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**Are Corporate Tax Burdens Racing
to the Bottom in the European Union?**

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ARE CORPORATE TAX BURDENS RACING TO THE BOTTOM IN THE EUROPEAN UNION?

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Abstract This paper tests the central predictions of the theoretical tax competition literature for capital tax rates for a panel of European Union countries, notably a race to the bottom in corporate tax burdens. In contrast to the previous empirical literature, empirical support for increasing capital mobility to be resulting in a reduction in corporate tax burdens is found. The results also suggest that other factors driving the corporate tax burden should not be neglected and may provide substantial counterweight to tax competition forces.

Keywords: Tax competition; Capital taxation; Corporate tax burden; European financial integration; Capital mobility

JEL Classification: H2; F2; F36

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1. Introduction

The theoretical literature on tax competition shows that under certain assumptions, increasing capital mobility within the European Union should result in a race to the bottom taxes on mobile capital taxed at source, such as corporate income. But when the restrictive assumptions that this result is based on are relaxed, the theoretical consequences of increasing capital mobility for capital taxation become more nuanced. As an example, different types of cross-country asymmetries, such as size of the country as well as degree of agglomeration of economic activity, may play a non-negligible role in determining a country's choice of tax rate. In particular, agglomeration of economic activity may reverse the effect of capital mobility on the tax rate and in theory result in a "race to the top" in corporate income taxation. As there is no clear a priori answer to how capital mobility affects capital taxes, the consequence of increasing financial market integration and capital mobility on corporate taxation in the European Union should therefore be an empirical one.

Turning to the facts, it has not been established beyond anecdotal evidence that tax competition and hence a race to the bottom in corporate income tax rates is taking place in the European Union. This is in spite of the fact that financial liberalization has been taking place for many years, and that capital mobility has reached high levels. A number of studies of OECD countries look for empirical evidence of a negative link between capital mobility and corporate or capital tax burdens, but do not find any. Instead, a few studies find evidence supporting the hypothesis of a race to the top. But the empirical literature is fragmented and thin and the result are inconclusive.

In spite of the intense political debate on this topic in the European Union, no studies investigate panels consisting of only European Union countries. Moreover, previous studies have tended to use problematic measures of capital and corporate tax burdens.

The paradox – lack of consistent empirical support for a theory that has gained political influence and a certain recognition – is re-visited in this paper, with the aim of providing more robust empirical support for or against a race to the bottom in corporate tax burdens in the European Union. As the main reason for the lack of previous empirical support for tax competition pressures can be found in measurement problems, relatively much effort is here directed at discussing how to best overcome the data and measurement problems involved in these types of panel regression analyses.

Additional hypotheses derived from the tax competition literature are also tested, in order to assess the importance of tax competition as a downward pressure on corporate tax burdens relative to the importance of other factors as determinants of corporate tax burdens, such as economic size country, tax exporting, and agglomeration forces.

The structure of the paper is the following. Section 2 presents five testable hypotheses derived from the theoretical literature on tax competition. Section 3 looks at the previous empirical literature on capital taxation and capital mobility and identifies problems and pitfalls in designing the tests of a negative relationship between measures of capital mobility and measures of the corporate tax burden in panel data. A methodology for testing for the presence of tax competition pressures in European Union countries is presented in Section 4. Section 5 discusses data issues

and presents the data and the results of the empirical analysis are presented in Section 6. The final section concludes.

2. Predictions of the theoretical literature on tax competition

The theoretical literature on capital tax competition is reviewed by Wilson (1999). Five testable predictions are derived from this literature and summarized below and tested in the following empirical analysis. The first hypothesis, put forward elegantly in the seminal paper by Zodrow and Mieszkowski (1986), is the central prediction concerning capital taxation in the European Union derived from the tax competition literature and states that when capital becomes more mobile, governments will increasingly lower their source based capital tax rates in order to compete for and attract capital to their country. This will lead to a downward spiral in capital tax rates and too low capital taxes from a social optimal point of view.

H1: The higher the capital mobility, the lower the tax revenues from and tax burden on capital taxed at the source.

This prediction is, however, based on a set of rather restrictive assumptions about the economies in which tax competition takes place. For example, assuming that labor income can also be taxed, and assuming that labor is immobile across international borders leads to hypothesis two, which states that as capital becomes more mobile, the distortionary effect of capital taxation increases relative to the distortionary effect of labor taxation, and the tax burden will hence be shifted from capital to labor:

H2: The higher the degree of capital mobility, the higher the tax revenues from and tax burden on labor income relative to that of capital income.

Allowing for differences in the size of capital endowments or population (economic country size), the elasticity of capital to the tax rate, and hence the distortionary effect of taxation, is perceived to be lower by larger countries, as shown in Wilson (1991) and Bucovetsky (1991). The larger country will therefore set a higher tax rate relative to the smaller country, leading to hypothesis three:

H3: The larger the country, the smaller the downward pressure of capital mobility on the tax rate

When agglomeration rents are allowed for, as done in the new economic geography literature, attracting industry to one location creates agglomeration rents, which can then be taxed without capital fleeing, in spite of capital being perfectly free to move. Capital becomes a quasi-fixed factor¹. Allowing for agglomeration forces hence has the potential to reverse the results of the standard tax competition model. Agglomeration rents will increase with the degree of goods-market integration, which in the EU should be rather correlated with the degree of capital market integration. Moreover, modeling capital mobility explicitly in models of agglomeration forces shows that for certain levels of capital mobility, the degree of capital mobility will have the standard negative effect on tax rates while for higher levels, the relationship may reverse due to agglomeration effects. Disregarding the potential non-linear effects and focusing on the effects of agglomeration rents, allowing for agglomeration rents hence leads to:

¹ See Baldwin et.al., 2003, chapter 16, for a thorough overview of tax competition in the presence of agglomeration forces.

H4: The more concentrated production, the smaller the downward pressure of capital mobility on the corporate tax burden

Finally, financial liberalization also leads to increased international diversification of ownership of economic activity. Huizinga and Nielsen (1997) show that if the policy maker does not care about the welfare loss experienced by a foreign investor when she or he is taxed, the marginal cost of increasing the tax rate in terms of lost private domestic net income is lower when some of the tax incidence is on foreigners. Policymakers will hence have an incentive to increase the tax rate with the degree of foreign ownership of economic activity, all else being equal. The effect on capital taxes is called tax exporting, and has the opposite effect on capital taxes of the tax competition effect that has been in focus till now, leading to hypothesis 5:

H5: The higher degree of foreign ownership of economic activity in the country, the smaller is the downward pressure of capital mobility on the corporate tax burden

Whether or not intensifying tax competition has lead to the mentioned effects on the corporate tax burden in the European Union is an empirical question. The next Section summarizes the results of the previous empirical literature on tax competition.

3 The Empirical Literature

There are three necessary conditions for tax competition to be taking place. First, investors must be both willing *and* able to react to tax differentials between countries, i.e. corporate capital must be technically mobile across borders. There is no doubt that corporate as well as other types of capital have become increasingly mobile across European countries since the inception of the

European Single Market in the early 1980s. This is further confirmed by measures of capital mobility for EU countries as will be shown in the empirical analysis below. Second, investors have to consider taxes as significant determinants in investment decisions. The empirical literature on the sensitivity of cross border capital flows, including FDI flows and bank deposits, finds that capital flows are indeed sensitive to tax rates². In particular, it has been rather robustly established that FDI flows are sensitive to host country capital taxation, while there is less empirical support for domestic investments to respond to domestic tax treatment. This means that there is scope for using tax policy to attract foreign capital to the country. A third necessary condition for tax competition to take place is that governments are able to actively use the tax policy instrument, and thus react to downward revisions of other countries' tax rates, or to capital outflows, by lowering the tax burden on capital. Some preliminary estimations of tax reaction functions shows that national tax rates do seem to respond to taxes of neighboring countries, implying that strategic interaction in tax rates is prone to take place³.

(Insert Table 1 here)

Since the empirical evidence implies that the three necessary conditions are fulfilled, a negative relationship between the degree of capital mobility and either absolute or relative corporate tax burdens should be present and thus somehow identifiable empirically, which would allow for an establishment of the importance of tax competition pressures. And it is at this point that the empirical evidence falls short of robustly validating tax competition pressures on capital tax rates.

Table 1 summarizes the rather sparse empirical literature on correlations between measures of

² See for example Hines (1996) for a review of the literature the tax sensitivity of US FDI flows, Devereux and Freeman (1995), Bènassy-Quéré, Fontagné and Lahréche-Révil (2000), Gropp and Kostial (2000) for studies of sensitivity of OECD FDI flows to tax rates.

³ See for example Devereux et al. (2001) or Altshuler and Goodspeed (2002).

capital mobility and the tax burden on capital for OECD country panel data. The bulk of this research is inconclusive, and some studies even find slight evidence that capital taxation has increased with the degree of capital mobility. Only Bretchger and Hettich (2002) find the expected negative correlations between capital mobility and tax burdens, but the negative correlation is only robust when using a rather unconventional measure of capital mobility, namely trade openness.

Regarding the empirical evidence for hypotheses 3 to 5, only Bretchger and Hettich test the additional hypothesis of a size effect on the tax competition (hypothesis 3) and find significant and expected effects, while none of the mentioned studies test the hypothesis that agglomeration rents mitigates or reverses tax competition pressures. Whether there is empirical support for the tax exporting hypothesis has been tested and found significant using firm level data for US states⁴, but has not been tested as an explanatory factor in panel regressions on macroeconomic data.

This general lack of empirical evidence for tax competition pressures to have had a negative influence on corporate tax burdens may of course mean that tax competition is not a significant force driving corporate tax burdens as of yet. But it may also be the consequence of problems with the empirical research design. Some such problems and possible solutions are listed below.

3. Problems, Pitfalls and Remedies

For it to be meaningful to carry out another panel regression analysis of tax competition pressures on corporate tax burdens, the problems of the design of previous studies need to be addressed,

⁴ See Eijffinger and Wagner (2001)

pitfalls need to be identified and remedies considered. Six problems and pitfalls and how they are taken into account in the following empirical analysis are identified below.

1. **Imprecise or poor measures of capital mobility.** The measures of capital mobility used in the literature may not adequately be capturing the degree of capital mobility. Finding remedies for this problem is not straightforward as capital mobility cannot be directly measured. The problem is accounted for in the following analysis by comparing the results of two measures of capital mobility rather than relying on just one.

2. **Imprecise of poor measures of the capital tax burden**

As forcefully argued in Devereux and Griffith (2003), the appropriate measure to use when evaluating tax competition pressures empirically is the average effective tax rate on capital. It is the average rather than the marginal tax rate which matters for the location decision of a firm, and it is the average rather than the marginal tax rate which indicates the corporate tax burden. While using proxies for the average tax rate has also been the manifest strategy followed in the previous empirical literature, there are two overall problems related to the measurement of such average effective tax burdens which could account for lack of or unexpected results. Consider first the problem of the **tax base effect** when using corporate tax revenues to GDP as a measure of the tax burden on capital. Corporate tax revenues in percent of GDP does not take into account changes in the capital income tax base (i.e. some measure of taxable profits) on which the tax rate is applied. Hence, if the capital income tax base is positively correlated with financial liberalization, a positive relationship between the tax burden measure and the capital mobility measure should be expected. Seeing that the corporate tax base, as well as financial liberalization, is likely to have been increasing in the latter part of the 1990s, such a correlation is likely, and the tax base effect can hence be a priori expected to lead to a systematic bias toward rejecting tax competition. The tax base effect may hence provide an explanation of the paradoxical finding of several

positive correlation between corporate tax revenues in percent of GDP in the previous literature, and should not be used as a measure of the corporate tax burden in empirical tests of tax competition pressures. There are other problems using tax revenues to GDP measures of the corporate tax burden. For example, the definition of the corporate tax base may change at a certain point in time, or incentives to register capital income in a certain category may change, in turn shifting tax revenues between the corporate and the personal income tax categories, without changes in the economic definition of tax rates or bases taking place. Such shifts in corporate tax revenues would obviously not be a sign of changes in the corporate tax burden. For these reasons, the corporate tax revenues in percent of GDP is not used as a measure of the tax burden on capital in the following empirical investigation.

Second, there is the issue of the **ex post nature of implicit measures of corporate or capital tax burdens**. The construction of implicit tax rates a la Mendoza et al. (1994) is an attempt to solve the tax base problem mentioned above. Mendoza et al. suggest measuring the overall capital tax burden by dividing capital tax revenues with measures of the tax base computed on the basis of aggregate national accounts and fiscal data. Implicit capital tax rates lump all capital income and capital tax revenues together in one measure and it is mainly this lumping together which provides source of inaccuracy. First, implicit tax rates measure ex post tax burdens, in the sense that they do not take into account the effect that a tax change on a specific category of capital income would have on that particular capital tax base, and hence in turn on collected tax revenue. If taxes on a particular type of economic activity increase, this particular activity – and hence the associated tax base – may fall, and in turn, the weight of this activity in the overall implicit tax rate falls. If the particular activity was taxed relatively heavily in the first place, the net effect could be a fall in the implicit capital tax rate. The net effect on the implicit tax rate of

increases in the tax burden on specific capital income categories is therefore uncertain, while the actual – or ex anti – tax burden has increased. Changes in the overall capital or corporate tax burden will hence not be reflected accurately by changes in the implicit tax rate if capital tax bases are elastic to their respective tax burden. If capital taxes are changed rather uniformly across different capital income categories this should be less of a problem. There are several additional potential problems relating to implicit capital tax rates. Implicit capital tax rates include taxes on bases such as savings, which are not as prone to capital tax competition, and more importantly, include taxes on tax bases which are not mobile, such as property income. Attempts at solving some of these problems by identifying an appropriate measure of the corporate income tax base in order to construct a narrower implicit *corporate* tax rate have largely been abandoned. But it is important to note that the inaccuracy of the implicit capital tax rate is not a priori expected to lead to a systematic bias which is directly or indirectly correlated with measures of financial liberalization, as is the case for the tax base problem mentioned above.

While being inaccurate in other ways, a third measure of the corporate tax burden, referred to as the average effective corporate tax rates in the following, provides remedies for both the tax base effect and the problem of the ex post nature of the implicit tax rate described above⁵. Average effective corporate tax rates measure the tax burden on a hypothetical corporate investment project as the difference between the gross and net of tax cost of capital associated with the particular type of investment project, using country specific tax code and various underlying assumptions regarding economic depreciation rates, inflation, type of financing and time horizon, etc.. The main drawback of using average effective corporate tax rates as measures of the corporate tax burden is that they are found to be highly sensitive to the underlying assumptions.

⁵ See Devereux, M.P and R. Griffith (2003) for a recent example of implicit corporate tax rates.

But there is no reason to expect this to lead to a systematic bias correlated with measures of capital mobility. As can be noted from Table 1, average effective corporate tax rates have not previously been employed for testing the tax competition hypotheses in panel regressions. The main reason for this is simply the fact that such data has not previously been computed consistently for a sufficient time horizon and for a sufficient panel of countries. But this situation has recently been changed by Devereux, M.P and R. Griffith (2003).

As there are sources of inaccuracies associated with the use of both the implicit capital tax rate and the average effective corporate tax rate as proxies for the corporate tax burden, both measures are used for the testing of hypothesis 1, 3, 4 and 5 rather than choosing one measure a priori as the most appropriate. The sensitivity of results to changes in some of the underlying assumptions of the average effective corporate tax rate are carried out as robustness checks.

3. **Omission of agglomeration, size and tax exporting effects.** A positive correlation of measures of capital mobility could be due to an omitted variables bias, in that previous studies largely neglect to control for asymmetries in size, agglomeration economies and tax exporting. The robustness of the results are tested for inclusion of control variables for these effects in the following analysis.
4. **Unit roots and spurious correlations.** Another issue which is not addressed in the above mentioned studies is that of unit roots. Several of the variables used in the regressions may have unit roots, implying that there is a potential risk of spurious correlations, although the risk of spurious regressions due to nonstationary data is lower in panel data than in traditional time series

analysis⁶. The stationarity of included variables is checked for the purposes of the following analysis, and variables which are likely to have a unit root are first differenced.

5. **Heterogeneity of the panels.** The panels studied in the previous literature may have been too heterogeneous, by using OECD countries and including observations from the early 1970s. Moreover, it is remarkable that while capital tax competition and the potential adverse effects on taxation in European Union countries are frequently discussed in the public debate over the future of fiscal policy in the European Union, no purely European empirical panel regression study of these issues has been carried out. In the following analysis, the sample is limited to EU countries and observations from the 1970s are excluded while later observations (i.e. for the last years of the 1990s) are included.

6. **Endogeneity.** The dependent variables are fiscal variables and hence may have an effect on economic activity, and in turn, on some of the explanatory variables. This may be the case for growth and inflation, country size, agglomeration economies and foreign corporate ownership, while the effect of fiscal policy on measures of capital mobility is less obvious. There are no perfect solutions to problems of endogeneity, but seeing as the persistence in the explanatory variables which are prone to being endogenous is low, lagging the explanatory variables by one year should substantially reduce the potential risk of endogeneity bias of the parameter estimates⁷.

This following panel regression analysis takes into account the 6 points mentioned above to the extend possible. Points four to six are considered in the empirical methodology and procedures

⁶ See Baltagi (2002)'s chapter on non-stationary panel data.

⁷ Using GMM or other forms of instrumental variables could also be employed, but seeing as there are no instruments which are not prone to exactly the same endogeneity short of the lags of the explanatory variables themselves, using IV methods has not been carried out here.

used, while the first three points are looked at in the robustness analysis of the regression results or included directly in the setup of the hypothesis specific estimating equations.

4. Methodology

Theoretical tax competition models do not provide a fully-fledged structural framework from which an estimating equation can be derived. Instead, following the empirical literature on fiscal effects of globalization reviewed above, a basic specification is proposed:

$$\Delta TAX_{it} = \alpha + \beta_1 \cdot [GR_{i,t-1}, INFL_{i,t-1}, \Delta OPEN_{i,t-1}, \Delta PART_{i,t-1}, \Delta UN_{i,t-1}] + \beta_2 \cdot [\Delta LEFT_{i,t-1}, ELEC_{i,t+1}, ELEC_{i,t}, MAAS_{i,t-1}] + \gamma \cdot \Delta [\Omega_{i,t-1}] + \nu_i + \varepsilon_{it} \quad (0-1)$$

Where TAX is a measure of the absolute or relative tax burden on capital depending on the hypothesis to be tested. Tax burden measures are discussed in further detail below. ν_i is a country specific error term which can be fixed or random, while ε_{it} is the country and time specific error term. Inflation ($INFL$) and real growth (GR) are included to capture the cyclicity of the budget and inflation or growth induced changes in tax revenues due to shifts of income between the nominal tax brackets with different marginal tax rates. Growth is expected to be negatively related to the tax burden on capital⁸. Inflation also proxies for money growth and hence also controls for monetary financing of the budget, and the expected sign of inflation hence does not lend itself to a priori identification. The effect of demographic changes on the government budget is controlled for by including the participation rate ($PART$), defined as the labor force divided by the population between 15 and 65 years old. The participation rate is expected to be negatively related to the tax burden. Cameron (1997) and Rodrik (1999), among others, argue that taxes

⁸ It can also be argued that according to Wagner's Law, growth should lead to preferences for larger government and hence to higher taxes and expenditures in percent of GDP. But this is a longer-term argument as opposed to the above, and will not be taken into account here.

should be expected to be positively related to the degree of openness of the country, and openness of the country to trade is controlled for by including the imports and exports to GDP ratio (*OPEN*). *OPEN* is cleaned of country size effects as proposed by Bretschger and Hettish (2002) by using the residuals from a regression of openness on country size as explained in appendix. The unemployment ratio (*UN*) is included to capture the direct influence of unemployment on personal income and social security payments, and is expected to affect taxes negatively.

As a robustness check of the results to political economy influences, a dummy for partisanship is included, taking the value one when the government in power is defined as being to the left in the political spectrum (*LEFT*. See details on construction in appendix). A leftwing government is a priori expected to prefer higher overall taxes and higher capital taxes, all else equal, thus implying that the a priori sign of *LEFT* is positive in all regressions. Moreover, the lead and the contemporaneous values of a dummy for parliamentary election years (*ELEC*) are included to account for election year cycles. While the lead of the dummy is expected to be negative, the expected sign of the contemporaneous dummy is less clear as it would depend on when the year the election takes place. Finally, a dummy for the ‘Maastricht years’, taking the value 1 from 1993 and onward, is included. Since the Maastricht Treaty imposes an upper limit to the budget deficit, the expected sign is positive in tax regressions, while not signed a priori in the regressions of capital taxes relative to other taxes⁹.

⁹ A dummy for whether the exemption or the credit system is used as double taxation relief system is not included in the analysis in spite of this variable being identified as having an effect on the location decision of investment. This dummy would provide no time variation and would hence be correlated with the country fixed effects of the regression. Carrying out the regressions for either exemption countries or credit countries separate does not change the results substantially (not shown, but results can be obtained from the author).

It should be kept in mind when testing hypothesis two that the expected signs of each of the explanatory and control variables is not necessarily the same in regressions of relative corporate tax burdens (i.e. when testing hypothesis two).

Ω is a vector of variables which are specific to the particular hypothesis tested. For the first two hypotheses concerning the effects of increased capital mobility on tax measures, the vector will simply consist of a measure of capital mobility, discussed in more detail in the section below.

When hypothesis three on the implications of differences in country size for the outcome of the tax competition game is tested, the Ω vector in addition includes capital mobility interacted with a measure of country size. A positive sign of the this interaction term would mean that tax competition pressures on tax rates of larger countries is smaller, and would hence lend support to hypothesis 3. When hypothesis four on the implications of the degree of agglomeration for the corporate tax burden is tested, an interaction term between the measure of capital and a measure of degree of agglomeration are added to the Ω vector. Again, a positive interaction term would imply that more “agglomerated” countries are less exposed to tax competition pressures as capital mobility increases, and would hence lend support to hypothesis 4. Finally, hypothesis five is tested by adding a measure of foreign owned capital relative to domestically owned capital into the regression. The degree of imported capital should not change the impact of capital mobility as in the two previous hypothesis, but under hypothesis 5, a higher degree of imported capital should increase the tax rate. Thus, a positive sign of the variable measuring imported capital would lend support to hypothesis 5. The hypothesis specific dependent and explanatory variables are summarized in Table 2 and measurement and data issues relating to these variables are discussed below.

Stationarity tests imply that all included variables except growth and inflation are likely to exhibit unit roots. Hence, growth and inflation are included in levels while the rest of the variables are first differenced in the basic specification. Including growth and inflation in first differences is, however, carried out as a robustness check.

5. Data and Measurement Issues

The dataset used for the panel regression analysis contains data for 14 EU countries from 1980 to 2000 (some series only go to 1997), and mainly includes data from OECD revenue statistics and OECD Economic Outlook, with a few exceptions. Details are given in Appendix. Choices of measures of tax burdens, the degree of capital mobility, the degree of agglomeration, size of a country and capital imports, are not straightforward and deserve further attention.

As mentioned previously, two measures of the corporate tax burden are used for the present purposes: Average effective tax rates computed by Devereux and Griffith (2003) (henceforth referred to as CORPTAX) and implicit capital tax rates based on macroeconomic data computed by David and Rabesona (2002) (henceforth referred to as CAPTAX). The underlying assumptions used for computing CORPTAX are stated in appendix.

(Insert Figure 5 and Figure 3 here)

The EU average and standard deviation of CORPTAX are plotted in Figure 5. The plot shows a downward trend in the average EU effective tax on returns to corporate investments since the late 1970s, and a reduction in the standard deviation, lending some initial support to hypothesis one. Figure 3 plots the EU average and standard deviation of CAPTAX and shows a quite different

picture of an increasing trend over the last two decades, in contrast to the predictions of standard tax competition models. Clearly, visual inspection of plots of measures of corporate tax burdens is not sufficient to conclude anything about the importance of tax competition in the European Union.

In lack of data on average effective labor or property tax rates which would be comparable to the average effective corporate tax rates computed by Devereux and Griffith (2002), hypothesis two is tested using only the implicit capital tax rate in percent of the implicit labor tax rate (henceforth CAPLAB) of David and Rabesona (2002). The EU average and standard deviation of CAPLAB are plotted in Figure 4 and show no clearly discernible trend, contrary to the predictions of tax competition theories.

(Insert Figure 4 here)

Two measures of capital mobility, which are characterized by having both time and cross country variation and are widely available for EU countries, have been chosen for the present study: Quinn's 14 point index of financial liberalization (henceforth Quinn's 14 point index, or Q14, see Quinn, 1997), and covered interest parity differentials on 3-month interbank deposits vis-à-vis German interbank deposits (henceforth *CIP*, see the exact definition in appendix). Quinn's 14 point index is constructed using a scoring system to translate restrictions on not only outward but also inward capital account transactions, outward and inward current account transactions, and finally, the existence of agreements limiting the future use of capital controls, into a quantitative measure ranging from 0 (financially closed) to 14 (financially open). Figure 6 shows the mean and standard deviation of Quinn's 14-point index for EU14. The trend is clear. Financial

liberalization in the EU has increased and the dispersion in the degree of liberalization has narrowed, confirming the general perception of how capital mobility has evolved in the last few decades in the European Union.

(Insert Figure 6 and Figure 7 here)

Perhaps the most important drawback of Quinn's 14 point index is its discrete nature, since the sheer presence of restrictions does not necessarily convey any information about the actual impact of the restriction on capital flows. This drawback is addressed by using the *CIP* as a second measure of capital mobility. The *CIP* is based on the assumption that when the price differential net of currency risk between two identical assets of different nationality is higher, restrictions, formal or informal, to capital mobility must also be higher since price-offsetting flows have not been triggered to take advantage of the arbitrage opportunity. Hence, in a regime of perfect capital mobility, interest parity should hold while the lower the degree of capital mobility, the higher a differential from interest parity is possible without triggering arbitrage activity. It is of course problematic that the *CIP* measures the international mobility of short term financial capital rather than the mobility of corporate taxable income. But as a line of defense of the *CIP* as a proxy for corporate capital mobility, it should be noted that the mobility of short term financial capital plays an indirect role in facilitating locational change in corporate economic activity. A plots of the EU average and standard deviation of the absolute deviations from interest parity is shown in Figure 7. The average absolute covered interest parity differential exhibits a decreasing trend, and hence indicates an increase in capital mobility over the past 20 years in line with the picture given by Quinn's 14 point index. The dispersion around the European mean absolute interest parity differential also fell during most of the period.

Real GDP relative to total EU real GDP (henceforth referred to as SIZE) is used as a measure of economic size for testing the hypothesis concerning the effect of economic size on the tax competition equilibrium. According to theories of asymmetric capital tax competition, what matters for the elasticity of capital to the tax rate is relative and not absolute size; that is, if real GDP increases in all competing countries in the same year, this should not matter for the equilibrium tax rate according to asymmetric capital tax competition models.

Turning to the test of the agglomeration and tax competition hypothesis, hypothesis 4, possible tax rate hikes made possible by the existence of agglomeration economies depend according to theory on the discrete differential in agglomeration economies - returns to capital employed in the corporate sectors, or profits – across countries. As including some measure of the return to capital would give rise to substantial endogeneity problems in the regressions, agglomeration economies are instead proxied by real value added in manufacturing and services per capita (this measure is henceforth referred to as AGGL). Inspired by the empirical literature on agglomeration economies, a second measure of agglomeration economies is also used in the test of hypothesis 4, namely that of market potential (henceforth MP)¹⁰. The MP, an average of real GDP of EU countries weighted by the distance to each country, measures agglomeration forces at play rather than the outcome – agglomeration economies – *per se*.

¹⁰ The empirical literature on economic geography suggests a list of variables relevant for agglomeration economies, including market size, trade costs and market potential. See for example Combe and Overman, *forthcoming*, for a review. The market size and market potential variables are highly correlated in the EU sample and only one of the two are therefore deemed necessary. Trade costs seem less relevant when financial market liberalization rather than goods market liberalization is concerned.

Finally, a measure of the degree of foreign ownership of corporate activity is needed in order to test the tax-exporting hypothesis. Firm level accounting data provides this information, but such data is not available back in time and consistently for all panel countries. As an approximation, data on inward FDI stocks are used. Preferably, FDI stocks should be scaled by a measure of the aggregate value of corporate assets since what matters is the degree of foreign ownership relative to domestic ownership, not to absolute value of foreign owned assets. But in lack of available good measures or proxies of the aggregate value of corporate assets, inward FDI stocks have been scaled by GDP. This source of inaccuracy as a measure of tax exporting should be kept in mind in interpreting the results.

Definitions of the various variables used for testing each of the five hypotheses in the panel regression analysis are summarized in Table 2.

6. Results

The results of the basic four regressions estimated for testing hypothesis 1 are given in columns 1 and 4 of Table 3 and Table 4. The regressions are estimated using FGLS, allowing for cross-country contemporaneous correlation of the error terms as well cross sectional heteroskedasticity. The Hausman tests for fixed effects against the alternative of random effects, shown in Table 3 and Table 4, are accepted in all four regressions, implying that the fixed effects model is the more appropriate of the two one-way error components models. Moreover, the test for the country specific fixed effects jointly being equal to zero rejects the null in all regressions on a 10 percent significance level. The fixed effects one-way error components specification is therefore kept¹¹.

¹¹ The R² of the regressions are reported along with the results of the various regressions, but it should be kept in mind that the R² is not meaningful when FGLS estimation is used.

(Insert Table 3 and Table 4 here)

Hypothesis one: The effect of capital mobility on the corporate tax burden. Hypothesis one is tested by regressing CORPTAX and CAPTAX in turn on the two measures of capital mobility in turn. The outcomes of the resulting regressions are shown in Table 3 and Table 4. The parameter estimates of the control variables of the basic regressions (columns 1 and 4 of the two tables) are all of expected sign or insignificant except in the case of the participation rate, which turns out significantly positive in most regressions opposite to expectation.

Starting with the CAPTAX regressions (Table 3), hypothesis one is accepted when using the CIP as a measure of capital mobility. This result is robust to the inclusion of growth and inflation first differences (column 2), and the inclusion of political economy variables (column 3) – of which only the election year effect turns out significant and with correct sign. The significantly negative parameter estimate is also robust to the inclusion of agglomeration effects, size effects and tax exporting effects, as shown in Table 7. (The implications of the results in Table 7 for hypotheses 3 to 5 are returned to below).

The result implies that a one percentage point increase in the *CIP* leads to a reduction in the implicit capital tax rate of 0.96 percentage points. While significant and robust, the effect is quantitatively small. The *CIP* increased by 0.8 percentage point on the average for the EU between 1985 and 2000, implying that the implicit capital tax rate has fallen by about 0.77 percentage points, or between 2 and 3 percent, due to tax competition pressures since 1985.

On the other hand, when Quinn's 14 point index of financial liberalization is used as a proxy for capital mobility in the CAPTAX regression, hypothesis one is not accepted (column 4 of Table 3). Q14 is not significant in any of the regressions carried out for CAPTAX¹².

Turning to the regressions testing hypothesis one using CORPTAX as the explanatory variable (Table 4), the *CIP* is significant in the basic regression (column 1). Here the estimated effect is smaller than for CAPTAX, implying a reduction of about 0.34 percentage points, or between 1 and 2 percent of the average effective corporate tax rate between since 1985. This result is not entirely robust, however. First, the inclusion of growth and inflation in first differences instead of levels renders the *CIP* insignificant (column 2)¹³. Moreover, the significance of the negative parameter estimate is not robust to changes in some of the underlying assumptions regarding type of financing of hypothetical investment project, underlying inflation rate and underlying rent, of the CORPTAX measure, as shown in Table 5.

When using Quinn's 14 point index as a proxy for capital mobility in the CORPTAX regression, however, the results are significant (column 4 of Table 4) and pass all robustness tests (column 5 and 6 of Table 4, column 4-6 of Table 5 and Table 8). Since the EU average of the Q14 increased with 4 points since 1985, the parameter estimate of Q14 of -0.41 implies that the average effective corporate tax rate fell with about 1.64 percentage points, or between 5 and 6 percent on the average for EU countries since 1985 – a slightly more important magnitude than implied by the *CIP* measure.

¹² The sample is shorter when *CIP* is used, as data on *CIP* does not stretch back further than 1985. This is not the reason for the different results for Q14 and *CIP*, as restricting the sample to 1985-2000 when using Q14 does not change the results.

¹³ At closer inspection, this turns out to be due to the inclusion of inflation in first differences. As the first differences of inflation and *CIP* are not correlated (correlation coefficient of 0.03), there is no evident reason for this change of significance.

All in all, the data gives support to hypothesis 1, in indicating a negative effect of tax competition on corporate tax burdens in the past decades. The estimated magnitude of the reduction in corporate tax burdens since 1985 due to tax competition pressures in EU countries varies between 1 and 6 percent on the average for EU countries.

The tests for robustness to the inclusion of political economy variables provide interesting information in themselves which deserve mention. The parameter estimates for the Maastricht Treaty dummy comes out positive and strongly significant in all regressions but one, implying that the Maastricht budget restrictions have had a significant impact on tax policy in EU member states. Moreover, the contemporaneous dummy for election year effects is significantly negative as expected in all regressions. The dummy for partisanship, *LEFT*, on the other hand, is significantly positive in all regressions, contrary to the general perception of left versus right wing ideology.

Hypothesis two: The effect of capital mobility on the corporate tax burden relative to the labor tax burden. The hypothesis that increased capital mobility shifts the tax burden from mobile capital toward the less mobile factors such as labor is tested regressing the implicit capital tax rate in percent of the implicit labor tax rate on the two measures of capital mobility respectively. The regression results are shown in Table 6.

(Insert Table 6 here)

The results listed in Table 6 show that using the CIP as a measure of capital mobility leads to the acceptance of hypothesis two, while the use of Q14 as the proxy for capital mobility leads not

only to the rejection of hypothesis two, but to the unexpected result that capital mobility has lead to a shift of the tax burden from labor to capital¹⁴. The data hence do not allow a clear conclusion on hypothesis two.

Hypothesis three: The effect of economic size on the impact of capital mobility on capital taxation

Whether the effect of capital mobility on the corporate tax burden depends on country size, as suggested by the asymmetric tax competition literature, is tested by regressing the two corporate tax burden measures on the two measures of capital mobility alone and in interaction with the measure of economic size of the country (*SIZE*). The results of the regressions are reported columns 1 and 5 of Table 7 and Table 8. Table 7 giving the results for the CAPTAX regressions shows that while *SIZE* itself is seen to have a positive effect on the implicit capital tax rate, the interaction of *SIZE* and the capital mobility proxy is not significant and hence does not alter the size of the impact of capital mobility on the CAPTAX.

(Insert Table 7 and Table 8 here)

In the regressions for CORPTAX (Table 8), the evidence is mixed. The interaction term between *SIZE* and *CIP* in the regression using *CIP* as a measure of capital mobility is insignificant, implying no size effects. Only in the CORPTAX regression using *Q14* as a capital mobility measure does the interaction term turn significantly positive, giving support to the hypothesis that

¹⁴ These mixed results are of course linked with the finding that *CIP* was significantly negative while *Q14* was insignificant in the CAPTAX regression carried out for the test of hypothesis 1. As *Q14* was statistically significant and with the expected sign in the CORPTAX regression commented on above, it would be interesting as a future extension to test hypothesis 2 using the CORPTAX measure in percent of a similarly computed average effective labor tax.

a greater economic size of the country makes the country less sensitive to tax competition. All in all, the data provides some, although rather weak, support of hypothesis 3.

Hypothesis four: The effect of agglomeration rents on the impact of capital mobility on the corporate tax burden

Hypothesis four, stating that the greater agglomeration economies in the country, the less the country will be pressured by tax competition, is tested for the implicit capital tax rate by including an interaction term between the capital mobility measures and the two agglomeration measures, AGGLOM and MP¹⁵, respectively. The results of these regressions are given in columns 2, 3, 6 and 7 of Table 7 and Table 8. Again, the CAPTAX regressions contain no significant parameter estimates of the interaction terms and hence no support of hypothesis four. In the CORPTAX regressions on the other hand, the interaction terms of both AGGLOM and MP are significant and with expected signs when the CIP is used as capital mobility measure. When using Q14 as capital mobility proxy, the interaction term of MP is also significantly positive supporting hypothesis four while the interaction term of AGGLOM is insignificant. Moreover, the estimated negative effects of CIP and Q14 on CORPTAX increases in size when the agglomeration terms are included and significant, which could imply an omitted variables bias when agglomeration economies are not taken into account.

All in all, the data provides weak support for hypothesis four that agglomeration economies act to mitigate the negative impact of capital mobility on corporate tax burdens.

Hypothesis five: The effect of Tax exporting on corporate tax burdens. The hypothesis that a higher degree of foreign corporate ownership leads to tax exporting and hence higher

¹⁵ Market size (MS – the level of real GDP) has also been tested as an agglomeration variable but using MS gives exactly the same conclusions as using MP, and the results for MS are hence not shown.

corporate tax burdens all else equal is tested by including the tax exporting variable, the inward FDI stock in percent of GDP, in the CORPTAX and CAPTAX regressions. The results are given in columns 4 and 8 of **Table 7 and Table 8**. As in the test regressions for hypotheses 3 and 4, the CAPTAX regression yields no significant parameter estimates of the hypothesis specific variable and hence no support of hypothesis five. When including FDII in the CORPTAX regression, the parameter estimates of FDII come out significantly positive, as expected under hypothesis 5. As the inward FDI stock in percent of GDP increased by 14 percentage points on average for EU countries between 1985 and 1998 for which FDII is available, the parameter estimate of FDII of 0.11 implies that tax exporting increased the average EU corporate tax burden by 1.56 percentage points, or between 5 and 6 percent in that time period – a magnitude similar to that of the estimated tax competition effect when using CORPTAX and Q14 as corporate tax burden and capital mobility measures respectively. In conclusion on the test of hypothesis five, there is some, although not entirely robust, empirical support for the tax exporting hypothesis to provide a mitigating effect on the downward pressures of tax competition on corporate tax burdens in EU countries.

7. Conclusions

Despite a widespread acceptance that a race to the bottom in capital tax rates in the European Union is taking place, no previous empirical support has been found for this. Several studies have even come to the opposite conclusion that capital mobility is positively correlated with capital taxation. This paper has highlighted some of the potential problems and pitfalls which should be taken into account in the design of panel regression tests of the correlation between capital mobility and the corporate tax burden, and which might account for the lack of or unexpected results of the previous literature. Furthermore, the paper has conducted the first panel regression

analysis including only European Union countries and using newly available panel data on average effective tax rates based on national tax code as a measure of the corporate tax burden in addition to the more widely used implicit capital tax rate based on macroeconomic revenue and national accounts data. Finally, the paper has tested a wider set of hypotheses derived from the theoretical literature on tax competition, namely those of asymmetric sized and tax competition, agglomeration effects and tax competition, and finally, tax exporting effects on the corporate tax burden.

The empirical analysis provides strong support for increased capital mobility to have resulted in a downward pressure on corporate tax burdens in the European Union since the early 1980.

Estimates suggest that increases in capital mobility has lead to between 1 and 5 percent reduction in corporate tax burdens since 1985 on the average for EU member countries. Moreover, there was some, although not entirely robust support for the hypothesis that a greater economic size of the country, or greater agglomeration economies mitigate tax competition pressures on the corporate tax burden and the hypothesis. Further, there was weak empirical evidence that increased foreign corporate ownership has increased tax exporting effects and hence increased the corporate tax burden. Estimates suggest that the corporate tax burden has increased by between 5 and 6 percent since 1985 as an average for EU countries, providing some counterweight to the downward tax competition pressure on corporate tax rates.

The main conclusion to draw from the analysis is that tax competition pressures on the corporate tax burden exist but have remained of relatively small magnitude and hardly qualify as a race to the bottom. Moreover, the results of the analysis emphasize that many factors other than capital mobility drive corporate tax burdens. And this latter point is important in the context of tax

harmonization. For example, in the presence of agglomeration economies, it is optimal to increase the tax rate on corporate income at the source unilaterally, and a harmonized corporate tax rate would prevent such taxation of agglomeration economies in agglomerated locations, which would be counter to the intention of harmonization in the first place.

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Appendix

Construction of an index of ideology In line with the empirical literature on the effects of ideology on fiscal policy, data provided by Woldendorp et. al (2000) on ideology of the government in power is used. They construct a classification of the ideology of government along the lines of five cases. In the first case, right wing parties dominate both government and parliament. In the second case, right wing or center parties make up between 33.3% and 66.6% of government. Center parties make up more than 50% of government in the third case. In the fourth case, left wing or center parties make up between 33.3% and 66.6% of government. Finally, in the fifth case, left wing parties dominate government. Woldendorp et al. describes how the distinction has been made between right wing, center and left wing parties. On the basis of these data, a left wing dummy (*LEFT*) is constructed and takes the value one in case 4 and 5.

Data Sources

(Insert Table 9 here)

8. Tables

Table 1: Summary of the literature on regression analysis of capital mobility and tax burdens.

Study	Dependent Variable	Capital Mobility Measure	Sample	Significant Effects
Garrett (1995)	-Capital taxation ^d	-Index of number of capital controls	OECD Countries, 1967-1990	No significant effect
Quinn (1997)	-Corporate Tax Revenues % Personal Tax Revenues -Corporate Tax Revenues % GDP -Corporate Tax Revenues % Total Tax Revenues	-Quinn's 14 point index ^b	OECD Countries, 1974-1989	Effect of Quinn's 14 point index on corporate tax in % of personal tax: 0.443 Effect of Quinn's 14 point index on corporate tax in % of GDP: 0.003
Swank (1998a)	-Implicit Tax Rates on Capital, Labor and Consumption ^c	-Total Capital Flows -FDI Flows % GDP -Quinn's 14 point index ^b -CIP ^a	OECD Countries, 1966-1993	Effect of Quinn's 14 point index on the implicit capital tax rate: 0.830
Garrett and Mitchell (2001)	-Government Spending % GDP -Implicit tax rate on Capital ^c -Ratio of Implicit Tax Rates on Capital and Labor ^c	-FDI Flows % GDP -Quinn's 14 point index ^b -CIP ^a	OECD Countries, 1967 – 1992	-Effect of FDI flows % GDP on Implicit Capital Tax: 0.419
Bretschger and Hettish (2002)	-Implicit corporate tax rate ^c	-Degree of openness (exports plus imports over GDP cleaned of country size effects) -Index of number of capital controls	14 OECD Countries, 1967-1996	-Effect of openness (index of capital controls) on implicit corporate tax: between -13 and -20 (0 and -2.96, not robust). -Effect of openness (index of capital controls) on implicit labor tax in percent of the implicit corporate tax: between 0.9 and 1.21 (0 and 0.12, not robust).

/a: Covered Interest Parity Differentials. /b: Quinn's 14 point index of financial liberalization. /c: Methodology proposed by Mendoza et. al (1994). /d: Garreth (1995) does not offer a more detailed definition of capital taxation.

Table 2. Overview of hypotheses to be tested and the hypothesis specific dependent and explanatory variables used in the panel regression analysis.

	Hypothesis	Dependent(s) variable(s)	Hypotheses specific explanatory variable(s)
H1	The higher the capital mobility, the lower the tax revenues from and tax burden of capital income taxed at the source	Tax burden on capital measured by the implicit capital tax rate and corporate tax revenues in percent of GDP	<ul style="list-style-type: none"> • Quinn's 14 point index • CIP
H2	The higher the degree of capital mobility, the higher the tax rate on labor relative to that of capital income	Tax burden on capital relative to the tax burden on labor measured by the implicit capital tax rate in percent of the implicit tax rate on labor, and corporate tax revenues in percent of total tax revenues	<ul style="list-style-type: none"> • Quinn's 14 point index • CIP
H3	The larger the country, the smaller the downward pressure of capital mobility on the capital tax rate	Tax burden on capital measured by the implicit capital tax rate and corporate tax revenues in percent of GDP	<ul style="list-style-type: none"> • Quinn's 14 point index • CIP alone and interaction with the percentage of EU real GDP produced in the country.
H4	The more production is clustered in a country, the lower the effect of capital mobility on the tax rate	Tax burden on capital measured by the implicit capital tax rate	<ul style="list-style-type: none"> • Quinn's 14 point index • CIP alone and interaction with GDP per capita.
H5	The higher degree of foreign ownership of production, the higher a tax rate on capital.	Inward FDI stock in percent of GDP	<ul style="list-style-type: none"> • Quinn's 14 point index • CIP

Table 3: The impact of capital mobility on the implicit capital tax rate (CAPTAX)

	1	2	3	4	5	6
ΔCIP_{-1}	-0.96 (-3.76 ^{***})	-0.78 (-3.05 ^{***})	-0.88 (-2.83 ^{***})	-	-	-
$\Delta Q14_{-1}$	-	-	-	0,04 (0,35)	0,05 (0,40)	-0,04 (-0,37)
GR_{-1}	0.14 (0.35)	-	0.04 (0,83)	-0,01 (-0,25)	-	0,001 (0,02)
$INFL_{-1}$	-0.19 (-5.34 ^{***})	-	-0.26 (-5,64 ^{***})	0,04 (1,83 [*])	-	-0,07 (2,57 ^{**})
ΔGR_{-1}	-	-0.07 (-2.35 ^{**})	-	-	-0,07 (-2,20 ^{**})	-
$\Delta INFL_{-1}$	-	-0.12 (-2.26 ^{**})	-	-	0,07 (1,46)	-
$\Delta OPEN_{-1}$	0.01 (2.15 ^{**})	0.01 (1.98 ^{**})	0,01 (1,71 [*])	0,02 (3,25 ^{***})	0,02 (3,23 ^{***})	0,02 (3,37 ^{***})
$\Delta PART_{-1}$	0.13 (5.04 ^{***})	0.14 (6.29 ^{***})	0,10 (4,27 ^{***})	0,13 (4,97 ^{***})	0,17 (6,11 ^{***})	0,11 (3,36 ^{***})
ΔUN_{-1}	-0.30 (-3.33 ^{***})	-0.51 (-6.46 ^{***})	-0,38 (-3,59 ^{***})	-0,30 (-3,26 ^{***})	-0,23 (-3,19 ^{***})	-0,35 (-3,34 ^{***})
$MAAS_{-1}$	-	-	-0,13 (-0,70)	-	-	0,50 (2,31 ^{**})
$ELEC_{+1}$	-	-	0,19 (1,31)	-	-	-0,05 (-0,42)
$ELEC$	-	-	-0,47 (-3,42 ^{***})	-	-	-0,78 (-6,21 ^{***})
$LEFT_{-1}$	-	-	-0,11 (-0,62)	-	-	-0,38 (-3,53 ^{***})
No. Obs	172	172	136	221	221	185
Sample	1985-2000	1985-2000	1985-199	1980-2000	1980-2000	1980-2000
R^2	0.19	0,16	0,23	0,12	0,14	0,16
DW statistic	1.80	1,79	1,77	1,70	1,70	1,71
Hausmann	$\chi^2=3.63$ (p=0.72)			$\chi^2=3.65$ (p=0.72)		
Wald (fixed effects=0)	$\chi^2=67.19$ (p=0.000)			$\chi^2=37.81$ (p=0.001)		
F-test (all slopes=0)	$\chi^2=115.7$ (p=0.000)			$\chi^2=59.62$ (p=0.000)		

***: Significant on the 1% level. **: Significant on the 5% level. *: Significant on the 10% level.

Table 4: The impact of capital mobility on the effective average corporate tax rate (CORPTAX)

	1	2	3	4	5	6
ΔCIP_{-1}	-0.43 (-1.99 ^{**})	0.03 (0.14)	-0.90 (-4.27 ^{***})	-	-	-
$\Delta Q14_{-1}$	-	-	-	-0.41 (-4.98 ^{***})	-0.47 (-5.33 ^{***})	-0.31 (-3.18 ^{***})
GR_{-1}	0.02 (0.51)	-	-0.02 (-0.56)	-0.05 (-0.72)	-	-0.06 (-1.01)
$INFL_{-1}$	-0.21 (-5.85 ^{***})	-	-0.21 (-6.73 ^{***})	0.0002 (0.01)	-	0.03 (1.25)
ΔGR_{-1}	-	0.08 (2.43 ^{**})	-	-	-0.05 (-1.25)	-
$\Delta INFL_{-1}$	-	-0.20 (-3.78 ^{***})	-	-	-0.06 (-1.54)	-
$\Delta OPEN_{-1}$	-0.01 (-2.10 ^{**})	-0.01 (-1.12)	-0.004 (-0.99)	-0.01 (-0.98)	-0.01 (-0.78)	-0.01 (-0.79)
$\Delta PART_{-1}$	0.17 (1.55)	0.12 (1.13)	0.21 (4.75 ^{***})	0.27 (2.52 ^{**})	0.27 (2.54 ^{**})	0.20 (3.30 ^{***})
ΔUN_{-1}	0.14 (1.80 [*])	-0.05 (-0.68)	0.22 (3.04 ^{***})	-0.09 (-0.98)	-0.10 (-2.03 ^{**})	-0.07 (-0.68)
$MAAS_{-1}$	-	-	0.47 (3.38 ^{***})	-	-	0.85 (3.37 ^{***})
$ELEC_{+1}$	-	-	-0.64 (-4.81 ^{***})	-	-	-0.46 (-2.38 ^{***})
$ELEC$	-	-	-0.81 (-7.73 ^{***})	-	-	-0.83 (-4.32 ^{***})
$LEFT_{-1}$	-	-	-0.62 (-3.29 ^{***})	-	-	-0.25 (-1.34 ^{***})
No. Obs	187	187	139	252	252	204
Sample	1985-2001	1985-2000	1985-1997	1980-2001	1980-2001	1980-2001
R^2	0.07	0.07	0.16	0.05	0.05	0.11
DW statistic	2.04	2.05	2.21	2.06	2.07	2.20
Hausmann	$\chi^2=4.68$ (p=0.58)			$\chi^2=10.11$ (p=0.12)		
Wald (fixed effects=0)	$\chi^2=18.48$ (p=0.10)			$\chi^2=27.00$ (p=0.007)		
F-test (all slopes=0)	$\chi^2=45.51$ (p=0.000)			$\chi^2=32.77$ (p=0.000)		

***: Significant on the 1% level. **: Significant on the 5% level. *: Significant on the 10% level.

Table 5: Robustness of results on hypothesis 1 to alternative underlying assumptions of the average effective tax rate (CORPTAX)

	CORPTAX1	CORPTAX2	CORPTAX3	CORPTAX1	CORPTAX2	CORPTAX3
ΔCIP_{-1}	-0.36 (-2.05 ^{**})	-0.32 (-1.43)	-0.29 (-1.34)	-	-	-
$\Delta Q14_{-1}$	-	-	-	-0.27 (-4.62 ^{***})	-0.74 (-6.51 ^{***})	-0.45 (-5.52 ^{***})
GR_{-1}	-0.08 (-2.06 ^{**})	0.05 (1.22)	0.003 (0.08)	-0.08 (-1.88 [*])	0.07 (0.93)	-0.09 (1.28)
$INFL_{-1}$	-0.13 (-5.05 ^{***})	-0.27 (-7.08 ^{***})	-0.22 (-5.67 ^{***})	-0.02 (-0.97)	-0.06 (-2.73 ^{***})	-0.01 (-0.67)
$\Delta OPEN_{-1}$	-0.01 (-3.70 ^{***})	-0.01 (-2.00 ^{**})	-0.01 (-1.86 [*])	-0.01 (-1.25)	-0.01 (-1.04)	-0.004 (-0.43)
$\Delta PART_{-1}$	0.26 (4.39 ^{***})	0.19 (2.04 ^{**})	0.15 (1.36)	0.24 (3.36 ^{***})	0.19 (1.76 [*])	0.27 (2.36)
ΔUN_{-1}	-0.04 (-0.55)	0.01 (0.09)	0.11 (1.29)	-0.16 (-2.30 ^{**})	-0.03 (-0.36)	-0.10 (-1.08)
No. Obs	187	187	187	252	252	252
Sample	1985-2001	1985-2000	1985-2001	1980-2001	1980-2001	1980-2001
R ²	0.09	0.09	0.09	0.07	0.07	0.04
DW statistic	2.16	2.08	2.00	2.17	1.85	2.04

***: Significant on the 1% level. **: Significant on the 5% level. *: Significant on the 10% level.

CORPTAX1: Debt financed investment instead of finance through equity of retained earnings.

CORPTAX2: Country and time specific inflation rates instead of a fixed uniform inflation rate.

CORPTAX3: 20% instead of 10% rent

Table 6: The impact of capital mobility on the implicit tax rate on capital relative to the implicit labor tax rate (CAPLAB)

	1	2	3	4	5	6
ΔCIP_{-1}	-1,89 (-3,21 ^{***})	-1,25 (-2,03 ^{**})	-1,77 (2,81 ^{***})	-	-	-
$\Delta Q14_{-1}$	-	-	-	0,68 (1,98 [*])	0,79 (2,23 ^{**})	1,06 (3,26 ^{***})
GR_{-1}	0,11 (-0,9)	-	0,27 (2,67 ^{***})	-0,15 (-1,26)	-	-0,04 (-0,36)
$INFL_{-1}$	-0,50 (-5,02 ^{***})	-	-0,61 (-5,11 ^{***})	0,001 (0,02)	-	0,14 (1,84 [*])
ΔGR_{-1}	-	-0,09 (-1,02)	-	-	-0,17 (-1,84 [*])	-
$\Delta INFL_{-1}$	-	-0,26 (-1,69)	-	-	0,06 (0,42)	-
$\Delta OPEN_{-1}$	0,04 (3,67 ^{***})	0,04 (3,55 ^{***})	0,04 (2,76 ^{***})	0,05 (3,86 ^{***})	0,05 (3,95 ^{***})	0,06 (4,15 ^{***})
$\Delta PART_{-1}$	0,22 (3,29 ^{***})	0,25 (3,88 ^{***})	0,15 (2,34 ^{**})	0,29 (3,84 ^{***})	0,32 (4,06 ^{***})	0,22 (2,40 ^{**})
ΔUN_{-1}	-0,80 (-3,38 ^{***})	-1,33 (-5,71 ^{***})	-1,03 (-4,22 ^{***})	1,41 (-5,01 ^{***})	-1,24 (-5,55 ^{***})	-1,64 (-5,53 ^{***})
$MAAS_{-1}$	-	-	0,01 (0,02)	-	-	1,75 (3,20 ^{***})
$ELEC_{+1}$	-	-	-0,07 (-0,22)	-	-	-0,59 (-1,49)
$ELEC$	-	-	-0,86 (-2,58 ^{**})	-	-	-1,27 (-3,14 ^{***})
$LEFT_{-1}$	-	-	-1,43 (-2,97 ^{***})	-	-	-1,37 (-3,85 ^{***})
No. Obs	172	172	136	221	221	185
Sample	1985-2000	1985-2000	1985-1997	1980-2000	1980-2000	1980-1997
R^2	0,21	0,19	0,24	0,19	0,20	0,21
DW statistic	1,80	1,75	1,82	1,68	1,70	1,72
Hausmann	$\chi^2=4.05$ (p=0.71)			$\chi^2=4.10$ (p=0.70)		
Wald (fixed effects=0)	$\chi^2=120.4$ (p=0.000)			$\chi^2=82.86$ (p=0.000)		
F-test (all slopes=0)	$\chi^2=119.3$ (p=0.000)			$\chi^2=82.09$ (p=0.000)		

***: Significant on the 1% level. **: Significant on the 5% level. *: Significant on the 10% level.

Table 7: Tests of hypotheses 3 to 5 for the implicit capital tax rate (CAPTAX)

	1	2	3	4	5	6	7	8
ΔCIP_{-1}	-0,74 (-2,00 ^{**})	-0,73 (-2,66 ^{***})	-0,96 (-2,49 ^{**})	-0,93 (-3,53 ^{***})	-	-	-	-
$\Delta Q14_{-1}$	-	-	-	-	-0,12 (-0,66)	0,05 (0,32)	-0,13 (-0,73)	0,01 (0,071)
$SIZE_{-1}^*$ $\Delta(CIP_{-1})$	-0,03 (-0,72)	-	-	-	-	-	-	-
$SIZE_{-1}^*$ $\Delta(Q14_{-1})$	-	-	-	-	0,02 (1,05)	-	-	-
$\Delta SIZE_{-1}$	0,29 (2,29 ^{**})	-	-	-	0,31 (2,35 ^{**})	-	-	-
$AGGL_{-1}^*$ $\Delta(CIP_{-1})$	-	-0,005 (-1,26)	-	-	-	-	-	-
$AGGL_{-1}^*$ $\Delta(Q14_{-1})$	-	-	-	-	-	0,0002 (0,12)	-	-
$\Delta AGGL_{-1}$	-	0,09 (5,19 ^{***})	-	-	-	0,07 (3,76 ^{***})	-	-
MP_{-1}^* $\Delta(CIP_{-1})$	-	-	0,0001 (0,29)	-	-	-	-	-
MP_{-1}^* $\Delta(Q14_{-1})$	-	-	-	-	-	-	0,0003 (1,27)	-
ΔMP_{-1}	-	-	0,001 (0,21)	-	-	-	0,002 (0,49)	-
FDII	-	-	-	0,03 (0,80)	-	-	-	-0,004 (-0,10)
GR_{-1}	0,03 (0,53)	-0,02 (-0,65)	0,01 (0,14)	-0,02 (-0,45)	-0,004 (-0,08)	-0,04 (-0,97)	-0,01 (-0,17)	-0,03 (-0,65)
$INFL_{-1}$	-0,23 (-5,95 ^{***})	-0,20 (-5,67 ^{***})	-0,19 (-5,23 ^{***})	-0,21 (-5,35 ^{***})	0,04 (1,61 [*])	0,05 (2,12 ^{**})	0,04 (2,00 ^{**})	0,04 (1,83 [*])
$\Delta OPEN_{-1}$	0,01 (1,02)	0,01 (2,12 ^{**})	0,01 (2,09 ^{**})	0,01 (1,68 [*])	0,01 (1,50)	0,01 (2,78 ^{***})	0,02 (3,25 ^{***})	0,02 (3,12 ^{***})
$\Delta PART_{-1}$	0,11 (2,95 ^{***})	0,01 (0,31)	0,12 (4,70 ^{***})	0,13 (4,63 ^{***})	0,11 (2,98 ^{***})	0,03 (0,72)	0,12 (4,41 ^{***})	0,13 (4,47 ^{***})
ΔUN_{-1}	-0,24 (-2,63 ^{***})	-0,23 (-2,66 ^{***})	-0,28 (-2,97 ^{***})	-0,43 (-4,54 ^{***})	-0,27 (-2,71 ^{***})	-0,28 (-2,93 ^{***})	-0,28 (-2,89 ^{***})	-0,37 (-3,69 ^{***})
No. Obs	172	172	172	160	221	221	221	209
Sample	1985-2000	1985-2000	1985-2000	1985-1999	1980-2000	1980-2000	1980-2000	1980-1999
R ²	0,20	0,22	0,19	0,19	0,14	0,14	0,13	0,12
DW statistic	1,76	1,75	1,76	1,82	1,67	1,66	1,66	1,67

***: Significant on the 1% level. **: Significant on the 5% level. *: Significant on the 10% level.

Table 8: Tests of hypotheses 3 to 5 for the average effective corporate tax (CORPTAX)

	1	2	3	4	5	6	7	8
ΔCIP_{-1}	-0.89 (-2.25 ^{**})	-1.08 (-2.90 ^{***})	-1.04 (-2.63 ^{***})	-0.60 (-2.43 ^{**})	-	-	-	-
$\Delta Q14_{-1}$	-	-	-	-	-0.93 (-7.18 ^{***})	-0.34 (-4.15 ^{***})	-1.02 (-6.57 ^{***})	-0.41 (-4.72 ^{***})
$SIZE_{-1}^*$ $\Delta(CIP_{-1})$	0.08 (1.31)	-	-	-	0.08 (4.95 ^{***})	-	-	-
$SIZE_{-1}^*$ $\Delta(Q14_{-1})$	-	-	-	-	-	-	-	-
$\Delta SIZE_{-1}$	-0.05 (-0.41)	-	-	-	0.02 (0.18 ^{**})	-	-	-
$AGGL_{-1}^*$ $\Delta(CIP_{-1})$	-	0.02 (3.96 ^{***})	-	-	-	-	-	-
$AGGL_{-1}^*$ $\Delta(Q14_{-1})$	-	-	-	-	-	0.001 (0.58)	-	-
$\Delta AGGL_{-1}$	-	0.04 (1.64 [*])	-	-	-	0.09 (1.99 [*])	-	-
MP_{-1}^* $\Delta(CIP_{-1})$	-	-	0.001 (1.86 [*])	-	-	-	-	-
MP_{-1}^* $\Delta(Q14_{-1})$	-	-	-	-	-	-	0.001 (4.45 ^{***})	-
ΔMP_{-1}	-	-	-0.01 (-1.68 [*])	-	-	-	-0.01 (-1.37)	-
FDII	-	-	-	0.13 (4.20 ^{***})	-	-	-	0.11 (2.60 ^{***})
GR ₋₁	0.02 (0.46)	-0.05 (-0.78)	0.07 (1.40)	-0.04 (-0.76)	-0.02 (-0.40)	-0.10 (-1.62 [*])	0.05 (0.58)	-0.02 (-0.28)
INFL ₋₁	-0.21 (-5.91 ^{***})	-0.17 (-4.06 ^{***})	-0.21 (-5.81 ^{***})	-0.20 (-5.37 ^{***})	-0.02 (-1.23)	-0.0002 (-0.01)	-0.01 (-0.84)	0.02 (0.88)
$\Delta OPEN_{-1}$	-0.01 (-2.25 ^{**})	-0.01 (-1.29)	-0.02 (-2.39 ^{**})	-0.01 (-1.97 ^{**})	-0.01 (-0.77)	-0.01 (-1.11)	-0.01 (-0.87)	-0.01 (-0.96)
$\Delta PART_{-1}$	0.17 (1.61)	0.20 (1.82 [*])	0.24 (2.16 ^{**})	0.26 (4.51 ^{***})	0.23 (2.52 ^{**})	0.19 (1.72 [*])	0.37 (3.37 ^{***})	0.19 (2.75 ^{***})
ΔUN_{-1}	0.15 (1.77 [*])	0.17 (1.74 [*])	0.14 (1.54)	0.11 (1.16)	-0.03 (-0.36)	-0.07 (-0.92)	-0.02 (-0.26)	-0.06 (-0.69)
No. Obs	187	187	187	163	252	252	242	228
Sample	1985-2001	1985-2001	1985-2000	1985-1999	1980-2001	1980-2001	1980-2000	1980-1999
R ²	0.08	0.10	0.08	0.10	0.06	0.05	0.06	0.06
DW statistic	2.03	2.05	2.02	2.12	2.07	2.07	2.07	2.10

Table 9: Definitions and sources of data used in the panel regression analysis

Variable	Definition and Sources
CORPGDP	Corporate tax revenues in percent of GDP. Source: OECD Economic Outlook
CAPTAX	Implicit tax rate on capital calculated according to Carey and Rabesona 2002 on the basis of OECD revenue statistics. Net or gross? Source: Carey and Rabesona (2002)
CORPTAX	Average effective corporate tax rate computed by Devereux and Griffith (2003).
CORPTAX1	As CORPTAX, but debt financed investment instead of finance through equity of retained earnings.
CORPTAX2	As CORPTAX, but country and time specific inflation rates are assumed instead of a fixed uniform inflation rate.
CORPTAX3	As CORPTAX, but an assumed 20% instead of 10% rent
CORPTOTALTAX	Corporate tax revenues in percent of total tax revenues. Source: OECD Economic Outlook
CAPLAB	The average effective tax rate on capital in percent of the average effective capital income tax. Source: Carey and Rabesona 2002.
CIP	The yearly average of monthly (end of month) observations of absolute deviation from covered interest parity on 3 month interbank deposit interest rates vis-à-vis the German ditto, multiplied by minus one. Monthly data on spot exchange rates, three months forward exchange rates and three month interbank rates are derived from Datastream. Some series have been extended backwards in time using treasury bill yields when interbank deposit rates were not available.
Q14	Quinn's 14 point index of financial liberalization as described in Quinn (1997). Source: Dennis Quinn.
SIZE	GDP relative to sum of GDP of countries included in the sample (EU13). Source: OECD Economic Outlook
AGGLOM	Real value added in manufacturing and services per capita, measured in millions of dollars in fixed 1995 prices. Source: Own calculations based on data from OECD Economic Outlook
MP	Market potential. Weighted sum of GDP for all 14 European countries included in this study weighted by its distance to the country in question (country i). $MP_i = \sum_{j=1}^n \frac{GDP_j}{d_{ij}}, i = \text{country subscript, } d_{ij} = \text{distance between the capitals of countries } i \text{ and } j. i=1, \dots, n, n=14.$ Source: Own calculations based on OECD Economic Outlook data and distance data from TravelNotes.Org
FDII	Inward FDI stock in percent of GDP. Inward FDI is approximated by an estimate of stock of direct investment liabilities (cumulative flow adjusted for relative price variations). Source: Dataset from Lane and Milesi-Ferretti (2001)
GR	Real growth rate, calculated using data on nominal GDP and the GDP deflator. Source: OECD Economic Outlook
INFL	The yearly percentage change in the consumer price index. Source: OECD Economic Outlook
OPEN	The sum of exports and imports divided by 1.000.000*GDP (all in current local currency). Source: OECD Economic Outlook
UN	Unemployment rate, percent. Source: OECD Economic Outlook
PART	The participation rate, constructed as the labor force in percent of the population between the age of 15 and 65. Data for Portugal are from the Ameco database. For other EU countries, data are from OECD Economic Outlook.
MAAS	Dummy for the Maastricht years, taking the value 1 from 1993 onwards.
EYEAR	Dummy taking the value 1 in years of parliamentary elections of the given country, and zero otherwise. Source: Parties and Elections in Europe: http://www.parties-and-elections.de/

LEFT	Dummy for the ideology of the government in power. Construction as explained above. Source: Woldendorp, Keman and Budge (2000)
IR	Short term interest rate, percent. Source: OECD Economic Outlook

9. Graphs

Figure 1: EU average and standard deviation of corporate tax revenues in percent of GDP, 1975-2000.

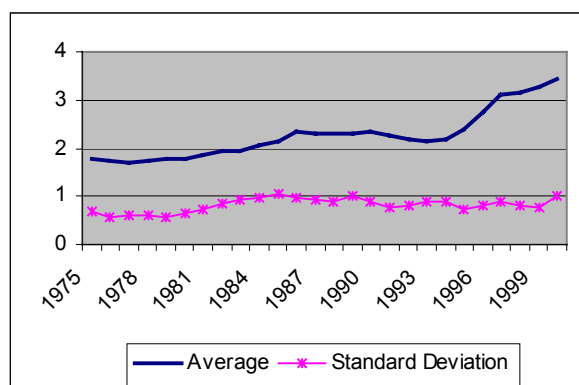


Figure 2: EU average and standard deviation of corporate income taxes in percent of total tax revenues, 1970 – 2000

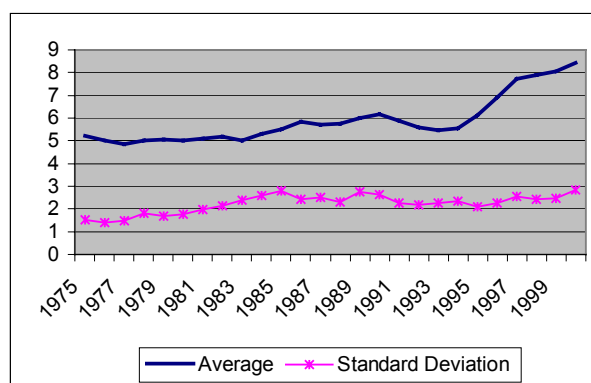


Figure 3: EU average and standard deviation of implicit capital income taxes, 1975 – 2000

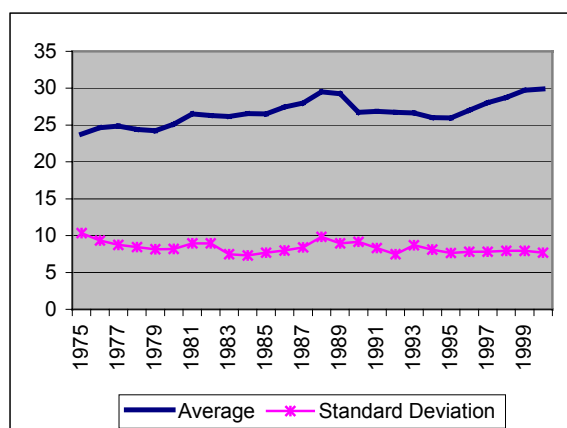


Figure 4: EU average and standard deviation of implicit capital income tax rates in percent of implicit labor income tax rates, 1975 – 2000

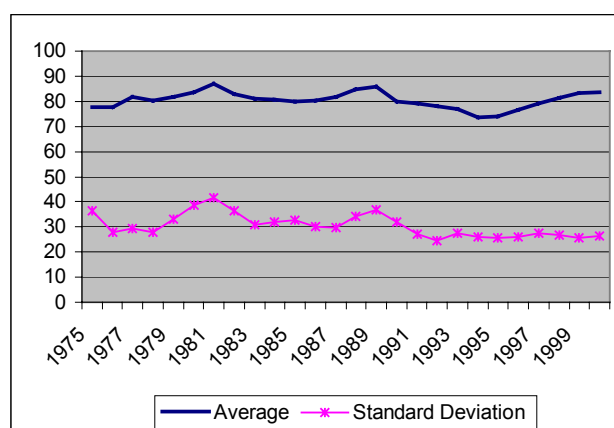


Figure 5: EU average and standard deviation of the effective average tax rate, CORPTAX, 1979 – 2003

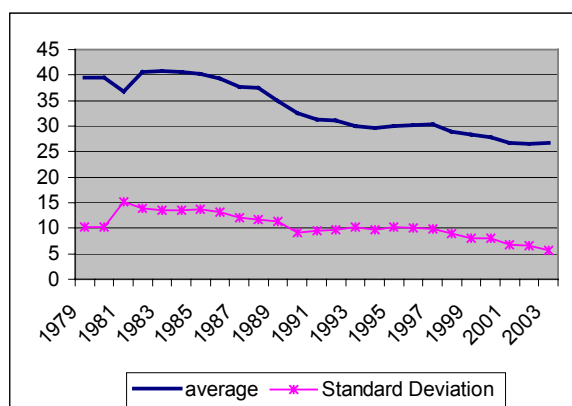


Figure 6: EU average and standard deviation of Quinn's 14 point index, 1975 – 2000

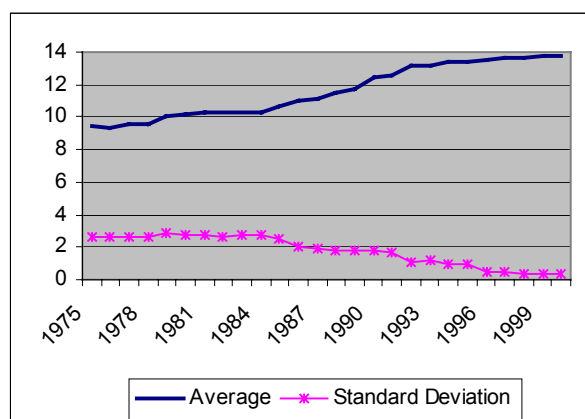
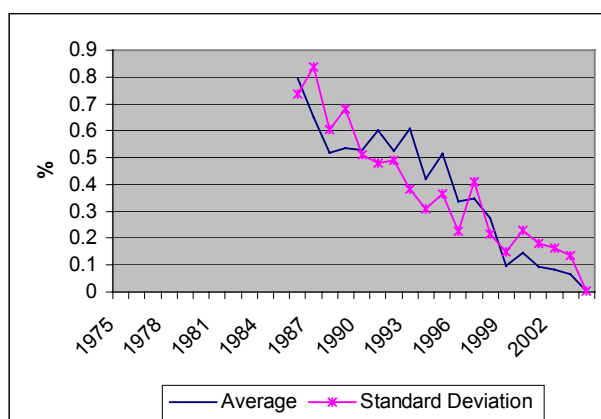


Figure 7: EU yearly averages and standard deviation of monthly absolute covered interest parity differentials (-CIP), percent, 1983 - 2003.



Note: the sharp increase between 1985 and 1986 is due to the fact that Spain and Portugal, both with high deviations from interest parity, only enter the average in 1986.