2\alpha$ of interest, but also its magnitude, since it measures the speed of convergence of δ_{it}. Hence, the estimate $0 \leq \hat{b} < 2$ (or alternatively, $0 \leq \hat{\alpha} < 1$) implies convergence in a relative sense, indicating that differentials tend to decrease over time within each club (i.e. convergence in growth rates). On the other hand, $\hat{b} \geq 2$ (or $\hat{\alpha} \geq 1$) indicates absolute convergence within the panel, that is, convergence to a club-specific tax burden level over the period (i.e. convergence in level).

Phillips and Sul (2007) propose a four-step clustering algorithm in order to identify convergence clubs. The main steps are outlined in Appendix 1. Also, Phillips and Sul (2009) state that their initial algorithm tends to over-estimate the number of convergence clubs, and propose to merge the clubs using the log t convergence test.

3. Data and Results

We investigate the convergence of tax revenues for the EU-15 with annual panel data for the sample period 1975-2011. Concretely, we focus on the overall tax burden and its main components following the main OECD subdivisions: 1000 - taxes on income, profits and capital gains; 2000 - social security contributions; and 5000 - taxes on goods and services. Additionally, within the latter we analyze the categories 5110 (general taxes) and 5120 (taxes on specific goods and services). All are expressed as a percentage of GDP. Then we focus on the tax mix, with the same categories, using the percentages of total tax revenue corresponding to each category. Note that since the variable is expressed as a percentage, it has not been transformed into logarithms. Also, since the business cycle is not a concern, the Hodrick-Prescott filter has not been applied.

Tables 1a and 1b report the descriptive statistics. Figure 1 depicts the evolution of the national tax magnitudes (tax burden). In addition, the preliminary study of sigma convergence is summarized in Figure 2. Note that the sigma convergence approach is based on the evolution of the dispersion of tax magnitudes. This dispersion can be analyzed with different measures, including the standard deviation of the logarithms, the coefficient of variation, and inequality indexes. In this study we report the coefficient of variation (*CV*):

$$CV_t = \frac{\left(\frac{1}{N}\sum_{i=1}^{N}(y_{it}-\bar{y}_t)^2\right)^{1/2}}{\bar{y}_t}, \tag{9}$$

where y_{it} is tax in the country i for the period t, and $\bar{y}_t$ is the average tax for all countries in year t.

In the overall period, the results point to the existence of sigma convergence in all categories, with different intensities, which is also reported in the last row of Table 1 (1a for tax burden and 1b for tax mix) through the coefficient of variation. However, to analyze this result in more detail, we use the club convergence approach. Table 2 presents some relevant facts regarding European tax policy in the years analyzed.

Table 1 Descriptive Statistics

Table 1a Tax Burden

	Total		Taxes on income, profits and capital gains		Social security contributions		Taxes on goods and services		General taxes on goods and services		Taxes on specific goods and services	
	1975	2011	1975	2011	1975	2011	1975	2011	1975	2011	1975	2011
Mean	32.10	38.84	11.32	13.09	8.79	11.05	9.82	11.65	4.89	7.46	4.46	3.55
St. dev.	7.70	5.62	6.12	4.93	3.89	4.10	2.40	1.70	1.71	1.27	1.57	0.63
Minimum	18.4	27.9	2.6	7.0	0.2	1.0	4.5	8.4	2.1	5.3	1.6	2.5
Maximum	41.3	47.7	22.7	29.1	15.6	16.7	13.2	15.2	8.3	9.9	8.4	4.8
CV	0.2483	0.1499	0.5599	0.3899	0.4580	0.3842	0.2526	0.1512	0.3627	0.1767	0.3640	0.1836

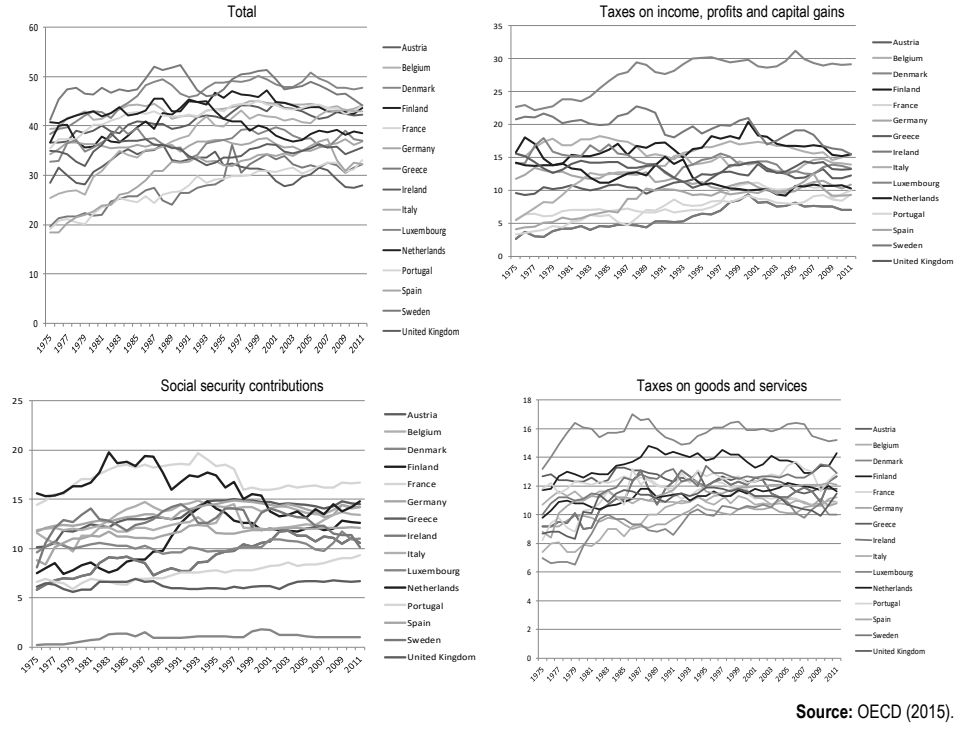
Source: Organisation for Economic Co-operation and Development - OECD (2015)[1] and own elaboration.

[1] **Organisation for Economic Co-operation and Development (OECD).** 2015. Tax Revenue. https://data.oecd.org/tax/tax-revenue.htm (accessed January 20, 2015).

Table 1b Tax Mix

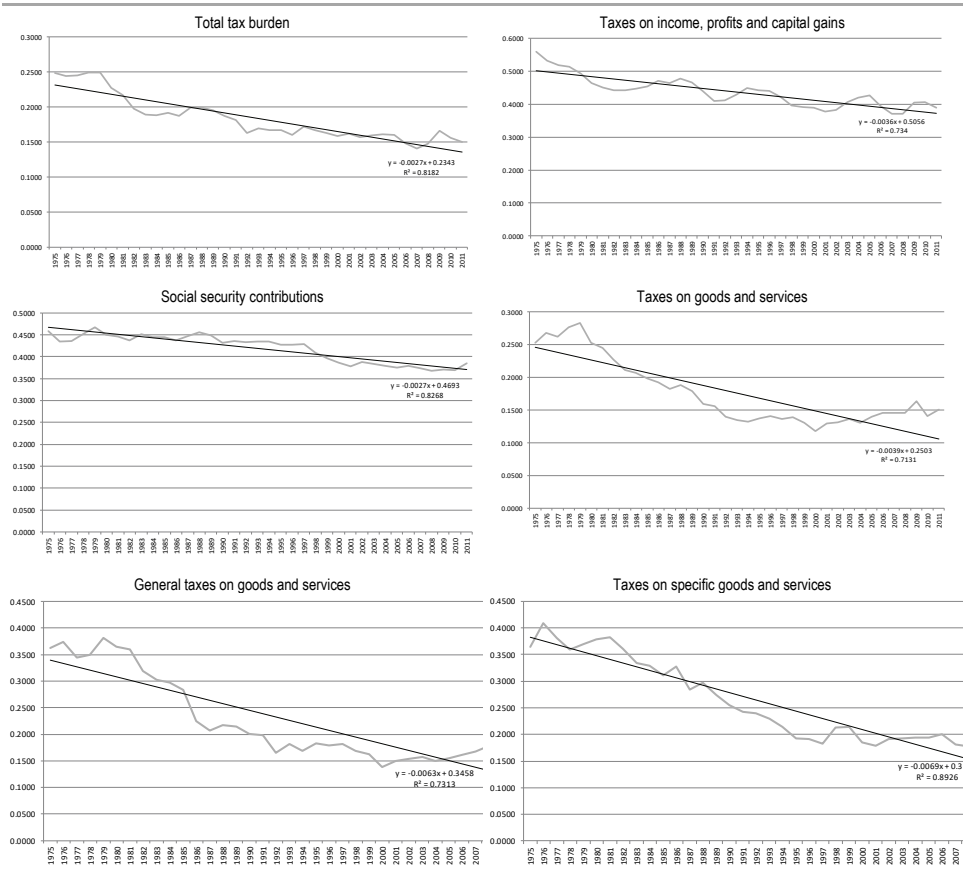
	Taxes on income, profits and capital gains		Social security contributions		Taxes on goods and services		General taxes on goods and services		Taxes on specific goods and services	
	1975	2011	1975	2011	2011	2011	1975	2011	1975	2011
Mean	33.05	33.30	28.63	28.67	31.49	30.32	15.21	19.37	14.79	9.29
St. dev.	13.18	9.01	12.23	9.70	7.97	4.52	3.48	2.92	6.93	1.89
Minimum	13.3	21.7	0.6	2.1	21.3	24.7	8.9	14.5	8.1	6.6
Maximum	59.0	60.9	47.5	38.5	46.8	39.4	23.4	25.2	29.7	13.0
CV	0.4130	0.2802	0.4421	0.3500	0.2619	0.1542	0.2366	0.1562	0.4853	0.2103

Source: OECD (2015) and own elaboration.



Source: OECD (2015).

Figure 1 Evolution of the Tax Indicators - Tax Burden



Source: Own elaboration.

Figure 2 Sigma-Convergence - Tax Burden

Table 2 Some Relevant Facts (in EU Taxation) in the Period 1975-2011

Mutual assistance in the field of direct taxation.	Greece joined EU.	Spain and Portugal joined EU.	Establishment of Maastricht criteria: convergence, including deficit (max. 3% GDP) and debt (max. 60% GDP). Arrangements on minimum tax rates (VAT and excise duties).	Austria and Finland joined EU.	Check of Maastricht criteria. The tax package: code of conduct for business taxation.	Introduction of euro as the new European currency in 12 countries (Eurozone). Note: since 1999 the euro was a non-physical currency.	Directive on taxation of income from savings.	Administrative cooperation - a new directive in the field of (direct) taxation.
1977	1981	1986	1993	1995	1997	2002	2003	2011

Source: Own elaboration.

The detailed results of the club convergence analysis for the tax burden appear in Table 3, with a summary in Table 4 to facilitate the interpretation of the results. Due to the different paths in the sample, which are observed in the previous graphs (Figure 2) and also in some of the papers reviewed in the introduction (e.g. Delgado 2009), we have decided to further investigate two subsamples: 1975-1994 and 1995-2011. Although there are different trajectories among the series, and it is difficult to find a unique breaking point for the overall analysis, we have selected 1994 as the breaking point year for two reasons: i) the graphs represented in Figure 2 for sigma convergence (tax burden) and those corresponding to the tax mix (not reported for reasons of space) reveal that the coefficients of variation turn around the years 1994 and 1995; ii) as summarized in Table 2, in 1993 the euro convergence or Maastricht criteria were approved, including those related to deficit and debt, with the consequent effects on taxes and public expenditures in the following years, with 1996 as the target year to satisfy the criteria; in this manner, again, 1994 and 1995 are relevant years for this study. Alternatively, we could consider the pre- and post-euro or the pre- and post-crisis periods; however, in these cases the time span corresponding to the second subsample would be too short to yield meaningful results.

Additionally, the evolution of the average relative transition function, $\overline{h}_{club,t}$ (calculated as the cross-sectional mean of the members of each club), appears in Figure 3 for the tax burden case. It allows the analysis of the heterogeneity of the sample and helps to understand the club results. With regard to the tax mix, and for the sake of brevity, we only present the summary in Table 5 (detailed results are available upon request).

Table 3 Convergence Club Results - Tax Burden

Club		Countries	$t_{\hat{b}}$	$\widehat{b}(s.e.)$	$\widehat{\alpha}$
a) Total	Period 1975-2011				
	Full sample		-2.095*	-0.133 (0.063)	-0.067
	Club 1	ALL EXCEPT IRE	2.878	0.168 (0.058)	0.084
	Diverging	IRE			
	Period 1975-1994				
	Full sample		-3.750*	-0.362 (0.096)	-0.181
	Club 1	DEN, FIN, SWE, BEL, FRA, NET, AUS, ITA, SPA	2.228	0.428 (0.192)	0.214
	Club 2	GER, LUX, IRE, UK, POR, GRE	3.059	0.563 (0.184)	0.282
	Period 1995-2011				
	Full sample		-11.899*	-0.641 (0.054)	-0.321
	Club 1	SWE, BEL, FRA, FIN, ITA, AUS, DEN, NET, GER	-0.803	-0.164 (0.205)	-0.082
	Club 2	LUX, UK, POR	1.202	0.384 (0.320)	0.192
	Club 3	SPA, GRE, IRE	-1.464	-0.654 (0.447)	-0.327
b) Taxes on income, profits and capital gains	Period 1975-2011				
	Full sample		-4.966*	-0.261 (0.052)	-0.131
	Club 1	ALL EXCEPT DEN	6.424	0.375 (0.058)	0.188
	Diverging	DEN			
	Period 1975-1994				
	Full sample		-7.400*	-0.642 (0.087)	-0.321
	Club 1	SWE, FIN, BEL, IRE, ITA, LUX, NET, GER, AUS, SPA, POR	0.813	0.181 (0.222)	0.091
	Club 2	UK, FRA, GRE	0.369	0.093 (0.251)	0.047
	Diverging	DEN			
	Period 1995-2011				
	Full sample		-11.796*	-0.774 (0.066)	-0.387
	Club 1	SWE, FIN, BEL, ITA, LUX, UK, GER, NET	1.554	0.321 (0.207)	0.161
	Club 2	AUS, IRE, SPA	0.261	0.297 (1.138)	0.149
	Club 3	FRA, POR	1.933	1.919 (0.993)	0.960
	Diverging	DEN, GRE	-17.812*	-0.994 (0.056)	-0.497
c) Social security contributions	Period 1975-2011				
	Full sample		-4.354*	-0.207 (0.048)	-0.104
	Club 1	NET, AUS, GER, BEL, FRA, ITA, FIN, SPA, LUX, GRE, SWE, POR	6.982	0.733 (0.105)	0.367
	Diverging	UK, IRE, DEN	-8.026*	-0.635 (0.079)	-0.318

	Period 1975-1994				
	Full sample		-20.163*	-0.673 (0.033)	-0.337
	Club 1	NET, AUS, FIN, BEL, FRA, GER, SWE, ITA, SPA, LUX, POR	-1.323	-0.299 (0.226)	-0.150
	Club 2	UK, IRE	0.924	0.416 (0.451)	0.208
	Diverging	GRE, DEN	-8.560*	-0.686 (0.080)	-0.343
	Period 1995-2011				
	Full sample		-26.175*	-0.690 (0.026)	-0.345
	Club 1	NET, AUS, GER, BEL, ITA, FIN	5.875	0.671 (0.114)	0.336
	Club 2	SPA, LUX, SWE	1.984	1.054 (0.531)	0.527
	Club 3	GRE, POR	0.983	0.482 (0.490)	0.241
	Club 4	UK, IRE	0.431	0.179 (0.415)	0.090
	Diverging	FRA, DEN	-17.183*	-0.949 (0.055)	-0.475
d) Taxes on goods and services	Period 1975-2011				
	Full sample		-0.920	-0.181 (0.196)	-0.091
	Period 1975-1994				
	Full sample		3.383	0.409 (0.121)	0.205
	Period 1995-2011				
	Full sample		-18.048*	-1.197 (0.066)	-0.599
	Club 1	DEN, FIN, SWE	0.027	0.012 (0.442)	0.006
	Club 2	GRE, POR	-0.731	-2.118 (2.899)	-1.059
	Club 3	AUS, NET, BEL, GER	0.479	0.190 (0.397)	0.095
	Club 4	UK, ITA	-0.997	-3.386 (3.395)	-1.693
	Club 5	FRA, LUX	-0.524	-4.005 (7.642)	-2.003
	Diverging	IRE, SPA	-2.458*	-3.531 (0.696)	-1.766
e) General taxes on goods and services	Period 1975-2011				
	Full sample		-0.740	-0.131 (0.176)	-0.066
	Period 1975-1994				
	Full sample		12.734	0.743 (0.058)	0.372
	Period 1995-2011				
	Full sample		-12.813*	-1.297 (0.101)	-0.649
	Club 1	DEN, SWE	1.495	12.543 (8.389)	6.271
	Club 2	FIN, POR	0.870	4.670 (5.369)	2.335
	Club 3	AUS, GRE, GER,FRA,NET, LUX, IRE	-1.282	-0.210 (0.163)	-0.105
	Club 4	UK, BEL	-1.090	-5.892 (5.407)	-2.946
	Club 5	ITA, SPA	-1.210	-8.565 (7.080)	-4.283
f) Taxes on specific goods and services	Period 1975-2011				
	Full sample		4.636	0.433 (0.094)	0.217
	Period 1975-1994				
	Full sample		3.610	0.321 (0.089)	0.161
	Period 1995-2011				
	Full sample		-3.511*	-0.542 (0.154)	-0.271
	Club 1	FIN, DEN, BEL, POR, GRE, ITA, NET	0.355	0.121 (0.341)	0.061
	Club 2	LUX, UK, FRA, GER, SWE, AUS	1.075	0.142 (0.132)	0.071
	Club 3	IRE, SPA	-0.718	-0.470 (0.654)	-0.235

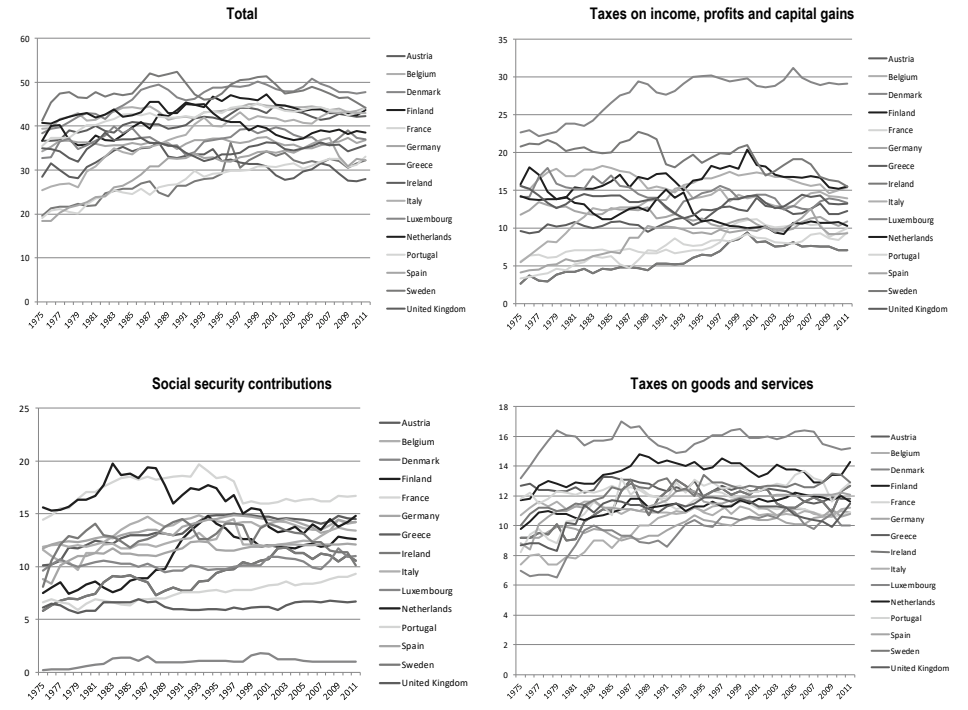
Notes: * Indicates rejection of the null hypothesis of convergence at the 5% level. Abbreviations: AUS - Austria, BEL - Belgium, DEN - Denmark, FIN - Finland, FRA - France, GER - Germany, GRE - Greece, IRE - Ireland, ITA - Italy, LUX - Luxembourg, NET - Netherlands, POR - Portugal, SPA - Spain, UK - United Kingdom, SWE - Sweden.

Source: Own elaboration.

Table 4 Summary of Convergence Club Results - Tax Burden

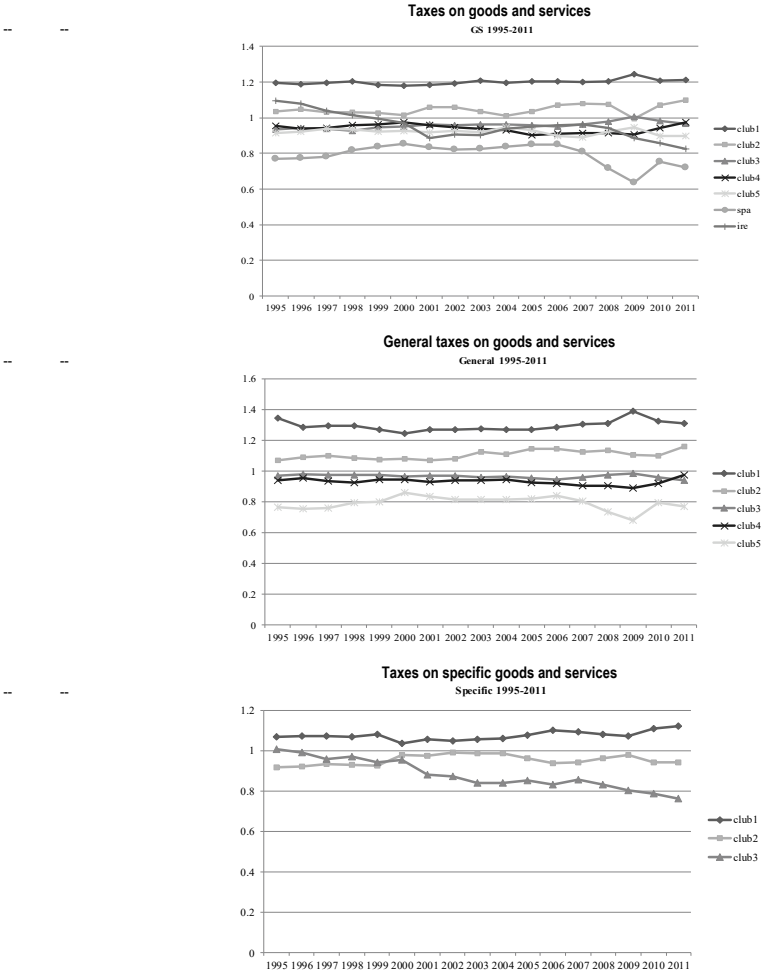
Club	Total	Taxes on income, profits and capital gains	Social security contributions	Taxes on goods and services	General taxes on goods and services	Taxes on specific goods and services
Period 1975-2011						
1	ALL EXCEPT IRE	ALL EXCEPT DEN	NET, AUS, GER, BEL, FRA, ITA, FIN, SPA, LUX, GRE, SWE, POR			
Non converging	IRE	DEN	UK, IRE, DEN			
Period 1975-1994						
1	DEN, FIN, SWE, BEL, FRA, NET, AUS, ITA, SPA	SWE, FIN, BEL, IRE, ITA, LUX, NET, GER, AUS, SPA, POR	NET, AUS, FIN, BEL, FRA, GER, SWE, ITA, SPA, LUX, POR			
2	GER, LUX, IRE, UK, POR, GRE	UK, FRA, GRE	UK, IRE			
Non converging		DEN	GRE, DEN			
Period 1995-2011						
1	SWE, BEL, FRA, FIN, ITA, AUS, DEN, NET, GER	SWE, FIN, BEL, ITA, LUX, UK, GER, NET	NET, AUS, GER, BEL, ITA, FIN	DEN, FIN, SWE	DEN, SWE	FIN, DEN, BEL, POR, GRE, ITA, NET
2	LUX, UK, POR	AUS, IRE, SPA	SPA, LUX, SWE	GRE, POR	FIN, POR	LUX, UK, FRA, GER, SWE, AUS
3	SPA, GRE, IRE	FRA, POR	GRE, POR	AUS, NET, BEL, GER	AUS, GRE, GER,FRA,NET, LUX, IRE	IRE, SPA
4			UK, IRE	UK, ITA	UK, BEL	
5				FRA, LUX	ITA, SPA	
Non converging		DEN, GRE	FRA, DEN	IRE, SPA		

Source: Own elaboration.



Source: Own elaboration.

Figure 3 Average Relative Transition Curve for Each Club - Tax Burden



Notes: It should be noted that, in the total period and the first sub-period, the hypothesis of overall convergence in these categories cannot be rejected.

Source: Own elaboration.

Figure 3 Average Relative Transition Curve for Each Club - Tax Burden (cont.)

3.1 Tax Burden

With regard to the total tax burden, the results provide evidence of a common trend or relative convergence, with the exception of Ireland (IRE) which presents a divergent path in the whole sample. It should be noted that IRE has a tax system which differs in several respects from the rest of the EU-15: the tax burden was 27.9% in 2011 (the lowest within these countries), or a corporate tax where the statutory rate is only 12.5% and hence attracts a good number of multinationals taking advantage of tax competition.

However, the conclusions are rather different if we look at the two subsamples. Thus, in the first period two clubs emerge, the second one including Germany (GER), Luxembourg (LUX), IRE, United Kingdom (UK), Portugal (POR) and Greece (GRE), and both with relative convergence ($\hat{\alpha}$ = 0.214 and 0.282 respectively). In the second subsample three clubs are formed, with LUX, UK and POR, and Spain (SPA), GRE and IRE in the two minority clubs, which are mainly derived from the division of the second club in the first period. Regarding the speed of convergence, only club 2 presents a weak relative convergence ($\hat{\alpha}$ = 0.192). Additionally, in both subsamples no countries diverge.

When we analyze the taxes on income, profits and capital gains, for the entire sample one club presents relative convergence ($\hat{\alpha}$ = 0.198) and only one country diverges - Denmark (DEN) in this case - two and three clubs appear in each subsample respectively (as in the previous case), with some nations diverging in the sub-periods (DEN in the first subsample and DEN and GRE in the second one). Again, no club achieves absolute convergence although club 3 in 1995-2011 has $\hat{\alpha}$ = 0.960. Regarding the divergent country, DEN, it should be noted that this tax category represented 29.1% of the tax burden in 2011, while the average was 13.1%. This situation is repeated for the tax mix, with 60.9% of total revenue compared to a mean of 33.3% in the EU-15 that year. More specifically, the Danish personal income tax contained a marginal tax rate of 55.4%, far from the average, whereas for corporate tax the statutory rate was 25%, in line with the mean.

The study of social security contributions reveals, as was expected due to the traditionally low rates in some countries in this category, that UK, IRE and DEN diverge in the total period, while the remaining nations form a single club with relative convergence ($\hat{\alpha}$ = 0.367). It should be noted that in those three countries the basic pensions are financed through the general budget and they are complemented with a (normally) private system of capitalization. However, when the analysis is divided into the two periods, IRE and UK form a club, with relative convergence ($\hat{\alpha}$ = 0.208 and $\hat{\alpha}$ = 0.090 for the first and second subsample, respectively). Going into more detail, in the first period two clubs are detected, while DEN and GRE are divergent cases. In the second period, four clubs - all of them with relative convergence - are observed. Concretely, the clubs are formed by Netherlands (NET), Austria (AUS), GER, Belgium (BEL), Italy (ITA) and Finland (FIN) ($\hat{\alpha}$ = 0.336); SPA, LUX and Sweden (SWE) ($\hat{\alpha}$ = 0.527); GRE and POR ($\hat{\alpha}$ = 0.241); and the aforementioned UK and IRE. Also, two non-convergent cases (FRA and DEN) are detected: Figure 3 reveals that the relative transition curves corresponding to these countries have the more extreme positions, which is a consequence of the traditionally different policies followed in both countries in terms of social security: in 2011, the ratio to GDP was 1% for DEN and 16.7% for FRA, being the extremes of the distribution.

Regarding the taxes on goods and services, in this case the hypothesis of overall convergence cannot be rejected for the sample as a whole or for the first subsample. However, in the sub-period 1995-2011 our results point to five clubs, plus two countries - SPA and IRE - diverging. Regarding the speed of convergence, among these clusters only clubs 1 - comprising the Nordic countries (DEN, FIN and SWE) with high VAT rates around 25% - and 3 (AUS, NET, BEL and GER) show smooth relative convergence, with $\hat{\alpha}$ = 0.006 and 0.095 respectively.

The detailed analysis of the two categories included in this main tax division - goods and services - shows that the results are similar, as the overall convergence hypothesis remains unrejected for the complete sample and the first sub-period. It should also be noted that some $\hat{\alpha}$ are negative, indicating the weakest convergence clubs following the interpretation of Phillips and Sul (2009). However, some differences observed in the second sub-period deserve some comments. In the general taxation on goods and services, five clubs are also detected, now without diverging countries and with a club 3 formed by seven countries. Now clubs 1 (DEN and SWE) and 2 (FIN and POR) show clear absolute convergence, as $\hat{\alpha}$ = 6.271 and 2.335 respectively. In the specific taxation, on the other hand, there are three clubs, with clubs 1 and 2 (including all countries except IRE and SPA) experiencing a slight relative convergence, with $\hat{\alpha}$ = 0.061 and 0.071 in each case.

In addition to these results, Appendix 2 presents the results from the club merging approach, following Step 5 defined in Appendix 1, where it is observed that some of these clubs could be aggregated in a larger club.

3.2 Tax Mix

When we carry out our analysis from the tax mix perspective, we can observe some different patterns. For the sake of brevity, we only comment the most relevant patterns and we focus on the whole sample, 1975-2011. More detailed analysis can be carried out from the results contained in Table 5.

From this perspective, in the case of the taxes on income, profits and capital gains, the observations are grouped into three clubs, plus DEN as divergent. In addition, all these groups present a relative convergence with parameters ($\hat{\alpha}$) around 0.25. In the social security contributions two clubs are formed, again with DEN as non-converging case. Both clusters, the second comprising SWE, UK and IRE, show relative convergence with $\hat{\alpha}$ = 0.170 and 0.111 respectively. In the case of the taxes on goods and services, we cannot reject the hypothesis of overall convergence, as in the tax burden approach, but when we analyze the general taxation - on goods and services - two clubs emerge, the second one including SPA, AUS, FRA, BEL and ITA, experiencing relative convergence with $\hat{\alpha}$ = 0.094 and 0.176 respectively. On the contrary, in the specific taxation the hypothesis of overall convergence cannot be rejected.

With regard to the previous literature on tax convergence in the EU with the club approach, it should be noted that this is the first study with a wide focus, as the unique related work by Regis, Cuestas, and Chen (2015) only analyzed the convergence in statutory corporate tax rates for the EU-25 over the period 1980-2014. These authors concluded that the dispersion of corporate tax rates had fallen in the period under study, and found heterogeneous tax-setting behavior, identifying four clubs: the tax havens (Cyprus, Germany, Ireland and Switzerland), a core of Eastern European countries plus Luxembourg, a large club formed by 12 Central-Western European countries, and the high tax countries (Belgium, France and Malta).

Table 5 Summarize of Convergence Club Results - Tax Mix

Club	Taxes on income, profits and capital gains	Social security contributions	Taxes on goods and services	General taxes on goods and services	Taxes on specific goods and services
Period 1975-2011					
1	IRE, UK, FIN, SWE, AUS, FRA, GRE	GER, NET, FRA, SPA, AUS, GRE, BEL, ITA, LUX, FIN, POR		POR, GRE, IRE, SWE, DEN, FIN, UK, GER, NET, LUX	
2	LUX, BEL, SPA, POR, ITA	SWE, UK, IRE		SPA, AUS, FRA, BEL, ITA	
3	GER, NET				
Non converging	DEN	DEN			
Period 1975-1994					
1	SWE, IRE, LUX, BEL, UK, FIN, ITA, SPA, NET, POR	NET, GER, SPA, AUS, FRA, BEL, FIN, ITA, GRE, SWE, LUX, POR	POR, GRE, UK	GRE, POR, AUS, IRE, UK, DEN, GER, FRA, FIN, SWE, SPA, LUX	
2	GER, AUS, GRE		NET, GER, SPA, AUS, FRA, BEL, FIN, ITA, SWE, LUX, IRE, DEN	BEL, ITA, NET	
Non converging	DEN, FRA	UK, IRE, DEN			
Period 1995-2011					
1	IRE, UK, LUX, FIN, SWE, ITA, GER, SPA, NET	GER, NET, FRA, SPA, AUS, GRE, ITA, FIN	GRE, POR, SWE	POR, GRE, IRE, SWE, DEN, FIN, GER	GRE, POR, FIN
2	BEL, AUS, POR	BEL, LUX, POR	IRE, FIN, UK, DEN, NET, GER	UK, AUS, NET, LUX	AUS, IRE, UK, DEN, GER, FRA, SWE, SPA, LUX, BEL, ITA, NET
3	FRA, GRE	SWE, UK, IRE	AUS, LUX, SPA, ITA, FRA, BEL	SPA, FRA, BEL	
Non converging	DEN	DEN		ITA	

Source: Own elaboration.

4. Concluding Remarks

Although economic convergence is a widely studied topic in the literature, tax convergence has received less attention among the researchers in international public finance. However, this is an especially important topic in a globalized world, and particularly in the European Union context with the single market and the common currency. This study investigates tax convergence in the EU-15 using the club convergence approach following the Phillips and Sul (2007) methodology, and after a preliminary sigma convergence study.

We investigate the tax burden and tax mix in the sample period 1975-2011, and we also split the period into two subsamples, 1975-1994 and 1995-2011. As general result, we have found fewer clubs in the whole sample and the choice of breakpoint, based on the sigma convergence results, was confirmed by the different clubs formed in each subsample. With this more detailed analysis, we have identified both

overall convergence in some cases - as in taxation on goods and services for the whole sample, an area where the harmonization process is more intense - and club convergence in different degrees in other variables, with the highest disaggregation being experienced by taxation on goods and services in the second subsample, from 1995-2011. In addition, countries such as Ireland or Denmark show a divergent path in a good number of tax categories, denoting the continued existence of several fiscal systems in the EU-15 despite the efforts and the relative homogeneity among these 15 European countries, at least in comparison to the current EU-28 where the disparities are notable.

The results achieved in this research are useful for policy-makers. As is well-known, the European Union is a group of very different countries with regard to economic growth and development, welfare, inequality and also in taxation, as we have seen in this study. Hence, to achieve the main objectives of the European agenda, great efforts must be made in coordinating fiscal policies and designing a fiscal union, which of course comprises tax policy. We believe that a path to the consolidation of the Union is, for example, the establishment of a very small surcharge for the European budget to personal income tax and business taxation. If citizens directly contribute with their main direct taxes to the common policies, such that with a bigger budget some additional measures could be arranged, integration would be more successful.

Finally, this study can be extended in several ways. First, all EU member states could be considered, although this would involve a shorter sample period due to data availability. Second, it would be interesting to further study the determinants of the clubs formed, such as location, welfare systems or debt. And third, in our study we consider two subsamples: 1975-1994 and 1995-2011. A further interesting avenue of research could be based on considering the pre- and post-euro or pre- and post-crisis periods.

References

Apergis, Nicholas, Christina Christou, and Christis Hassapis. 2013. "Convergence in Public Expenditures across EU Countries: Evidence from Club Convergence." *Economics & Finance Research: An Open Access Journal*, 1(1): 45-59. http://dx.doi.org/10.1080/21649480.2013.862735

Apergis, Nicholas, and Arusha Cooray. 2014a. "Tax Revenues Convergence across ASEAN, Pacific and Oceania Countries: Evidence from Club Convergence." *Journal of Multinational Financial Management*, 27: 11-21. http://dx.doi.org/10.1016/j.mulfin.2014.06.007

Apergis, Nicholas, and Arusha Cooray. 2014b. "Convergence in Sovereign Debt Ratios across Heavily Indebted EU Countries: Evidence from Club Convergence." *Applied Economics Letters*, 21(11): 786-788. http://dx.doi.org/10.1080/13504851.2014.889798

Attia, Nicole, and Valerie Berenger. 2007. "Social Protection Convergence in the European Union: Impact of Maastricht Treaty." *Panoeconomicus*, 54(4): 469-487. http://dx.doi.org/10.2298/PAN0704469A

Bertarelli, Silvia, Roberto Censolo, and Caterina Colombo. 2014. "Fiscal Convergence in the European Union before the Crisis." *Contemporary Economic Policy*, 32(4): 784-801. http://dx.doi.org/10.1111/coep.12073

Blot, Christophe, and Francisco Serranito. 2006. "Convergence of Fiscal Policies in EMU: A Unit Root Tests Analysis with Structural Break." *Applied Economic Letters*, 13(4): 211-216. http://dx.doi.org/10.1080/13504850500396009

Chen, Yang, Juan Carlos Cuestas, and Paulo Jose Regis. 2016. "Corporate Tax Convergence in Asian and Pacific Economies." *International Journal of Finance & Economics*, 21(3): 266-278. http://dx.doi.org/10.1002/ijfe.1546

Delgado, Francisco J., and Javier Salinas-Jimenez. 2008. "Impuestos y Crecimiento Económico: Una Panorámica." *Revista Asturiana de Economía*, 42: 9-30.

Delgado, Francisco J. 2009. "Presión Fiscal en la Unión Europea: Un Análisis de Beta, Sigma y Gamma Convergencia." *Revista de Economía Mundial*, 22: 141-166.

Delgado, Francisco J., and Maria Jose Presno. 2010. "Tax Policy Convergence in the EU: An Empirical Analysis." *Revista de Economía Mundial*, 26: 53-83.

Delgado, Francisco J., and Maria Jose Presno. 2011. "Convergence of the Fiscal Pressure in the European Union: A Time Series Approach." *Applied Economics*, 43(28): 4257-4267. http://dx.doi.org/10.1080/00036846.2010.491449

Duncan, Denvil, and Ed Gerrish. 2014. "Personal Income Tax Mimicry: Evidence from International Panel Data." *International Tax and Public Finance*, 21(1): 119-152. http://dx.doi.org/10.1007/s10797-012-9261-9

Esteve, Vicente, Simon Sosvilla-Rivero, and Cecilio Tamarit. 2000. "Convergence in Fiscal Pressure across EU Countries." *Applied Economic Letters*, 7(2): 117-123. http://dx.doi.org/10.1080/135048500351942

Ferreiro, Jesús, Carlos Alberto Carrasco, and Carmen Gomez. 2014. "Convergence of Public Expenditures and Implementation of a Single Model of Public Finances in the European Union." *Revista de Economía Mundial*, 37: 75-102.

Fuest, Clemens, and Bernd Huber. 1999. "Can Tax Coordination Work?" *Public Finance Analysis*, 56: 443-458.

Kammas, Pantelis. 2011. "Strategic Fiscal Interaction among OECD Countries." *Public Choice*, 147(3-4): 459-480. http://dx.doi.org/10.1007/s11127-010-9641-6

Keen, Michael, and Kai A. Konrad. 2013. "The Theory of International Tax Competition and Coordination." In *Handbook of Public Economics*, ed. Alan J. Auerbach, Raj Chetty, Martin Feldstein, and Emmanuel Saez, 257-328. Netherlands: Elsevier.

Kocenda, Evzen, Ali M. Kutan, and Taner M. Yigit. 2008. "Fiscal Convergence in the European Union." *North American Journal of Economics and Finance*, 19: 319-330. http://dx.doi.org/10.1016/j.najef.2008.06.003

Leibrecht, Markus, and Claudia Hochgatterer. 2012. "Tax Competition as Cause of Falling Corporate Income Tax Rates: A Survey of Empirical Literature." *Journal of Economic Surveys*, 26(4): 616-648. http://dx.doi.org/10.1111/j.1467-6419.2010.00656.x

Marchand, Maurice, Pierre Pestieau, and Motohiro Sato. 2003. "Can Partial Fiscal Coordination Be Welfare Worsening?: A Model of Tax Competition." *Journal of Urban Economics*, 54(3): 451-458. http://dx.doi.org/10.1016/S0094-1190(03)00057-3

Phillips, Peter C. B., and Donggyu Sul. 2007. "Transition Modeling and Econometric Convergence Tests." *Econometrica*, 75(6): 1771-1855. http://dx.doi.org/10.1111/j.1468-0262.2007.00811.x

Phillips, Peter C. B., and Donggyu Sul. 2009. "Economic Transition and Growth." *Journal of Applied Econometrics*, 24(7): 1153-1185. http://dx.doi.org/10.1002/jae.1080

Regis, Paulo Jose, Juan Carlos Cuestas, and Yang Chen. 2015. "Corporate Tax in Europe: Towards Convergence?" *Economics Letters*, 134(C): 9-12. http://dx.doi.org/10.1016/j.econlet.2015.05.030

Tosun, Mehmet Serkan, and Sohrab Abizadeh. 2005. "Economic Growth and Tax Components: An Analysis of Tax Changes in OECD." *Applied Economics*, 37(19): 2251-2263. http://dx.doi.org/10.1080/00036840500293813

Appendix 1

Clustering Algorithm (Phillips and Sul 2007)

Step 1. Cross section ordering. Order the N countries in the panel according to the last observation.

Step 2. Form a core group. Select the first k highest individuals (for $2 \leq k < N$) to form the subgroups G_k, run the log t regression and calculate the test statistic $t_k = t(G_k)$ for each subgroup. Choose the core group of size k^* by maximizing t_k subject to $\min\{t_k\} > -1.65$. If the condition $\min\{t_k\} > -1.65$ does not hold for $k = 2$, drop the highest individual in the panel, form new subgroups $G_{2j} = \{2,\ldots,j\}$, $3 \leq j \leq N$ and repeat the procedure with test statistic $t_j = t(G_{2j})$. Continue until a subsequent pair of countries is found with t-statistic greater than -1.65 in order to form a core group. If no such pair is detected, conclude that there are no convergence clubs; otherwise, if $k^* = N$ all units converge.

Step 3. Sieve the data for new club members. After the core group is formed, add one country at a time and run the log t regression. Include the unit in the subgroup if the corresponding t-statistic is greater than the criterion c^* (a critical value). Add all units satisfying the sieve criterion and run the log t test for the subgroup; if the t-statistic is greater than -1.65, a convergence club is obtained; otherwise increase the critical value c^* and repeat the procedure until that the club satisfies the criterion for convergence. If no more units can be sieved to the initial core group, the group forms a club.

Step 4. Recursion and stopping rule. Form a complementary group from those countries for which the sieve condition fails in Step 3 and run the log t test. If the t-statistic is greater than -1.65 (i.e. this group converges), conclude that there are two convergence clubs. If not, repeat Step 1 through Step 3 to see if this second group can itself be subdivided into smaller subgroups that constitute convergence clusters. If no other clubs are detected, conclude that the remaining countries have divergent behavior.

Step 5. Club merging. Phillips and Sul (2009) point out their algorithm may overestimate the number of clusters, so they propose a test for overall convergence in order to test whether or not the clusters converge amongst themselves - a convergence club merging test. It consists on running the log t regressions to test for convergence across adjacent groups. If the t-statistic is greater than -1.65, merge the clusters into a larger club. Finally, add the diverging countries to each cluster separately and run the log t test.

Appendix 2

Table A1 Convergence Club Results: Merge - Tax Burden

	Club	Countries	Test of club merging	
a) Total	Period 1995-2011			
	Club 1	SWE, BEL, FRA, FIN, ITA, AUS, DEN, NET, GER	Clubs 1-2 $\hat{b}$ =-0.386 $t_{\hat{b}}$ =-3.578*	
	Club 2	LUX, UK, POR	Clubs 2-3 $\hat{b}$ =-0.565 $t_{\hat{b}}$ =-1.999*	
	Club 3	SPA, GRE, IRE		
b) Taxes on income, profits and capital gains	Period 1975-1994			
	Club 1	SWE, FIN, BEL, IRE, ITA, LUX, NET, GER, AUS, SPA, POR	Clubs 1-2 $\hat{b}$ =-0.130 $t_{\hat{b}}$ =-0.918	
	Club 2	UK, FRA, GRE		
	Diverging	DEN		
	Period 1995-2011			
	Club 1	SWE, FIN, BEL, ITA, LUX, UK, GER, NET	Clubs 1-2 $\hat{b}$ =0.026 $t_{\hat{b}}$ =0.318	Clubs 1-2-3 $\hat{b}$ =-0.123 $t_{\hat{b}}$ =-1.429
	Club 2	AUS, IRE, SPA	Clubs 2-3 $\hat{b}$ =-0.259 $t_{\hat{b}}$ =-1.606	
	Club 3	FRA, POR		
	Diverging	DEN, GRE		
c) Social security contributions	Period 1975-1994			
	Club 1	NET, AUS, FIN, BEL, FRA, GER, SWE, ITA, SPA, LUX, POR	Clubs 1-2 $\hat{b}$ =-0.588 $t_{\hat{b}}$ =-6.436*	
	Club 2	UK, IRE		
	Diverging	GRE, DEN		
	Period 1995-2011			
	Club 1	NET, AUS, GER, BEL, ITA, FIN	Clubs 1-2 $\hat{b}$ =-0.631 $t_{\hat{b}}$ =-2.828*	
	Club 2	SPA, LUX, SWE	Clubs 2-3 $\hat{b}$ =0.526 $t_{\hat{b}}$ =2.781	Clubs 2-3-4 $\hat{b}$ =-0.118 $t_{\hat{b}}$ =-1.067
	Club 3	GRE, POR	Clubs 3-4 $\hat{b}$ =-0.234 $t_{\hat{b}}$ =-1.224	
	Club 4	UK, IRE		
	Diverging	FRA, DEN		
d) Taxes on goods and services	Period 1995-2011			
	Club 1	DEN, FIN, SWE	Clubs 1-2 $\hat{b}$ =-0.394 $t_{\hat{b}}$ =-1.046	
	Club 2	GRE, POR	Clubs 2-3 $\hat{b}$ =-0.501 $t_{\hat{b}}$ =-1.102	Clubs 1-2-3 $\hat{b}$ =-0.571 $t_{\hat{b}}$ =-2.980*
	Club 3	AUS, NET, BEL, GER	Clubs 3-4 $\hat{b}$ =-0.351 $t_{\hat{b}}$ =-0.788	Clubs 2-3-4 $\hat{b}$ =-0.983 $t_{\hat{b}}$ =-2.392*
	Club 4	UK, ITA	Clubs 4-5 $\hat{b}$ =-1.265 $t_{\hat{b}}$ =-1.802*	
	Club 5	FRA, LUX		
	Diverging	IRE, SPA		
e) General taxes on goods and services	Period 1995-2011			
	Club 1	DEN, SWE	Clubs 1-2 $\hat{b}$ =-0.782 $t_{\hat{b}}$ =-2.855*	

	Club 2	FIN, POR	Clubs 2-3 $\hat{b}$ =-0.744 $t_{\hat{b}}$ =-5.113*
	Club 3	AUS, GRE, GER,FRA,NET, LUX, IRE	Clubs 3-4 $\hat{b}$ =-0.442 $t_{\hat{b}}$ =-4.461*
	Club 4	UK, BEL	Clubs 4-5 $\hat{b}$ =-2.230 $t_{\hat{b}}$ =-6.642*
	Club 5	ITA, SPA	
f) Taxes on specific goods and services	Period 1995-2011 Club 1	FIN, DEN, BEL, POR, GRE, ITA, NET	Clubs 1-2 $\hat{b}$ =-0.240 $t_{\hat{b}}$ =-1.108
	Club 2	LUX, UK, FRA, GER, SWE, AUS	Clubs 2-3 $\hat{b}$ =-0.420 $t_{\hat{b}}$ =-3.818*
	Club 3	IRE, SPA	

Notes: * Indicates rejection of the null hypothesis of convergence at the 5% level.

Source: Own elaboration.