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Abstract

This paper provides a simple theoretical model of capital tax competition between countries that differ in spatial location, and where cross-border investment costs are proportional to distance (a gravity model). We model EU membership as a reduction in 'distance' between countries. Precise predictions about reaction functions' intercepts and slopes are derived. In particular we find that joining the Union lowers tax reaction function's intercept and that all countries react more to member countries than they do to non-members. These predictions are largely confirmed using a panel data set of statutory corporate tax rates on Western European countries.

KEYWORDS: Corporate Taxes, Tax Competition, European Union.
JEL CLASSIFICATION: H2, H77, H87, D7

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1. Introduction

This paper explores the impact of EU membership on tax interactions among European countries. The creation of a 'common market' for goods, capital and to some extent labour was the main focus of the Treaty of Rome in 1957, and also of the Single European Act, which came into force in July 1987. Its provisions included gradually establishing a single market over a period up to the end of 1992, by means of a vast legislative programme involving the adoption of hundreds of directives and regulations. This programme has been largely successful, and has reduced the costs of trade and investment between EU countries. To take only one example, European Union countries have to comply with a number of technical harmonization standards for goods and services, which means a firm located in one EU country faces a lower cost of exporting goods to, or indeed of investing in, another EU country than to a third country outside the EU, where different technical standards may apply[1]. Economic theory suggests that such market integration will impact positively on FDI flows both between member states and between member states and the rest of the world (Motta and Norman (1996)).

There is supporting empirical evidence for this. For example Brenton (1996) finds that the EU single market programme led to a significant increase in investment by EU firms in other EU countries in the late 1980s. Barrell and Pain (1997, 1998, 1999) and Van Aarle (1996) show that the removal of internal barriers to trade and capital mobility during the single market programme has been accompanied by a rapid growth in multinational activity in the European Union both by European and non-European firms. Other research concentrates on the effect of the EMU on FDI; Petroulas (2007) shows that the introduction of the Euro raised inward FDI by 14 to 16 percent between Eurozone countries, by 11 to 13 percent from member countries to non-members, and by around 8 percent from non-member countries to member countries; Schiavo (2007) uses a gravity model on a sample of OECD countries to demonstrate that currency unions have a positive impact on FDI.

However, while the deepening of the single market in goods, capital and labour has progressed, there has been little progress on corporate and personal income tax harmonization. This is not a direct objective of the EU[2] and, in practice, harmonization has

[1] An important example are standards for the production of new motor vehicles. Here, EU emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states.

[2] The legal basis for corporate tax harmonization is formed by art. 100, which deals with the harmonization of laws in general. This general harmonization is obligatory only in so far as the establishment

been minimal: member states are reasonably free to set their own direct and corporate tax rates and tax bases. For example, although a common consolidated tax base for the corporate tax is an objective of the European Commission, little progress on this has been made to date (Fuest (2008)), and harmonization of personal taxes on capital income is not even on the agenda. Rather, the EU has adopted a policy of exchange of information to minimize evasion of these taxes.[3]

Our hypothesis is that the combination of these two factors, i.e., the lower cost of cross-border FDI between EU member countries, on the one hand, and the lack of tax harmonization programmes between members, on the other hand, should cause EU countries compete more intensively for FDI amongst themselves than with countries outside the EU. This might in turn cause them to react more to each others' taxes than to taxes of countries outside the EU.

We develop a simple model of tax competition which verifies and refines this intuition. Motivated by the success of 'gravity models' in explaining FDI flows (e.g., Egger and Pfaffermayr (2004)), we assume that, conditional on taxes, the size of cross-border investment between two countries is inversely proportional to the marginal cost of cross-border investment (these marginal costs could be physical, legal, or regulatory). We model EU membership as a reduction in 'distance' to other EU countries. We derive precise predictions on reaction function slopes and intercepts. In particular we predict (i) that EU members react more to each other than they do to non-members; (ii) non-EU countries also react to EU countries more than non-EU countries; (iii) EU membership lowers the intercept of the tax reaction function.

We then take the model to the data: we investigate competition in both statutory tax rates and income tax rates using a dataset on seventeen western European countries for a period of up to thirty years. Tax reaction functions are estimated following a literature initiated by Case, Hines and Rosen (1993) and followed by several other researchers (e.g. Brueckner and Saavedra, (2001), Solè-Ollè (2003), Devereux, Lockwood and Redoano

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or functioning of the internal market is at stake. Additionally article 94 of the EC Treaty provides for approximation of such laws, regulations or administrative provisions of the Member States as directly affect the establishment or functioning of the common market.

[3] "The Council on 21 April 2004 adopted an amending Directive that is designed to speed up the flow of information between the tax authorities of Member States. The Directive which relates to direct taxation (income tax, company tax and capital gains tax), together with Insurance Premium Tax, enables Member States to co-ordinate their investigative action against cross-border tax fraud and carry out more procedures on behalf of each other." Council Directive 2004/56/EC of 21 April 2004.

(2008)). Specifically, taxes in any given country are assumed to depend linearly on a weighted average of taxes in other countries, where the weights are not estimated, but chosen *a priori.*

We find evidence in support of our theory for statutory corporate tax rates. Specifically, in our preferred specification, with weights inversely related to the *effective* distance between countries, EU countries react to a one percentage point decrease in the statutory rate of corporate tax of EU members by cutting their own taxes by 0.86 percentage points, and to a one percentage point decrease in the statutory rate of corporate tax of other non-EU countries by cutting their own tax by only 0.02 percentage points. Moreover we find that non-EU countries react to a one percentage point cut in the statutory tax rate of corporate tax of EU members by decreasing their own tax rate by 0.62 percentage points, and to a one percentage point decrease in the statutory rate of corporate tax of non-EU countries by cutting its own tax by 0.25 percentage points. Finally, we find that joining the EU have a negative effect on the level of taxes equal to 0.02 points. Other alternative weighting schemes work much worse. So, overall, our results are consistent with the pattern of tax competition that emerges endogenously from a model where cross-border investment costs are lower for and towards union members.

The related literature is as follows. Bretschger and Hettich (2002), Dreher (2006), Haufler, Klemm and Schjelderup (2008) analyze the impact of market integration on corporate tax setting. Altshuler and Goodspeed (2006), Besley, Griffith and Klemm (2001) Crabbe and Vandenbussche (2008), Devereux, Lockwood and Redoano (2008), and Overesch and Rincke (2008) all estimate corporate tax reaction functions for OECD countries. For Europe, in particular, Altshuler and Goodspeed (2006) find that European countries behaved as if the US were a leader in setting corporate taxes after the 1986 tax reform; Crabbe and Vandenbussche (2008) investigates the effect of the new members on EU 15 members, finding a positive correlation for countries close to the new countries. Overesch and Rincke (2008) estimate a dynamic panel data on European countries that relates current tax rates to lagged values of a country's own as well as other countries' tax rates. But none of these papers explicitly models the impact of EU membership on tax competition, either theoretically or empirically.

The most closely related paper to ours is the independent[4] work of Davies and Voget (2009). They construct a theoretical model of firm location and corporate tax competition, where the derived tax relative tax reaction slopes (i.e., how the tax in country i reacts to the tax in country j relative to how it reacts to the tax in country k) depend on relative market potentials of countries j and k. The market potential of a country, according to their theoretical model, is the expected profit a firm can expect by locating in that country. Their argument is then that the market potential of a country is increased when it joins the EU. So, Davies and Voget's theoretical predictions do not make a distinction between the behavior of EU and non-EU countries per se, but derive a general prediction that countries respond more to countries that have greater market potential. We, instead, predict directly from the theoretical model what effect EU membership will have on the slope of the tax reaction functions. A second difference is that we also predict that EU members will react differently to the taxes of both EU and non-EU countries than non-members will, and this is verified in our empirical results. Finally, our paper covers a different time period (for reasons that we will explain later), and focusses only on western European countries. So in practice, Davies and Voget (2009) paper is somehow complementary to ours, and provides a sort of robustness check for the idea that EU membership has indeed increased tax competition in Europe.

The remainder of the paper is organized as follows. Section 2 introduces the theoretical framework. Section 3 presents the dataset and the empirical methodology. Empirical results are discussed in Section 4. The last section concludes.

2. The Theoretical Framework

In this section, we set up a theoretical model of tax competition between both EU and non-EU countries, which is designed to capture the effect that EU membership has on lowering the costs of cross-border FDI. Tax reaction functions can be explicitly calculated, and predictions about how EU membership affects the slope of these reaction functions can then be derived.

We use an $n-$country version of Persson and Tabellini (2002). There are $i = 1, .., n$

[4] The first version of this paper (Redoano, (2003)) only studied fiscal interactions between EU members. A later version (Redoano, (2007)) addressed the issue of different responses by EU members and non-members by running separate regressions for the two groups. The first version of the paper by Davies and Voget came out in 2008.

countries, n even. The distance between countries i and j is d_{ij}; 'distance' can be interpreted geographically, or by similarity of characteristics, institutions, etc.[5] The role of distance is that it determines the cost of cross-border investment between i and j. A subset U of these countries are members of an international union. The key feature of union membership is that if i, j are members, the effective distance between them is reduced, making cross-border investment more profitable.

In each country i, there is a single household, with a capital endowment, $\tilde{k}_i$, that can be allocated across all countries. Let k_{ij} be the amount allocated by the household in country i to country j. The production function is linear: output in country i is $y_i = k_i$, where k_i is capital employed in country i. So, the pre-tax return on capital is fixed at 1. Capital is taxed at source, i.e. tax revenue is $R_i = \tau_i k_i$.

The portfolio design problem of the household in country i is, then, to choose k_{ij}, $j = 1, ..n$ to maximize the net return to capital

$$V_i = \sum_j k_{ij}(1 - \tau_j) - \sum_{j \neq i} c_{ij} \frac{(k_{ij})^2}{2} \tag{2.1}$$

subject to the resource constraint

$$\sum_j k_{ij} = \tilde{k}_i, \quad k_{ij} \geq 0 \tag{2.2}$$

Here, c_{ij} is the cost of cross-border investment between i and j and is

$$c_{ij} = \begin{cases} \lambda d_{ij} & \text{if } i, j \in U \\ \theta d_{ij} & \quad i \notin U, \; j \in U, \quad \lambda < \theta < 1 \\ d_{ij} & \text{otherwise} \end{cases} \tag{2.3}$$

This captures the idea that, other things being equal, the cost of cross-border investment is proportional to the distance (with the constant of proportionality being set at 1), but that union membership by one or both countries lowers the cost of cross-border investment. The rationale for $\lambda < 1$ is straightforward: cross-border investment from one member country to another is governed by similar tax and regulatory rules, and the firm locating in one country can sell into the entire internal market, i.e. *bilateral union membership*. For an investment from a non-member to a member (*unilateral union membership*), again

[5] This is consistent with some recent findings; for example, a study by the European Commission (2006) has have found that proximity to the home region is an important factor in explaining the pattern of FDI across regions in Europe.

the advantage of being able to sell to the internal market reduces the effective cost. So, we also expect $\theta < 1$, but possibly $\lambda < \theta$.

Substituting the resource constraint (2.2) in (2.1), the maximand becomes

$$\sum_j k_{ij}(\tau_i - \tau_j) - \sum_{j \neq i} c_{ij} \frac{(k_{ij})^2}{2}$$

The solution to this problem is that the household in country i will invest abroad only if the tax is lower than that in the home country, i.e.,

$$k_{ij} = \max\left\{\frac{\tau_i - \tau_j}{c_{ij}}, 0\right\}$$

Hence the capital employed in country i, and thus the tax base of country i, is

$$\begin{aligned} k_i &= \tilde{k}_i - \sum_{j \neq i} k_{ij} + \sum_{j \neq i} k_{ji} \\ &= \tilde{k}_i - \sum_{j \neq i} \max\left\{\frac{\tau_i - \tau_j}{c_{ij}}, 0\right\} + \sum_{j \neq i} \max\left\{\frac{\tau_j - \tau_i}{c_{ji}}, 0\right\} \\ &= \tilde{k}_i + \sum_{j \neq i} \frac{\tau_j - \tau_i}{c_{ij}} \end{aligned}$$

using $c_{ij} = c_{ji}$. Following Kanbur and Keen (1993), we assume that governments are revenue-maximizers. This assumption could be relaxed, at the cost of not being able to obtain closed-form solutions for the reaction functions.[6] Then, the government of country i chooses τ_i to maximize

$$TR_i = \tau_i \left(\tilde{k}_i + \sum_{j \neq i} \frac{\tau_j - \tau_i}{c_{ij}}\right). \tag{2.4}$$

The first-order condition for a maximum of (2.4) with respect to τ_i is

$$\tilde{k}_i + \sum_{j \neq i} \frac{\tau_j}{c_{ij}} - 2\sum_{j \neq i} \frac{\tau_i}{c_{ij}} = 0.$$

These first-order conditions give reaction functions

$$\tau_i = \frac{\tilde{k}_i + \sum_{j \neq i} \frac{\tau_j}{c_{ij}}}{2\left(\sum_{j \neq i} \frac{1}{c_{ij}}\right)}, \quad i = 1, .., n$$

[6] In particular, the welfare of the representative household is $V_i + H(\tau_i k_i)$ where V_i is national income net of investment costs, and $H(\tau_i k_i)$ is utility from public good provision. Even if H is linear, it can be checked that with this maximand, the first-order conditions do not solve to give linear reaction functions.

Writing out reaction functions for union members and non-members separately and using (2.3):

$$\tau_i = \frac{\tilde{k}_i + \sum_{j\neq i, j\in U} \frac{\tau_j}{\lambda d_{ij}} + \sum_{j\neq i, j\notin U} \frac{\tau_j}{\theta d_{ij}}}{2\left(\sum_{j\neq i, j\in U} \frac{1}{\lambda d_{ij}} + \sum_{j\neq i, j\notin U} \frac{1}{\theta d_{ij}}\right)},\ i\in U, \tag{2.5}$$

and

$$\tau_i = \frac{\tilde{k}_i + \sum_{j\neq i, j\in U} \frac{\tau_j}{\theta d_{ij}} + \sum_{j\neq i, j\notin U} \frac{\tau_j}{d_{ij}}}{2\left(\sum_{j\neq i, j\in U} \frac{1}{\theta d_{ij}} + \sum_{j\neq i, j\notin U} \frac{1}{d_{ij}}\right)},\ i\notin U. \tag{2.6}$$

Next, we reformulate (2.5) and (2.6), following standard practice in the empirical tax competition literature, so that the taxes of other countries enter as weighted sums with exogenously specified weights, w_{ij}. We define $\tau_{-i,U}$ and $\tau_{-i,NU}$ to be the two distance-weighted averages of other countries' taxes for, respectively, the sets of countries in the union or not in the union

$$\tau_{-i,U} = \sum_{j\neq i, j\in U} w_{ij}^U \tau_j,\ \tau_{-i,NU} = \sum_{j\neq i, j\notin U} w_{ij}^{NU}\tau_j, \tag{2.7}$$

where the weights w_{ij}^U, w_{ij}^{NU} are inversely proportional to the normalized distance between i and j i.e.

$$w_{ij}^U = \frac{\frac{1}{d_{ij}}}{A_i},\ \ A_i = \sum_{j\neq i, j\in U}\frac{1}{d_{ij}},\ w_{ij}^{NU} = \frac{\frac{1}{d_{ij}}}{B_i},\ B_i = \sum_{j\neq i, j\notin U}\frac{1}{d_{ij}} \tag{2.8}$$

Note that by construction, the weights sum to 1, i.e., $\sum_{j\neq i} w_{ij}^U = 1$ and $\sum_{j\neq i} w_{ij}^{NU} = 1$. Then, the reaction functions (2.5) and (2.6) can be equivalently written:

$$\tau_i = \frac{\tilde{k}_i + \frac{A_i}{\lambda}\tau_{-i,U} + \frac{B_i}{\theta}\tau_{-i,NU}}{2\left(\frac{1}{\lambda}A_i + \frac{1}{\theta}B_i\right)},\ \ i\in U,\ \tau_i = \frac{\tilde{k}_i + \frac{A_i}{\theta}\tau_{-i,U} + B_i\tau_{-i,NU}}{2\left(\frac{1}{\theta}A_i + B_i\right)},\ \ i\notin U \tag{2.9}$$

Now let $R_i = A_i/B_i$; this is the distance-weighted average number of countries in the EU, other than i, relative to the distance-weighted average number of countries out of the EU, other than i, or the relative size of the union, for short. Using this definition, and further rearranging, we get a formulation where τ_i responds to a weighted average of $\tau_{-i,U},\ \tau_{i,NU}$:

$$\tau_i = \alpha_{i,U} + \frac{1}{2}[\omega_{i,U}\tau_{-i,U} + (1-\omega_{i,U})\tau_{i,NU}],\ \omega_{i,U} = \frac{\theta R_i}{\theta R_i + \lambda},\ i\in U, \tag{2.10}$$

$$\tau_i = \alpha_{i,NU} + \frac{1}{2}[\omega_{i,NU}\tau_{-i,U} + (1-\omega_{i,NU})\tau_{i,NU}],\ \ \omega_{i,NU} = \frac{R_i}{R_i+\theta},\ i\notin U \tag{2.11}$$

Also, the intercept terms for a country in and out of the union are:

$$\alpha_{i,U} = \frac{\lambda\theta\tilde{k}_i}{2B_i(\theta R_i+\lambda)},\ \alpha_{i,NU} = \frac{\theta\tilde{k}_i}{2B_i(R_i+\theta)} \tag{2.12}$$

Finally, let

$$\tau_{-i} = \sum_{j\neq i} w_{ij}\tau_j,\ w_{ij} = \frac{\frac{1}{d_{ij}}}{\sum_{j\neq i}\frac{1}{d_{ij}}} \tag{2.13}$$

be the ordinary distance-weighted average of taxes other than country $i's$. We can now state our first Proposition:

Proposition 1: *(i) If $\lambda = \theta = 1$ (a) then $\alpha_{i,U} = \alpha_{i,NU}$, i.e. for any country, joining the union does not affect the intercept of the tax reaction function; (b) then any country i responds in the same way to country j irrespective of whether i, j are in the union or not i.e.*

$$\omega_{i,U}\tau_{-i,U} + (1-\omega_{i,U})\tau_{-i,NU} = \omega_{i,NU}\tau_{-i,U} + (1-\omega_{i,NU})\tau_{-i,NU} = \tau_{-i}.$$

(ii) If $\lambda < \theta = 1$, then (a) $\alpha_{i,U} < \alpha_{i,NU}$, i.e. for any country, joining the union reduces the intercept of the tax reaction function; (b) $\omega_{i,U} > \omega_{i,NU}$ i.e. conditional on the size of the union (measured by R), any country in the union will react more to other union members, and less to countries outside the union, than a non member; (c) non-members respond the same way to members and non members i.e.

$$\omega_{i,NU}\tau_{-i,U} + (1-\omega_{i,NU})\tau_{-i,NU} = \tau_{-i}.$$

(iii) If $\lambda < \theta < 1$, then (a) $\alpha_{i,U} < \alpha_{i,NU}$, i.e. for any country, joining the union reduces the intercept of the tax reaction function; (b) if $\theta^2 > (<)\ \lambda \Longrightarrow \omega_{i,U} > (<)\ \omega_{i,NU}$ i.e. conditional on the size of the union, any country in the union will react more (less) to other union members, and less (more) to countries outside the union, than a non member does.

Proof. To prove (i), if $\lambda = \theta = 1$, it is easy to check from (2.12) that $\alpha_{i,U} = \alpha_{i,NU}$. Also, (2.9) becomes

$$\begin{aligned}\tau_i &= \frac{\tilde{k}_i + A_i\tau_{-i,U} + B_i\tau_{-i,NU}}{2(A_i+B_i)} = \frac{\tilde{k}_i}{2(A_i+B_i)} + \frac{\sum_{j\neq i,j\in U}\frac{\tau_j}{d_{ij}} + \sum_{j\neq i,j\notin U}\frac{\tau_j}{d_{ij}}}{2(A_i+B_i)} \\ &= \alpha_i + \frac{\sum_{j\neq i}\frac{1}{d_{ij}}\tau_j}{2\sum_{j\neq i}\frac{1}{d_{ij}}} \\ &= \alpha_i + \frac{\tau_{-i}}{2}\end{aligned} \tag{2.14}$$

for both countries in the union and not in the union.

To prove (ii.a) and (iii.a), note that

$$\sigma_i = \alpha_{i,U} - \alpha_{i,NU} = -\frac{\theta\tilde{k}_i[(R_i(\theta-\lambda)+\lambda(1-\theta)]}{2B_i(R_i+\theta)(\theta R_i+\lambda)} < 0$$

To prove (ii.b), note that $\omega_{i,U} = \frac{R_i}{R_i+\lambda} > \frac{R_i}{R_i+1} = \omega_{i,NU}$. To prove (ii.c), note that (2.14) continues to hold for $i \notin U$ when $\theta = 1$. To prove (iii.b), note that $\omega_{i,U} = \frac{\theta R_i}{\theta R_i+\lambda} > \frac{R_i}{R_i+\theta} = \omega_{i,NU}$ iff $\theta^2 > \lambda$. QED.

So, in the benchmark case ($\lambda = \theta = 1$) where union membership has no effect on cross-border investment costs, the coefficients of the tax reactions function do not depend on union membership, and we get a tax reaction function as is standard in the literature. (The reaction function slope of $\frac{1}{2}$ is just an artefact of the simplicity of the theoretical model, and we make no attempt to impose this in the empirical estimation).

In the case where union membership has an effect on cross-border investment costs, the coefficients of the tax reaction functions will be affected by union membership but its intensity will depends on the parameters λ and θ. A direct test of this would be to try and estimate λ and θ directly. However, a complication for doing this comes from the fact (2.10) and (2.11) are non linear functions of both underlying parameters λ, θ and of observed regressors $\tau_{-i,U}, \tau_{-i,NU}, R_i$, apart from the special case where $\theta = 1$,where τ_i, $i \notin U$, is a linear function of τ_{-i} only.

So, we proceed as follows. First, we take a linear approximation of (2.10) and (2.11) of around $\tau_{-i,U}, \tau_{-i,NU}, R_i$ sample means ($\overline{\tau}_U, \overline{\tau}_{NU}, \overline{R}$) and, after explicit calculation of the first derivatives, we get the system of reaction functions in linear form;

$$\begin{aligned} \tau_i &= \alpha_{i,U} + \frac{a_U}{2}\tau_{-i,U} + \frac{(1-a_U)}{2}\tau_{i,NU} + \frac{b_U\Delta\overline{\tau}}{2}R_i,\ i \in U, \\ a_U &= \frac{\theta\overline{R}}{\left(\theta\overline{R}+\lambda\right)}, b_U = \frac{\theta\lambda}{\left(\theta\overline{R}+\lambda\right)^2},\quad \Delta\overline{\tau} = (\overline{\tau}_U - \overline{\tau}_{NU}) \end{aligned} \tag{2.15}$$

$$\begin{aligned} \tau_i &= \alpha_{i,NU} + \frac{a_{NU}}{2}\tau_{-i,U} + (\frac{(1-a_{NU})}{2})\tau_{i,NU} + \frac{b_{NU}\Delta\overline{\tau}}{2}R_i,\ i \notin U, \\ a_{NU} &= \frac{\overline{R}}{\left(\overline{R}+\theta\right)},\ b_{NU} = \frac{\theta}{\left(\overline{R}+\theta\right)^2} \end{aligned} \tag{2.16}$$

Also, from now on we will distinguish between *large unions*, ($\overline{R} \geq 1$), and *small unions* ($\overline{R} < 1$). Given that our empirical analysis refers to large unions (i.e. $\overline{R} = 2.6$) we will restrict our next Proposition to this case, but it is easy to derive results for small unions. We will only consider the case where $\lambda < \theta \leq 1$, since in the the benchmark case $\lambda = \theta = 1$, the reaction function is linear in τ_{-i} and independent of R_i. We can now state:

Proposition 2 *Assume a large union ($\overline{R} > 1$). Then:*

(i) if $\lambda < 1$, $\theta = 1$, then $a_U > \frac{1}{2}$ i.e. union countries react more to $\tau_{-i,U}$ than to $\tau_{-i,NU}$, and $b_U > 0$ i.e. a positive union size effect.

(ii) if $\lambda < \theta < 1$, then $a_U, a_{NU} > \frac{1}{2}$, i.e., all countries react more to $\tau_{-i,U}$ than to $\tau_{-i,NU}$ and $b_{NU}, b_U > 0$, i.e. the union size effect is positive for all countries.

(iii) if $\theta^2 > (<) \lambda$, then $a_U > (<) a_{NU}$, i.e. countries in the union react more (less) to $\tau_{-i,U}$ but less (more) to $\tau_{-i,NU}$ than countries outside the union, and also $b_{NU} > (<) b_U$, i.e. the union size effect is larger (smaller) for countries outside the union.

Proof. (i) If $\overline{R} > 1$, the coefficients in (2.10) are $a_U = \frac{\overline{R}}{2(\overline{R}+\lambda)} > (1 - a_U) = \frac{\lambda}{2(\overline{R}+\lambda)}$. (ii) From the inspection of (2.10) and (2.11) $a_U = \frac{\theta\overline{R}}{2(\theta\overline{R}+\lambda)} > (1 - a_U) = \frac{\lambda}{2(\theta\overline{R}+\lambda)}$ and $a_{NU} = \frac{\overline{R}}{2(\overline{R}+\theta)} > (1 - a_{NU}) = \frac{\theta}{2(\overline{R}+\theta)}$ also b_{NU}, b_U are unambiguously positive. (iii) $a_U > a_{NU}$ iff $\frac{\theta\overline{R}}{(\theta\overline{R}+\lambda)} > \frac{\overline{R}}{(\overline{R}+\theta)}$, and $b_U = \frac{\theta\lambda}{(\theta\overline{R}+\lambda)^2} < b_U = \frac{\theta}{(\overline{R}+\theta)^2}$ which is the case iff $\theta^2 > \lambda$. QED

In the most plausible case, i.e., that union membership lowers costs, but that this effect is bigger if both countries are members, we have a clear-cut theoretical predictions, viz., all countries react more to members than to non-members.

Proposition 2 indicates that R must be included as a regressor when λ and θ are different from one. This is because R controls for the relative size of the union on the slope of the reaction function, and thus addresses the issue that the weight assigned to each country is dependent on the number of countries in and out the union. Finally, the interpretation of the positive union size effect is as follows: if $\Delta\overline{\tau}$ is positive, which is the case in our sample, since $\overline{\tau}_U = 0.40$, $\overline{\tau}_{NU} = 0.30$, then, as $b_U, b_{NU} > 0$, we should expect an additional increase in the country i taxes, proportional to the size of the union measured by R_i.

3. Empirical Specification

The reaction functions (2.15) and (2.16) can be equivalently written:

$$\tau_i = \alpha_{iU} + \beta_U \tau_{-i,U} + \gamma_U \tau_{-i,NU} + \mu_U R_i, \ i \in U \tag{3.1}$$

$$\tau_i = \alpha_{iNU} + \beta_{NU} \tau_{-i,U} + \gamma_{NU} \tau_{-i,NU} + \mu_{NU} R_i, \ i \in N/U \tag{3.2}$$

This will be the basis of our regression analysis. Note that (2.15) and (2.16) additionally imply $\beta_U + \gamma_U = \beta_{NU} + \gamma_{NU} = \frac{1}{2}$. We do not impose the equal to half but we test for $\beta_U + \gamma_U = \beta_{NU} + \gamma_{NU}$; which is generally accepted.

To obtain an estimable equation, we add country-specific linear time trends, $YEAR_{it}$, a vector of controls, X_{it} and an i.i.d. error term u_{it} and we write (3.1) and (3.2) more compactly as:

$$\begin{aligned} \tau_{it} = {} & \alpha_{iNU} + \sigma_i U_{it} + \beta_U \left(U_{it} \times \tau_{-it,U} \right) + \beta_{NU} ((1 - U_{it}) \times \tau_{-it,U}) + \\ & + \gamma_U \left(U_{it} \times \tau_{-it,NU} \right) + + \gamma_{NU} ((1 - U_{it}) \times \tau_{-it,NU}) + \mu_U \left(U_{it} \times R_{it} \right) + \\ & + \mu_{NU} ((1 - U_{it}) \times R_{it}) + \delta' X_{it} + YEAR_{it} + u_{it} \end{aligned} \tag{3.3}$$

where U_{it} is a dummy for EU membership i.e. $U_{it} = 1$ if i is a member at time t and $\sigma_i = \alpha_{iU} - \alpha_{iNU}$. We now face a problem; σ_i cannot be estimated independently of α_i. Initially, we deal with this by assuming that $\sigma_i = \sigma$ i.e. that the effect of joining the EU on the intercept is uniform across countries. This coefficient σ is identified because some countries (Denmark, Ireland, United Kingdom, Greece, Spain, Portugal, Austria, Finland and Sweden) joined during the sample period. Later on, we relax this. Note that to retain degrees of freedom, we impose the restriction that union and non-union countries respond in the same way to changes in country-specific controls. Relaxing this assumption would imply that the regressions for the union and non-EU countries would be completely separate.

Equation (3.3) is our *unrestricted* model. Note from Proposition 1 that there are two special cases of (3.3). The first, in part (i) in Proposition 1, is where EU membership has no effect on cross-border FDI costs, i.e., $\lambda = \theta = 1$. Then, (3.3) implies a *restricted* model:

$$\tau_{it} = \alpha_i + \zeta \tau_{-it} + \delta' X_{it} + YEAR_{it} + u_{it} \tag{3.4}$$

where $\sigma = 0$, $\beta_U = \gamma_U = \beta_{NU} = \gamma_{NU} = \zeta$, and τ_{-it} is defined in (2.13) above. This is a standard tax reaction function, as estimated in many contexts by other researchers.

The second one, from part (ii) in Proposition 1, is where EU membership lowers cross border costs only for members (*bilateral union membership effect*), i.e., $\lambda < \theta = 1$, in which case we get $\beta_U > \gamma_U$, $\mu_U > 0$, $\sigma < 0$ and $\beta_{NU} = \gamma_{NU} = \zeta_{NU}$. Under these restrictions we obtain our *intermediate* model:

$$\begin{aligned}\tau_{it} &= \alpha_i + \sigma U_{it} + \beta_U (U_{it} \times \tau_{-it,U}) + \gamma_U (U_{it} \times \tau_{-it,NU}) + \\ &\quad \mu_U (U_{it} \times R_{it}) + \zeta_{NU} \tau_{-it} + \delta' X_{it} + YEAR_{it} + u_{it}\end{aligned} \tag{3.5}$$

Our approach is to run all these regressions, (3.3), (3.5), (3.4), and examine whether the restrictions implied by (3.4) or (3.5) can be accepted.

The estimation of (3.3), (3.5) or (3.4) requires the construction of the w_{ij} and R_{it} and thus, from (2.8), an empirical proxy for d_{ij}. There are many ways in which this distance can be computed, for example geographical distance, or cultural distance, or distance in institutions. However geographical distance is the one that fits the purposes of this paper best and it is motivated by the existing literature pointing out the importance of geographical distance for the location of FDI; see for example Carr, Markusen, and Maskus (2001); Blonigen, Davies, and Head (2003); Markusen (2002), and Overesch and Rincke (2008).

The simplest way to do so is to measure the linear distance in kilometers or miles between the capital cities of i and j[7]; another way is to assign a positive weights only to those countries sharing a common border and zero to the others[8]. However these two approaches fail to account for the location of human and economic activities within and between countries which might well affect FDI. To allow for this, we construct our weighting matrix using the well known measure of *effective bilateral distance*[9] developed by Head and Mayer (2002). This measure uses city-level data to assess the geographic distribution of population inside each nation. The idea is to calculate distance between two countries based on bilateral distances between the largest cities of those two countries, those inter-city distances being weighted by the share of the city in the country's population; we use this effective bilateral distance to construct our weights d_{ij}, and thus $\tau_{-it,U}$, $\tau_{-it,NU}$, τ_{-it} and R_{it}.

It remains to discuss econometric issues. The system (3.3) is known as a spatial autoregressive model (SAR). OLS estimation of a SAR is inappropriate because the right-

[7] Devereux, Lockwood and Redoano (2007) for example follow this approach.

[8] This is quite common way to proceed when the researcher aim to estimate tax reaction functions under the assumptions of cross-border shopping, see for example Devereux, Lockwood and Redoano (2008).

[9] This measure is available on line at http://www.cepii.fr/anglaisgraph/bdd/distances.htm, for more information see Mayer and Zignago (2006).

hand side variables τ_{-it} are endogenous. So, we estimate (3.3) by instrumental variables. In particular, we follow a now standard procedure where at the first stage, the endogenous variables defined in (2.8), i.e., τ_{-it}, $\tau_{-it,U}$, and $\tau_{-it,NU}$, are instrumented by the corresponding weighted averages of the control variables, using the same set of weights. That is, for example, $\tau_{-it,U} = \sum_{j\neq i,j\in U} w_{ij}\tau_{jt}$ is instrumented by $\sum_{j\neq i,j\in U} w_{ij}x_{jt}^k$, $k = 1,..K$, where x_{jt}^k is the value of the control variable k in country j at time t.

Second, if neighbors are subject to correlated random shocks, this determines a correlation between states' fiscal choices, which could be erroneously interpreted as causal influence. So if we omit in the regressions variables that are spatially dependent, these variables enter into the error term, and this complicates the estimation of (3.3). However Kelejian and Prucha (1998) have demonstrated that even in the presence of spatial error dependence, the IV method yields a consistent estimation of ζ, β and γ[10].

Another issue is that in practice, our tax rates are serially correlated, perhaps because abrupt changes in the tax system are likely to be costly to governments, either because such changes impose costs of adjustment on the private sector, or because such changes may be blocked at the political level by interest groups who stand to lose from the change. We present t-statistics based on standard errors clustered by country which are robust to serial correlation.

Finally, while we would like to include time dummies, to capture shocks in each period which are common to all countries, this is not generally feasible (see Devereux, Lockwood and Redoano (2008) for an explanation). However, we do allow for unobserved factors varying over time as far as possible by also including country-specific linear time trends in all our regressions.

[10] If we do not take into account spatial error dependence in equation (3.3), this would not bias the estimation of β but it would reduce the efficiency of the estimation and produced biased standard errors. There are two more ways in addition to IV method to deal with this. One approach is to use maximum likelihood to estimate (3.3) taking into account of the error structure, this methodology has been explored by Case et al. (1993). The other way is to estimate (3.3) by ML under the hypothesis of error independence and rely on hypothesis tests to verify the absence of spatial correlation. Examples of this approach can be found in Brueckner (1998), Saavedra (2001) and Brueckner and Saavedra (2001). Anselin et al (1996) suggest a robust test that can be employed to detect the presence of spatial error dependance, which is based on the analysis of the residual generated by regressing the dependent variables on the exogenous variables using OLS.

4. The Data

We use annual data on the Western European states over the period 1970 -1999[11]. Our sample includes countries: (i) that were members of the European Union at the beginning of the period, (ii) that became subsequently members, and (iii) that never joined. Details on countries included and accession year to the EU are given in Table 1(a).

Turning to the tax variable, the tax in the theoretical model is a capital income tax. Because the theoretical model does not distinguish between personal and corporate taxation, we use both the statutory corporate tax rate[12] and the top marginal rate of personal income tax as empirical proxies for this variable. The main sources are the *Price Waterhouse -Corporate Taxes and Individual Taxes (A Worldwide Summary)*, and the on-line database at the Office of Tax Policy Research at Michigan State University.

Table 1(b) gives some basic summary statistics of both taxes and covariates. In Figure 1-2, we report for each of the two type of taxes the time series by country, and also the corresponding weighted averages of the other countries in the sample, (i) across the all sample,(ii) across EU members, and (iii) across non-EU states.

Following our theoretical prediction we include R_{it} as regressor, which is a measure of the relative size of the EU compared to the rest of Europe using our effective distance measure.

Moreover we use a set of time varying variables X_{it} which are conventionally assumed to affect the determination of the above fiscal choices. These variables include:

1. *Socio-demographic characteristics*: total population (*POPUL*), proportion of population less than 14 years old and over 65 (*POPDEP*).

2. *Economic variables*: GDP per capita expressed in dollars at 1995 prices (*GDPPC*),

[11] Our sample stops in 1999 because we want to abstract from additional complications to our analysis deriving from the accession to the EU of Eastern European countries, which had very different charactristics from the existing EU members at that time.

[12] Following Devereux, Griffith and Klemm (2002) the correct tax measure for analysing discrete capital choices is the effective average tax rates or, alternatively, the statutory tax rate. In this paper we use the latter measure since average tax rates are available only for a shorter period. Precisely our data refer to the top marginal tax rate on corporations. Unless otherwise mentioned, this is the tax rate applicable at the national level on domestic companies.An alternative approach to measure capital taxes is proposed by Mendoza et al. (1994), and is based on the ratio of tax payments to a measure of the operating surplus of the economy. This approach is not ideal for analyzing the competition between jurisdictions over taxes on corporate income because, it does not necessarily reflect the impact of taxes on the incentive to invest in a particular location, for reasons discussed in Devereux, Lockwood and Redoano (2008).

the ratio of public expenditures as a proportion of GDP (*PUBEXP*).

3. *Political variables*: *U* is equal to 1 if the country is a member of the *EU* and 0 otherwise; *ELECTION* is equal to 1 if there is an election in that year (either executive or legislative). Political variables in this dataset come from two sources: *Comparative Political Dataset* [13] and *Database of Political Institutions.*[14] The descriptive statistics for the controls are also given in Table 1.

5. Regression Results

5.1. The Main Results

Our main regression results are described in Tables 2 and 3. All tables have the same format. The top panel gives regression coefficients. The results for the restricted model are in the first two columns; columns three, four and five are for the intermediate model; while next three columns report the results for the unrestricted model. In the last column we propose the results of a robustness check that we will be discussed later in this section. In columns one, three and six the respective models are run without controls; while in the remaining columns the control variables are added. Under the restricted model the underlining assumption is that union membership does not have any effect on the slopes of the reaction functions either for members or for non-members (i.e., $\beta_U = \beta_{NU} = \gamma_U = \gamma_{NU} = \zeta$),which is what it is stated in part (i) of Proposition 1. In the intermediate model (3.5) the assumption is that union membership affects only the behavior of its members (i.e., $\beta_U > \gamma_U$ and $\beta_{NU} = \gamma_{NU}$); i.e. part (ii) of Proposition 1. Finally in the unrestricted model (3.3) we estimate four coefficients, allowing two types of asymmetric response both 'by' and 'towards' EU and non EU countries, which cover the full set of possibilities as illustrated in parts (ii) and (iii) of Proposition 2. Also, this will enable us to compare the intensity of bilateral and unilateral union membership effects. Given our theoretical predictions, we should expect that at least $\beta_U > \gamma_U$, but possibly also that $\beta_{NU} > \gamma_{NU}$: union membership has an effect also on non members, but possibly the effect on members is stronger than on non-members, $\beta_U > \beta_{NU}$.

The middle panel gives the number of observations, an F-test for joint significance of the controls and the following diagnostic tests are reported: $F_{IV_1}, F_{IV_2}, F_{IV_3}$ F_{IV_3}, F_{IV_4} are

[13] Available at http://www.ipw.unibe.ch/mitarbeiter/ru_armingeon/CPD_Set_en.asp

[14] Available at http://www.worldbank.org/research/bios/pkeefer.htm

F-tests of the significance of the instruments in the first-stage regressions, with p-values in brackets[15]. Note that there may be more than one endogenous weighted tax variable in our specification (actually up to four), so there can be up to four F-tests. Note also that the weighted controls are jointly significant in all first-stage regressions.

In the last part of the panel we first report some tests on the equality of the coefficients of the tax interaction terms. Second, we test the linear restriction that $\beta_U + \gamma_U = \beta_{NU} + \gamma_{NU}$. Third, the Anderson canonical correlations likelihood-ratio test, reported in the tables, tests whether the equation is identified. The statistic provides a measure of instrument relevance, and rejection of the null indicates that the model is identified. Last, the Hansen-Sargan test is a test of overidentifying restrictions. The null hypothesis is that the instruments are valid instruments, i.e., uncorrelated with the error term. Under the null, the test statistic is distributed as chi-squared in the number of overidentifying restrictions. A rejection casts doubt on the validity of the instruments.

We now discuss the results for the corporate statutory tax rate reported in Table 2. The interpretation of these figures, and all the ones that follow, is that a coefficient of (say) ζ means that a one percentage point in a tax rate of the right-hand side of the regression leads to an increase of ζ percentage points in the dependent tax variable.

Looking now at columns one and two, we estimate our restricted model (3.4), which is a standard tax reaction function, as estimated in many contexts by other researchers. Column 1 includes only $\tau_{-i,t}$ and no country controls Xs_{it} as regressors. In column 2, we add country controls. The coefficients on τ_{-i} have always the expected positive sign, with a value between 0.84 and 0.89, and are significant, at least at 5%, in both specifications.

In column three, four and five we estimate (3.5). Recall in that case, we allow countries in the EU to respond differently to EU ($\tau_{-i,U}$) and non-EU countries ($\tau_{-i,NU}$), but we restrict the response of non-EU countries to be the same towards EU countries and non-EU countries, which is the case if $\lambda < \theta = 1$. Moreover we include an EU dummy membership, U_{it} and, in column five, we also include the variable $U\text{x}R_{it}$, which is directly derived from the theory. We see that these responses, measured by β_U and γ_U and ζ_{NU}, as expected are positive, but they are statistically significant only for β_U, (i.e., the response of EU countries towards other EU countries) and ζ_{NU} (the response of non-EU countries toward other European countries) but the response of EU countries towards non-EU ones (γ_U) is not significant and much lower. This is the case both without and with controls.

[15]Under the null hypothesis that the instruments are not correlated with the endogenous variable, F_{IV} follow an F distribution.

So the first departure from standard results is that EU countries respond significantly more to EU countries than to non-EU countries, the response relative to the weighted average of EU countries is 0.71, 0.88 and 0.97 in the three columns, and to the weighted average of non-EU countries is only 0.17, 0.13 and 0.11, respectively. Moreover γ_U is significantly smaller than β_U, as emerged from our tests reported in the last part of the panel. Turning to non-EU countries, their response to other countries is 0.57, 0.54 and 0.64 (without and with controls respectively). Moreover the effect of EU membership on the level of taxes measured by the coefficient of EU is always negative and equal to -0.21 in column five, but it is not significant. Finally μ_U, the coefficient of UxR, is positive, significant and equal to 0.005, which means that an increase of union size of 1 point will determine a variation in taxes of 0.005 points.

So the predictions of part (ii) in Proposition 1 seem to hold, and this is the first step in support of, at least, the unilateral union membership effect versus no effect.

In columns six, seven and eight we estimate the complete unrestricted model, this will allow us to explore the hypothesis of a bilateral union membership effect. Recall that, from Proposition 2, if this is the correct hypothesis we should expect that EU members react more to other members and less to non-members than non-members do. Moreover, if the effect of unilateral union membership is stronger than that of bilateral union membership, we should expect that all countries react more to members than to non members.

Again we propose three variations of the same model: in column six the model is run without controls, in column seven with controls; in column eight with controls and with UxR and $(1-U)$xR. There, we see that our parameter estimates are in the case with all controls: $\beta_U = 0.86$, $\gamma_U = 0.021$, $\beta_{NU} = 0.62$, $\gamma_{NU} = 0.25$, however the γs are not significant. This is quite consistent with our theoretical model. Specifically, an EU country reacts to a one percentage point decrease in the statutory rate of corporate tax of EU members by cutting its own tax by $\beta_U = 0.86$ percentage points, and to a one percentage point decrease in the statutory rate of corporate tax by other non-members by cutting its tax by only $\gamma_U = 0.021$ percentage points, although this second effect is insignificant. Similarly, a non-EU country reacts to a one percentage point decrease in the statutory rate of corporate tax of other EU members by cutting its own tax by $\beta_{NU} = 0.62$ percentage points, and to a one percentage point decrease in the statutory rate of corporate tax of non-members by cutting its tax by $\gamma_{NU} = 0.25$ percentage points, although this latter effect is insignificant. The effect of EU membership on the new members' statutory taxes is a negative one, as predicted by the theory, but it is never statistically significant. Finally in column eight we find that UxR and $(1-U)$xR both enter with their expected positive sign, but the coefficient is only significant for the latter. The interpretation of the coefficients is as follows: the larger is the set of countries in the EU relative to countries outside the EU, the more EU taxes will effect tax setting towards their own level.

We can now compare the fit of the restricted, intermediate, and unrestricted models. An F-test reported in the bottom panel of columns three, four and five of Table 2, where the null hypothesis is that $\beta_U = \gamma_U$, comparing the intermediate and restricted models, can clearly be rejected in favour of the intermediate. Proceeding further, the last panel in the last two columns provides a test for equality of coefficients; in particular the null hypotheses that $\beta_U = \beta_{NU}, \gamma_U$ and that $\beta_{NU} = \gamma_{NU}$ can be rejected but not that $\gamma_U = \gamma_{NU}$. In conclusion our evidence seem to support the claim that the EU has caused an increase in the tax interdependence not only for its members, but also towards the other European countries; however the latter effect is less strong, consistently with the hypothesis of "strong" bilateral union membership. Moreover the linear restrictions that $\beta_U + \gamma_U = \beta_{NU} + \gamma_{NU}$ implied by Proposition 2 can be accepted in all three specifications.

Finally for all specifications the control variables are jointly significant as the F- test in the second panel of the table shows. The coefficient of the population dependency ratio variable is always positive and significant in all our specifications and equal to 0.01, consistent with the hypothesis that it is a proxy for demand for public goods that must be funded via taxation. The coefficient on size of a country measured by its population is always negative, significant and, in column eight, equal to -0.035. At first glance the fact that larger countries have, *ceteris paribus*, smaller taxes is somehow counter-intuitive, but it becomes more understandable since we control for per capita income. Moreover richer countries, measured by the variable GDP per capita ($GDPpc$), not surprisingly, have higher taxes, the coefficient being significantly different from zero and equal to 0.053 in column eight. This is because, for a given size of the economy, poorer countries have to cut their corporate taxes more because they rely more on international investments. The coefficient of proportion of public expenditures as a proportion of GDP ($PEXP$) is always significant at 1% and positive, in column eight of the table it is equal to 0.32, showing an expected direct relationship between taxation and fiscal needs.

Table 3 shows the results when our dependent variable is the income tax rate. The structure of the table is the same as Table 2. Let us start with the restricted model displayed in the first two columns of the table. The coefficient ζ on τ_{-i} has the expected positive sign (in the first two columns it goes from 0.90 to 0.82) and it is significant at 1%.

When we move to the intermediate model (columns three, four and five), we see a different picture from statutory taxes; non-EU countries still exhibit a positive response towards other European taxes, (ζ_{NU} is 0.52 in the fifth column), but it is not significant. For EU countries both tax interaction coefficients (β_U and γ_U) are positive but not significant in any specification. Specifically, the response of EU countries towards other members, measured by β_U, is $0.50, 0.40$ and 0.70 (with and without controls), while towards non-EU countries, it is 0.19, 0.21 and 0.18, respectively. An F-test reported in the last part of the panel testing the null that $\beta_U = \gamma_U$ is accepted. So for income taxes the baseline is that only EU countries are affected by their neighbors tax setting but there is no distinction between EU and non-EU states.

Moving to the unrestricted model of columns six, seven and eight, we can see that the picture for income taxes is less clear than statutory taxes, the coefficients of the relevant neighbors' tax variables exhibit always the expected positive sign, but the coefficients are in general not significantly different from zero. This result is perhaps not surprising, given that the type of tax that matches the theory best is probably the corporate tax.

Finally in the last column of Tables 2 and 3, we address a possible concern that, since EU membership grew over time during the period, different tax interaction coefficients can just reflect this. In order to explore this possibility, we run a "placebo" regression reported in the last column of Tables 2 and 3, where the baseline regressions (reported in column two of the same tables) are augmented with an additional term, the interaction between the weighted average of the other countries' taxes (τ_{-i}) and a time trend ($Trend$). If the coefficient of the above new variable ($Trend \times \tau_{-i}$) turns out to be positive and significant, this should be interpreted as evidence in support of this hypothesis; if not, this can reasonably be ruled out. From Table 2 we can see that for corporate taxes, the coefficient of $Trend\times \tau_{-i}$ is 0.009 and not significant, while the coefficient of τ_{-i} is 0.734 and significant at 10%. Similarly, from Table 3, we can see that for income taxes, the coefficient of $Trend\times \tau_{-i}$ is -0.010 and not significant, while the coefficient of τ_{-i} is 1.008 and significant at 10%. This is a confirmation that our main results are not an artefact of some exogenous process driving up the interaction coefficient over time.

To summarize, evidence on corporate taxes fits the predictions of the theory quite well, specifically, in all our regressions we find consistency with the theory that, when we allow asymmetric response between EU and non-EU countries, all the countries in our dataset mainly respond to EU members tax setting, and in particular they do so more if they are themselves part of the EU, which is supportive of the strong bilateral union membership hypothesis in Proposition 2 part (iii). The results for income taxes instead suggest that union membership has no effect on tax setting. So a further question left open for future research is to explore the nature of income tax interactions.

5.2. Do Countries React More When They Join the EU?

So far, we have assumed that the effect of joining the EU on both the level of taxes[16], and the degree of interaction, is uniform across all countries in the sample. We cannot completely relax this, and allow these coefficients to vary by country, due to lack of degrees of freedom. But, we can use the fact that Denmark, Ireland, United Kingdom, Greece, Spain, Portugal, Austria, Finland and Sweden joined the EU during the sample period. It this section, we relax the uniformity assumption by allowing the "joiners" to react differently to other countries, possibly those already in the EU, after they join than before - our theory suggests that actually, they should react more, given that the effect of union membership is to reduce effective distance costs and therefore to increase tax competition. We will consider two different variants of this exercise, first by considering all the countries who joined, and then by considering just Greece, Spain, Portugal, who joined in the middle of the sample period. So, each variant is defined by a list of "joiners". Define $J_i = 1$ if country i is on the list of joiners, and $J_i = 0$ otherwise. Let $O_i = 1 - J_i$, where "O" stands for others. Then the first and fourth regressions in Table 4 are of the form

$$\begin{aligned} \tau_{it} &= \alpha_i + \sigma U_{it} + \beta_{J,NU}\left(J_i \times (1 - U_{it}) \times \tau_{-i,t}\right) + \beta_{J,U}(J_i \times EU_{it} \times \tau_{-i,t}) + \\ &\quad \beta_{O,NU}\left(O_i \times (1 - U_{it}) \times \tau_{-i,t}\right) + \beta_{O,U}(O_i \times U_{it} \times \tau_{-i,t}) + \delta' X_{it} + YEAR_{it} + u_{it} \end{aligned} \tag{5.1}$$

This regression allows the "joiners" to respond differently to the taxes of all other countries, τ_{-it} after they join ($\beta_{J,U}$) and before they join ($\beta_{J,NU}$). They are also allowed to respond differently to τ_{-it} than the other countries, who may be members or not. We restrict our attention to statutory corporate tax rates.

The results are as follows. In the case where $J_i = 1$ for i being all joining countries, before joining the EU the joiners would have responded to an increase of one percentage

[16] This is the assumption that $\sigma_i = \sigma$.

point of other countries' taxes by increasing their own by 0.27 percentage points; however this coefficient is not statistically significant from zero. After joining the union, their reaction to their European partners would increase to 0.69 and also would become significant at 10%. Moreover, these two figures are statistically different from each other as the t-test in the bottom panel suggests. The other countries in the sample, by definition, are either non-members or members throughout the sample period. Call the latter group *initial members;* they comprise Belgium, the Netherlands, Luxembourg, France, Germany and Italy. Consistently with previous results and with the theory, initial members respond to a one-point tax increase of others of others by 0.63 points ($\beta_{O,U} = 0.63$), this being significant at 1%, whereas non-members do respond positively ($\beta_{O,NU} = 0.55$), but this is only just significant at 10%.

Sharper results are obtained if we restrict the set of joiners to be just Greece, Spain, Portugal. The results in column 4 indicate that before joining the EU, these three countries would have followed an increase of one percentage point of other countries taxes by increasing their own by 0.54 percentage points; however this coefficient is not statistically significant from zero. After joining the union, their reaction to their European partners would increase to 0.91 and also would become significant at 1%. Again, these two figures are statistically different from each other as the t-test in the bottom panel suggests.

Next, we re-run regression (5.1), allowing a differential response of joiners before and after joining to the weighted average of *just the current EU members* i.e. we replace τ_{-i} in (5.1) with $\tau_{-i,U}$ where the latter is defined in (2.8). We also add $\tau_{i,NU}$ to allow all countries also to respond to non-EU countries. The results are reported in columns 2 and 5 of Table 4, and qualitatively quite similar, except that the response of joiners to EU members after joining is now higher and significant at, at least, 5% level, whereas it was only significant at 10% in column 1.

Finally, we re-run regression (5.1), allowing a differential response of joiners before and after joining to the weighted average of just the *initial EU members* i.e. we replace τ_{-i} in (5.1) with $\tau_{-i,IN}$ where the latter is defined as the weighted average of the taxes of countries that were initially in the union at the beginning of the sample, using the same weighting scheme. The results are reported in columns 3 and 6 of Table 4, and are again qualitatively quite similar, except that the response of joiners to EU members after joining is now significant, at least, 5% level.

5.3. Other Robustness Checks

So far, we have weighted other countries' taxes using effective geographical distance weights, which are the weights suggested by the theory. However, we conduct several robustness checks to see if there are other alternative weighting schemes that can work better. First, the main predictions of the theory are unchanged if we hypothesize that physical distance does not matter i.e. d_{ij} does not affect the costs of cross-border investment c_{ij}. This can be captured in the model by setting $d_{ij} = d$, for all $i, j,$; this is the case of so-called *uniform weights*.

A possible source of criticism of distance weights could be that the fiscal interaction process may not depend on the EU as a whole but, instead, countries with smaller GDP simply follow larger countries. This would not be picked up by our weights since three of the largest four countries in Europe were members of the then European Community from the beginning of the sample period. In order to check if this is indeed the case, we replace the distance weights by *GDP weights*, (where each country weights are calculated as the ratio between its own GDP and the sum all countries GDP.

Finally we try a more "crude" measure of geographical distance, which does not take into account the distribution of economic activities and population between and within countries, but we measure d_{ij}, instead, by the distance in kilometers between the capital cities of i and j; this is our *simple geographical distance weights*.

Table 5 replicates the regressions in columns 2, 4 and 6 of Tables 2 and 3 using uniform weights in the first panel, GDP weights in the second and, simple distance weights in the last one. The first three columns refer to statutory tax rates and the last three to income taxes. All the regressions are run using the full set of controls as in the previous tables as well as fixed effects and individual time trends.

For statutory taxes we see that using uniform weights the coefficient estimates, and their significance levels, do not differ much across the two tables. In our preferred specification, column 3, we see that (i) an EU country reacts to a one percentage point decrease in taxes in other EU countries by cutting its own taxes by the 0.88 points, while a non-EU country reacts by cutting 0.69 points, but the latter coefficient is not significant. Moreover a one percentage point cut undertaken by non-EU countries has the effect of cutting 0.001 and 0.069 percentage points in non-EU and EU countries' tax rates respectively; but both coefficients are again not significant.

If GDP weights are better, we should expect the coefficients of the weighted average tax rate to be positive and significant, in particular the one relative to the weighted average of the EU members tax rates, since the largest European economies are also EU members. The results for this second exercise are reported in the second panel. The general picture is that this weighting scheme performs less well than effective distance or even uniform weights. Finally, if instead of *effective* distance we use *simple* distance weights, the coefficients of interest become unambiguously less significant, showing that our effective distance weights better explains corporate tax setting in western Europe. For income taxes instead, for all three sets of weights we do not find evidence of different behavior between and towards EU and non-EU countries, similarly to the results depicted in Table 3.

Finally, note that in our simple model union membership is treated as exogenous; we do believe that this the correct way to proceed given that EU formation is a very complex phenomenon which is driven by several forces, and it is a combination of both a political vision, based on European common history, as well as economic considerations. However in Table six we address a possible concern that current EU membership status is endogenously determined along with taxes : this would cause the U dummy as well as $U \times R$ and $(1 - U) \times R$ to be endogenous. In the Table, we replicate columns five and eight of Tables two and three, where the only difference is that we instrument[17] U, $U \times R$ and $(1-U) \times R$. The coefficient estimates in Table six are very similar both in magnitude and in significance compared with the corresponding coefficients in Tables two and three.

6. Conclusions

This paper has explored the impact of EU membership on fiscal interactions among countries. The starting point is the observation that the principal achievement of the European Union since its inception in 1957 has been the creation of a single market for goods, capital and labour, and this should have contributed to lower the cost of investing abroad, i.e. by facilitating capital mobility. This might in turn have caused countries to react more to each others' taxes.

We have developed a simple model of tax competition which verifies this intuition. In the model, conditional on taxes, the size (in absolute terms) of cross-border investment between two countries is inversely proportional to the (marginal) cost of cross-border investment (these marginal costs could be physical, legal, or regulatory). EU membership is modelled as a reduction in 'distance' to other EU countries. We have derived precise

[17] The instruments used are lagged trade over GDP, as well as lagged values of R.

predictions the slopes of the reaction function: that the EU countries react more to each other than they do to non-EU countries, and non-EU countries react to all countries less than EU countries react to each other, but more than EU countries react to non-EU countries. These predictions are confirmed using a panel data set of statutory corporate tax rates. Income tax setting seems to follow a different behavior, whose nature is left to future research.

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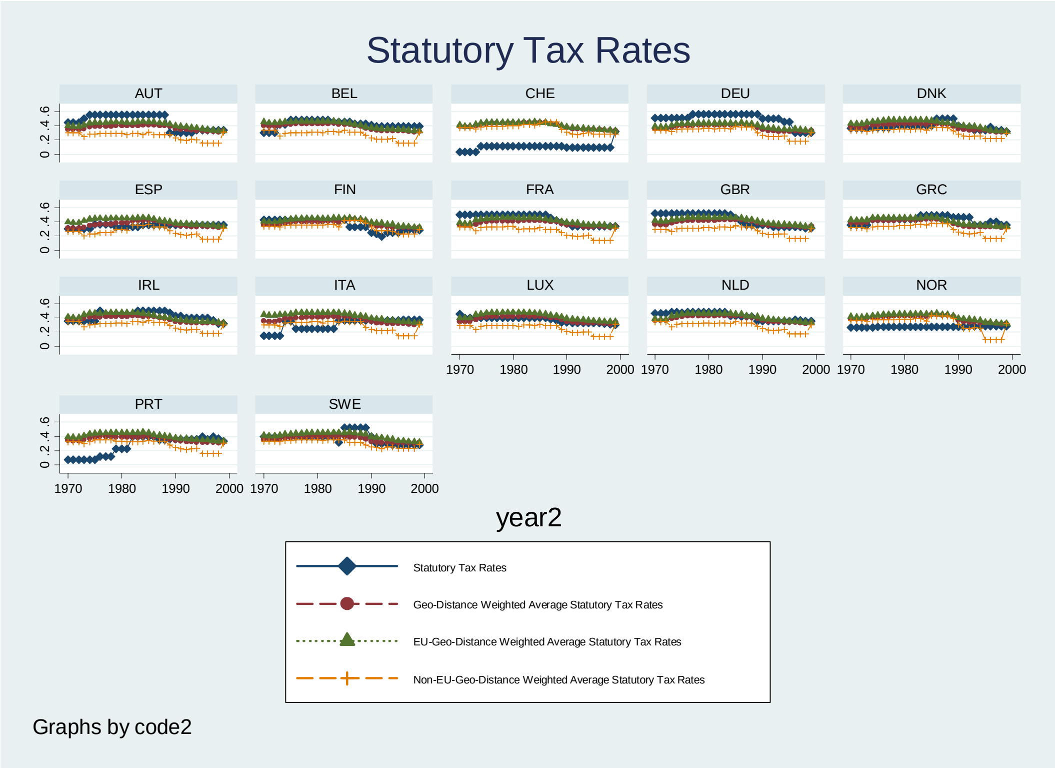
Year of Accession to the EU	Countries
Original members	Belgium, France, Germany, Italy, Luxemburg, the Netherlands.
Joined in 1973	Denmark, Ireland, United Kingdom.
Joined in 1981	Greece.
Joined in 1986	Spain, Portugal.
Joined in 1995	Austria, Finland, Sweden.
Never joined	Switzerland, Norway

Table 1(b): Summary Statistics

Variable	Source	Observations	Mean	Standard Deviation	Min	Max
Statutory tax rates	Office of Tax Policy Reseach*	510	0.37	0.11	0.10	0.56
Income tax rates	Office of Tax Policy Reseach*	510	0.56	0.16	0.12	0.91
EU	EU	510	0.63	0.48	0.00	1.00
R	Our calculations	510	2.60	2.97	0.17	14.33
Election	Comparative Political Database***	510	0.28	0.45	0.00	1.00
GDPpc	WDI**	510	2.17	0.92	0.50	5.30
PopDep	WDI**	510	20.82	3.56	14.38	31.33
Population	WDI**	510	21.75	24.12	0.34	82.09
PubExp	WDI**	510	0.36	.084	0.13	0.55

* Available at otpr.org
** World Bank, World Development Indicators
*** Available at nsd.uib.no
**** Available http://europa.eu/abc/history/index_en.ht


Statutory Tax Rates
AUT
BEL
CHE
DEU
DNK
ESP
FIN
FRA
GBR
GRC
IRL
ITA
LUX
NLD
NOR
PRT
SWE
0 .2 .4 .6
1970 1980 1990 2000
year2
Statutory Tax Rates
Geo-Distance Weighted Average Statutory Tax Rates
EU-Geo-Distance Weighted Average Statutory Tax Rates
Non-EU-Geo-Distance Weighted Average Statutory Tax Rates
Graphs by code2

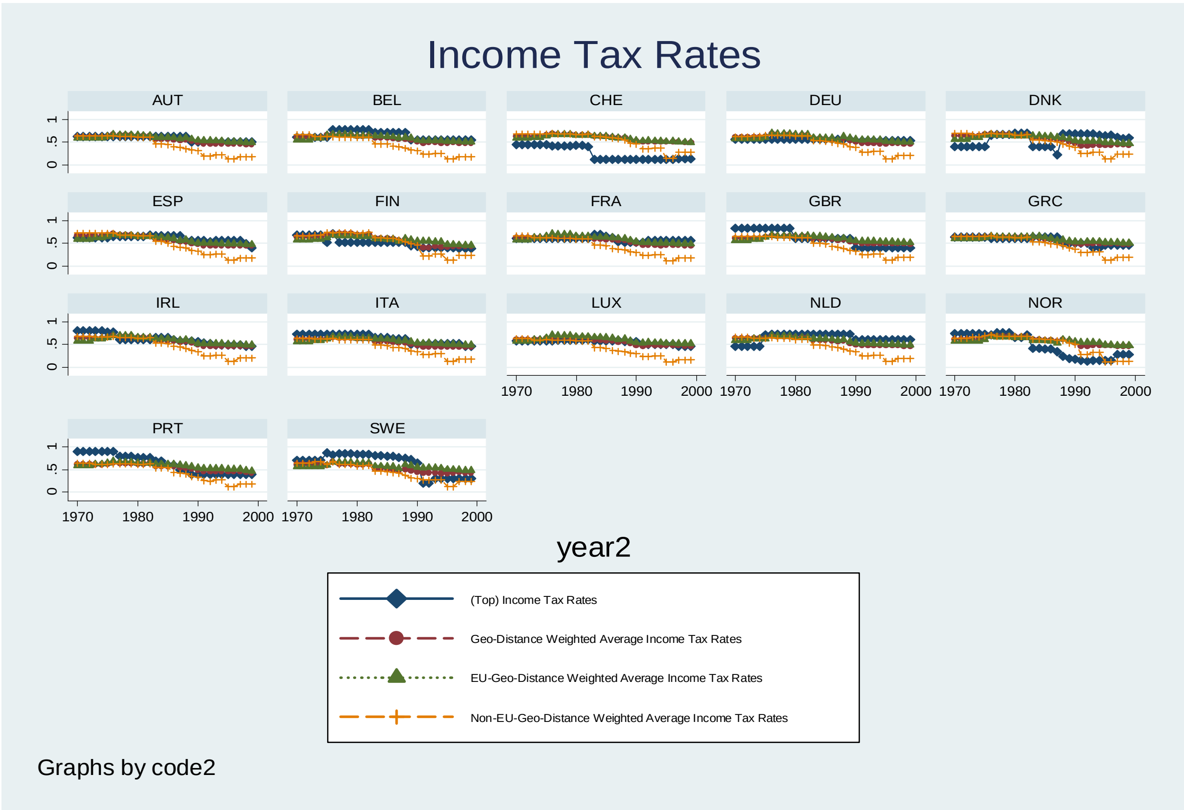

Income Tax Rates
AUT
BEL
CHE
DEU
DNK
ESP
FIN
FRA
GBR
GRC
IRL
ITA
LUX
NLD
NOR
PRT
SWE
0 .5 1
1970 1980 1990 2000
year2
(Top) Income Tax Rates
Geo-Distance Weighted Average Income Tax Rates
EU-Geo-Distance Weighted Average Income Tax Rates
Non-EU-Geo-Distance Weighted Average Income Tax Rates
Graphs by code2

Table 2: Dependent Variable: Statutory Tax Rates

	RESTRICTED MODEL		INTERMEDIATE MODEL			UNRESTRICTED MODEL			TREND
	-1	-2	-3	-4	-5	-6	-7	-8	-9
τ_{-i}	0.896	0.845							0.734
	[6.24]***	[6.27]**							[1.74]*
(1-U) X τ_{-i}			0.571	0.540	0.641				
			[2.04]**	[1.61]*	[1.99]**				
U X $\tau_{-i,U}$			0.719	0.882	0.971	0.666	0.847	0.863	
			[1.74]*	[2.11]**	[3.06]***	[2.30]**	[4.24]***	[4.83]***	
U X $\tau_{-i,NU}$			0.176	0.130	0.114	0.222	0.024	0.021	
			[0.53]	[0.31]	[0.44]	[0.96]	[0.13]	[0.13]	
(1-U)X $\tau_{-i,NU}$						0.114	0.113	0.254	
						[0.45]	[0.43]	[0.95]	
(1−U) X $\tau_{-i,U}$						0.530	0.622	0.626	
						[1.66]*	[1.78]*	[1.92]*	
U X R					0.005			0.003	
					[2.10]**			[1.52]	
(1-U) X R								0.007	
								[1.89]*	
Trend X τ_{-i}									0.009
									[0.28]
U			-0.124	-0.201	-0.211	-0.081	-0.071	-0.022	0.000
			[0.83]	[1.02]	[1.34]	[0.52]	[0.43]	[0.16]	[0.01]
Election		0.001		0.002	0.003		0.002	0.002	0.001
		[0.39]		[0.66]	[0.92]		[0.57]	[0.64]	[0.36]
GDPpc		0.046		0.054	0.055		0.055	0.053	0.045
		[1.81]*		[2.10]**	[2.12]**		[2.03]**	[2.24]**	[1.74]*
PopDep		0.011		0.013	0.012		0.012	0.009	0.012
		[2.09]**		[2.63]***	[2.15]**		[1.97]**	[1.53]	[2.18]**
Population		-0.033		-0.040	-0.041		-0.036	-0.035	-0.034
		[3.06]***		[3.31]***	[4.36]***		[3.88]***	[3.92]***	[3.80]***
PubExp		0.309		0.193	0.245		0.287	0.324	0.298
		[4.40]***		[1.74]*	[2.59]***		[3.02]***	[3.53]***	[3.85]***
N	493	493	493	493	493	493	493	493	493
F-test		31.5		17.84	27.02		29.1	29.44	37.25
p-value		[0.00]		[0.00]	[0.00]		[0.00]	[0.00]	[0.00]
F_{IV1}	2098.01	1173.72	71.42	83.97	194.9	1543.52	442.27	504.13	2891.67
p-value	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
F_{IV2}			121.92	80.01	1137.3	544.8	294.84	1951.05	3183.93
p-value			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
F_{IV3}			362.7	312.13	26.9	151.18	395.96	80.52	
p-value			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	
F_{IV4}						34.55	39.89	164.86	
p-value						[0.00]	[0.00]	[0.00]	
Ho: $\beta_U=\gamma_U$			24.45	20.5	28.1	22.23	23.83	29.42	
p-value			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	
Ho: $\beta_U=\beta_{NU}$						7.48	22.37	28.8	
p-value						[0.02]	[0.00]	[0.00]	
Ho: $\beta_{NU}=\gamma_{NU}$						5.4	6	7.84	
p-value						[0.06]	[0.04]	[0.01]	
Ho: $\gamma_U=\gamma_{NU}$						1.89	0.19	2.64	
p-value						[0.60]	[0.91]	[0.26]	
Ho: $\gamma U+\beta_U=\gamma NU+\beta_{NU}$						0.41	0.11	0.01	
p-value						[0.51]	[0.73]	[0.98]	
Anderson	16.99	16.09	8.23	8.62	13.22	15.74	16.41	11.5	14.81
p-value	[0.01]	[0.01]	[0.04]	[0.07]	[0.04]	[0.02]	[0.01]	[0.04]	[0.00]
Hansen	2.05	0.77	0.48	1.58	2.76	6.1	8.06	2.97	1.57
p-value	[0.84]	[0.94]	[0.79]	[0.66]	[0.74]	[0.3]	[0.15]	[0.56]	[0.46]

Significance levels : * 10%, ** 5%, ∗ *** 1%.

T-statistics based on standard errors clustered by country which are robust to heteroskedasticity and serial correlation.

Country dummies and country time trend included in all regressions

Table 3: Dependent Variable: Income Tax Rates

	RESTRICTED MODEL		INTERMEDIATE MODEL			UNRESTRICTED MODEL			TREND
	-1	-2	-3	-4	-5	-6	-7	-8	-9
τ_{-i}	0.908	0.828							1.008
	[3.24]***	[3.34]***							[1.97]**
(1-U) X τ_{-i}			0.754	0.831	0.524				
			[1.42]	[1.84]*	[1.09]				
U X $\tau_{-i,U}$			0.504	0.404	0.700	0.476	0.519	0.324	
			[0.99]	[0.95]	[1.27]	[1.16]	[0.96]	[0.71]	
U X $\tau_{-i,NU}$			0.193	0.218	0.184	0.107	0.064	0.227	
			[0.79]	[1.13]	[0.72]	[0.64]	[0.51]	[2.15]**	
(1-U)X $\tau_{-i,NU}$						-0.018	0.051	0.344	
						[0.09]	[0.17]	[1.04]	
(1−U) X $\tau_{-i,U}$						0.613	0.462	0.362	
						[1.50]	[0.56]	[0.45]	
U X R					0.008			0.008	
					[2.34]**			[2.13]**	
(1-U) X R								0.025	
								[3.88]***	
Trend X τ_{-i}									-0.010
									[0.46]
U			0.017	0.099	-0.251		-0.067	0.089	-0.033
			[0.05]	[0.36]	[0.78]		[0.12]	[0.17]	[1.23]
Election		-0.004		-0.004	-0.004		-0.003	-0.003	-0.003
		[1.10]		[1.01]	[0.88]		[0.80]	[0.75]	[0.89]
GDPpc		0.062		0.063	0.055		0.049	0.059	0.063
		[0.74]		[0.72]	[0.63]		[0.61]	[0.80]	[0.77]
PopDep		0.002		0.007	0.002		0.008	-0.002	-0.002
		[0.19]		[0.57]	[0.16]		[0.68]	[0.20]	[0.15]
Population		0.030		0.002	0.002		-0.002	0.002	0.001
		[0.25]		[0.17]	[0.12]		[0.15]	[0.16]	[0.07]
PubExp		0.386		0.333	0.317		0.304	0.443	0.451
		[1.43]		[1.13]	[0.99]		[0.97]	[1.43]	[1.76]*
N	493	493	493	493	493	493	493	493	493
F-test		10.14		10.14	15.68		29.1	10.6	10.31
p-value		[0.00]		[0.11]	[0.05]		[0.00]	[0.10]	[0.10]
F_{IV1}	2005.37	2062.37	71.42	83.97	15.79	1543.52	442.27	269.96	1469.05
p-value	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
F_{IV2}			121.92	80.01	50.09	544.8	294.84	806.78	3255.43
p-value			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
F_{IV3}			362.7	312.13	116.45	151.18	395.96	278.05	
p-value			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	
F_{IV4}						34.55	39.89	82.97	
p-value						[0.00]	[0.00]	[0.00]	
Ho: $\beta_U=\gamma_U$			0.22	0.44	0.57	0.45	0.51	0.32	
p-value			[0.64]	[0.52]	[0.45]	[0.40]	[0.47]	[0.86]	
Ho: $\beta_U=\beta_{NU}$						1.51	0.03	0.01	
p-value						[0.21]	[0.96]	[0.92]	
Ho: $\beta_{NU}=\gamma_{NU}$						1.31	0.14	0.09	
p-value						[0.25]	[0.70]	[0.98]	
Ho: $\gamma_U=\gamma_{NU}$						0.78	0.43	0.11	
p-value						[0.37]	[0.81]	[0.73]	
Ho: $\gamma U+\beta_U=\gamma NU+\beta_{NU}$						0.04	0.01	0.03	
p-value						[0.84]	[0.93]	[0.86]	
Anderson	16.85	16.85	14.49	13.74	15.8	15.74	16.41	14.36	14.78
p-value	[0.02]	[0.02]	[0.02]	[0.06]	[0.03]	[0.02]	[0.01]	[0.01]	[0.00]
Hansen	5.67	5.76	6.71	10.23	6.04	6.1	8.06	2.8	3.14
p-value	[0.46]	[0.45]	[0.24]	[0.12]	[0.42]	[0.3]	[0.15]	[0.59]	[0.21]

Significance levels : * 10%, ** 5%, * *** 1% .
T-statistics based on standard errors clustered by country which are robust to heteroskedasticity and serial correlation.
Country dummies and country time trend included in all regressions

Table 4. Stautory tax rates: Countries who joined during 1970-99.

	ALL JOINERS			GREECE, SPAIN, PORTUGAL (GSP)		
	-1	-2	-3	-4	-5	-6
	All	All EU members	Initial EU Members	All	All EU members	Initial EU Members
J X(1-U)X τ_{-i}	0.278			0.544		
	[1.10]			[1.42]		
J X U X τ_{-i}	0.695			0.913		
	[1.65]*			[3.83]***		
J X (1-U) X $\tau_{-i,U}$		0.297			0.435	
		[1.18]			[1.25]	
J X U X $\tau_{-i,U}$		0.707			0.751	
		[1.98]**			[2.97]***	
J X (1-U) X $\tau_{-i,IN}$			0.423			0.448
			[1.41]			[1.31]
J X U X $\tau_{-i,IN}$			0.846			0.779
			[1.94]*			[2.53]**
O X (1-U) X τ_{-i}	0.554			0.714		
	[1.90]*			[2.57]**		
O X U X τ_{-i}	0.639			1.054		
	[3.64]***			[3.74]***		
O X (1-U) X $\tau_{-i,U}$		0.394			0.591	
		[1.34]			[1.44]	
O X U X $\tau_{-i,U}$		0.463			0.846	
		[2.47]**			[2.35]**	
O X (1- U) X $\tau_{-i,IN}$			0.349			0.542
			[1.19]			[1.68]*
O X U X $\tau_{-i,IN}$			0.444			0.838
			[2.21]**			[2.18]**
$\tau_{-i,NU}$		0.239			0.207	
		[1.62]			[0.96]	
$\tau_{-i,NIN}$			0.25			0.345
			[1.58]			[2.41]**
U	-0.16	-0.179	-0.189	-0.13	-0.121	-0.131
	[1.19]	[1.21]	[1.20]	[0.74]	[0.65]	[0.60]
R		0.034	0.031		0.033	0.022
		[2.20]**	[1.97]**		[2.11]**	[1.57]
Election	0.001	0.001	0.001	0.001	0.002	0.002
	[0.00]	[0.13]	[0.01]	[0.42]	[0.63]	[0.57]
GDPpc	0.054	0.058	0.054	0.052	0.052	0.051
	[1.69]*	[1.73]*	[1.59]	[1.85]*	[1.90]*	[1.82]*
PopDep	0.007	0.005	0.003	0.013	0.012	0.011
	[1.07]	[0.80]	[0.45]	[2.26]**	[1.86]*	[1.78]*
Population	-0.028	-0.031	-0.033	-0.03	-0.034	-0.037
	[2.09]**	[2.81]***	[2.81]***	[2.46]**	[3.58]***	[3.66]***
PubExp	0.304	0.286	0.311	0.26	0.257	0.274
	[3.54]***	[3.22]***	[3.86]***	[2.93]***	[2.63]***	[3.01]***
N	493	493	493	493	493	493
F-test	21.83	17.69	32.92	29.8	27.13	26.91
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Ho: $\beta_{before}=\beta_{after}$	2.72	2.56	2.33	17.04	10.47	9.81
p-value	[0.09]	[0.10]	[0.12]	[0.00]	[0.02]	[0.03]
Anderson	10.95	13.5	13.44	15.49	14.57	16.27
p-value	[0.09]	[0.01]	[0.02]	[0.03]	[0.02]	[0.02]
Hansen	2.47	1.93	3.66	3.43	4.4	5.91
p-value	[0.78]	[0.57]	[0.45]	[0.75]	[0.49]	[0.43]

Significance levels : * 10%, ** 5%, * *** 1% .
T-statistics based on standard errors clustered by country which are robust to heteroskedasticity and serial correlation.
Country dummies and country time trend included in all regressions

Table 5: Robustness checks: Altenative weighting Schemes

	STATUTORY TAX RATES			INCOME TAX RATES		
	RESTRICTED	INTERMEDIATE	UNRESTRICTED	RESTRICTED	INTERMEDIATE	UNRESTRICTED
UNIFORM WEIGHTS	-1	-2	-3	-4	-5	-6
τ_{-i}	0.841			0.709		
	[5.97]***			[3.20]***		
(1-U)X τ_{-i}		0.878			1.043	
		[1.95]*			[2.38]**	
U X $\tau_{-i,U}$		0.537	0.889		0.419	0.496
		[0.90]	[2.85]***		[0.60]	[0.76]
U X $\tau_{-i,NU}$		0.197	0.070		0.123	0.116
		[0.51]	[0.38]		[0.40]	[0.33]
(1-U)X $\tau_{-i,U}$			0.694			-0.770
			[1.03]			[0.53]
(1-U)X $\tau_{-i,NU}$			0.002			0.443
			[0.01]			[0.67]
Anderson	16.34	10.25	9.75	16.59	13.23	10.55
	[0.01]	[0.04]	[0.08]	[0.01]	[0.04]	[0.01]
Hansen	0.54	1.9	2.44	2.09	4.71	1.95
	[0.97]	[0.59]	[0.66]	[0.84]	[0.45]	[0.16]
GDP WEIGHTS						
τ_{-i}	0.933			0.922		
	[4.88]***			[3.15]***		
(1-U)X τ_{-i}		1.867			-0.087	
		[1.14]			[0.09]	
U X $\tau_{-i,U}$		2.205	1.690		5.621	5.404
		[0.31]	[0.21]		[1.15]	[0.22]
U X $\tau_{-i,NU}$		-1.172	-0.591		-4.492	-4.397
		[0.17]	[0.07]		[1.01]	[0.17]
(1-U)X $\tau_{-i,U}$			-0.445			-0.134
			[0.13]			[0.01]
(1-U)X $\tau_{-i,NU}$			0.608			1.173
			[0.23]			[0.10]
Anderson	82.11	71.34	8.07	16.85	3.79	0.28
	[0.00]	[0.00]	[0.00]	[0.01]	[0.58]	[0.87]
Hansen	11.69	0.84	3.27	4.41	7.52	1.71
	[0.02]	[0.66]	[0.19]	[0.49]	[0.11]	[0.19]
SIMPLE DISTANCE WEIGHTS						
τ_{-i}	0.796			0.568		
	[5.78]***			[2.97]***		
(1-U)X τ_{-i}		0.825			0.968	
		[2.43]**			[2.57]**	
U X $\tau_{-i,U}$		0.652	0.694		0.056	0.858
		[1.78]*	[3.15]***		[0.13]	[1.65]*
U X $\tau_{-i,NU}$		0.180	0.257		0.240	-0.365
		[0.59]	[1.10]		[1.06]	[1.70]*
(1-U)X $\tau_{-i,U}$			1.015			0.969
			[1.43]			[1.40]
(1-U)X $\tau_{-i,NU}$			-0.332			-0.332
			[1.38]			[1.31]
Anderson	15.92	9.81	11.09	16.03	29.82	10.7
	[0.01]	[0.02]	[0.05]	[0.01]	[0.00]	[0.01]
Hansen	0.5	0.04	2.93	4.26	4.77	0.03
	[0.97]	[0.98]	[0.48]	[0.51]	[0.44]	[0.98]
N	493	493	493	493	493	493
Controls	yes	yes	yes	yes	yes	yes
Individual country time t	yes	yes	yes	yes	yes	yes

Significance levels : * 10%, ** 5%, * *** 1% .

T-statistics based on standard errors clustered by country which are robust to heteroskedasticity and serial correlation.

Country dummies and country time trend included in all regressions

Table 6: Robustness checks: Possible Membership Endogeneity.

	Statutory Tax Rates		(Top) Income tax Rates	
	-1	-2	-3	-4
(1-U) X τ_{-i}	0.621		0.546	
	[2.34]**		[1.10]	
U X $\tau_{-i,U}$	0.817	0.835	0.601	0.510
	[1.63]*	[3.63]***	[1.60]*	[1.23]
U X $\tau_{-i,NU}$	0.196	0.015	0.206	0.098
	[0.53]	[0.11]	[1.76]*	[0.96]
(1-U)X $\tau_{-i,NU}$		0.246		0.207
		[0.97]		[0.66]
(1–U) X $\tau_{-i,U}$		0.616		0.557
		[1.53]		[0.66]
U X R	0.004	0.004	0.009	0.012
	[0.83]	[0.94]	[1.82]*	[2.30]**
(1-U) X R		0.007		0.032
		[1.58]		[3.60]***
U	-0.176	-0.014	-0.227	0.093
	[1.34]	[0.09]	[0.72]	[0.18]
Election	0.002	0.002	-0.002	-0.003
	[0.54]	[0.68]	[0.54]	[0.61]
GDPpc	0.050	0.053	0.052	0.054
	[1.89]*	[2.03]**	[0.61]	[0.79]
PopDep	0.010	0.008	0.004	-0.007
	[1.69]*	[1.23]	[0.29]	[0.74]
Population	-0.033	-0.035	-0.002	0.003
	[3.04]***	[3.67]***	[0.15]	[0.17]
PubExp	0.277	0.340	0.385	0.493
	[2.83]***	[3.66]***	[1.24]	[1.54]
Anderson	13.18	14.98	10.57	14.18
	0	0.01	0.06	0.01
Hansen	0.71	2.74	6.78	3.97
	0.7	0.6	0.15	0.26
N	493	493	493	493
Controls	yes	yes	yes	yes
Individual country time trend	yes	yes	yes	yes

Significance levels : * 10%, ** 5%, ∗ *** 1% .

T-statistics based on standard errors clustered by country which are robust to heteroskedasticity and serial correlation.