

ARE CORPORATE TAXES RACING TO THE BOTTOM IN THE EUROPEAN UNION?

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Abstract Previous studies of the relationship between capital tax burdens and the degree of capital mobility have found little empirical evidence for tax competition to place a downward pressure on capital tax burdens. This paper identifies, and suggests remedies for, several problems with the design of such previous studies and tests the tax competition hypothesis for a panel of 13 European Union countries using a new dataset on corporate tax burdens. The analysis leads to robust empirical support for increasing capital mobility to be resulting in a reduction in corporate tax burdens is found. Estimates suggest that corporate tax burdens have fallen by about a fifth since 1980 due to tax competition pressures.

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

Capital mobility

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1. Introduction

The theoretical literature on tax competition predicts that increases in capital mobility, such as that observed during the last couple of decades within the European Union, generates a race to the bottom in taxes on mobile capital taxed at source¹. This tax competition effect is often accused of hampering efforts to balance public finances, of hindering the adequate provision of public goods, or of leading to a shift in the tax burden on to less mobile tax bases with resulting concerns regarding the equity of the tax mix. It has also led to numerous calls for tax harmonization in the European Union. Moreover, there seems to be an overall consensus that tax competition is currently taking place and sharpening in the EU, based on different sources of evidence. Such sources include anecdotal evidence suggesting that corporate income taxes are occasionally lowered – or not increased – due to tax competition pressures, evidence that governments do engage in strategic interaction in tax rates, and evidence on how capital flows are found to respond to tax differentials across countries.

If tax competition is really sharpening with the increase in capital mobility, thus leading to a lower tax burden on mobile capital, it should be possible to find a negative relationship between tax burdens on mobile capital and the degree of capital mobility. However, studies which estimate the relationship between capital mobility and capital tax burdens in cross-country panel datasets with a few exceptions fail to find any such significant effects. Rather on the contrary, a number of studies find that as capital mobility increases, so do capital or corporate income tax burdens. But the empirical literature on this issue is fragmented and thin and the result are at best inconclusive.

¹ See Wilson (1999) for a review of the theoretical tax competition literature.

There are several possible explanations for the lack of strong empirical evidence. One explanation could be that the theoretical result of a race to the bottom in corporate tax burdens is based on highly restrictive assumptions, and that taking into account more nuances in the modeling of tax competition shows us that we should not expect a race to the bottom in the first place. It is well known that companies do not only locate in low-tax countries, since many other factors, notably infrastructure, market access, access to an educated workforce, etc., are equally if not more important in the locational decision of a company. Such other factors are often provided by the public sector, and may therefore be positively correlated with the tax level of the country in question, which therefore would suggest a higher tax burden in attractive investment locations. Moreover, theory shows that if increasing returns are allowed for, as in the new economic geography literature, or if political economy mechanisms are introduced, capital mobility may result in an increase in capital taxation rather than a race to the bottom². These points just come to show that the theory of tax competition is far from clear on whether we should expect to see capital taxes being competed downward as economic integration increases.

Another reason for the weak empirical evidence could be that tax competition might only be taking place for a limited segment of corporations, namely those which are internationally highly mobile and able to negotiate substantial individual tax deals with EU countries' national tax authorities, while the large group of small and medium sized companies with a highly national focus are not yet mobile enough to challenge national tax authorities in the European Union. Moreover, larger and internationally focused corporations may have always been able to strike

² For example, Baldwin and Krugman (2004) analyze a tax competition game in a new economic geography model, finding an increase in capital taxes as capital – what they call entrepreneurs since the owners of the capital move along to the location of the investment – becomes mobile. Persson and Tabellini (1992) analyze tax competition issues allowing for the degree of tax competition to affect tax burden preferences, and in turn the tax burden through elections.

favorable individual tax deals, and hence, tax competition may not yet be significantly reducing the overall level of corporate tax revenues and corporate tax burdens in EU countries.

But it is also possible that the predicted race to the bottom is actually taking place, and that earlier empirical studies have failed to capture it due to problems in the design of the empirical methodology. An obvious pitfall in such exercises is the complications involved in measuring corporate tax burdens and the degree of capital mobility. Moreover, earlier studies have not taken into account such potential problems of endogeneity and non-stationarity, and there are no earlier panel studies exclusively studying the situation in the European Union – surprising in the light of the political urgency of the issue in a European Union context.

This paper addresses the mismatch of theory and empirics from the empirical side, with a focus on the European Union. This is done by conducting a panel data analysis of the hypothesis of a race to the bottom in capital tax rates, taking into account the problems and pitfalls of the previous literature, to the extent that this is feasible. Most of the improvements relative to earlier studies carried out here are merely fine-tuning of the methodology – panel regression analysis – which is adopted due to the lack of sufficiently long time series of the relevant variables for any individual country. As will be argued below, however, the prime suspect of being the source of the theory-empirics mismatch in the earlier literature is that of the use of inaccurate, even biased, measures of capital tax burdens. This study has a particular advantage in that regard, due to timing. A panel dataset on corporate tax burdens is now available, which on a priori grounds can be argued to have less sources of inaccuracy that could bias the results toward rejection of the hypothesis, than previously used measures of tax burdens. It turns out that implementing these

adjustments to the methodology leads to robust evidence in favor of a tax competition effect on corporate tax burdens in the European Union during the 1980s and 1990s.

The structure of the paper is the following. Section 2 takes a look at the results of the previous empirical literature on tax competition. Section 3 identifies problems and pitfalls in designing the tests of a negative relationship between measures of capital mobility and measures of the corporate tax burden using panel data. A methodology for testing for the presence of tax competition pressures in European Union countries is outlined in Section 4. The results of the empirical analysis are presented in Section 5 and the final section concludes.

2. Previous Empirical Evidence

There is no doubt that corporate as well as other types of capital have become increasingly mobile across European Union member countries since the inception of the European Single Market in the mid 1980s. That capital mobility has increased is further confirmed by measures of capital mobility for EU countries (an example of this is shown below in Figure 4). Moreover, the empirical literature on the sensitivity of cross border capital flows, including foreign direct investment flows and bank deposits, finds that capital flows are indeed sensitive to tax rates³. In particular, it has been rather robustly established that foreign direct investment 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, and hence, scope for tax competition to be taking place.

Furthermore, governments seem to be actively using the tax policy instrument, and thus reacting to downward revisions of other countries' tax rates, or to capital outflows, by lowering the tax

³ See for example Hines (1996) for a review of the literature on the tax sensitivity of US FDI flows, and Bènassy-Quéré, Fontagné and Lahréche-Révil (2000), for a study of sensitivity of OECD FDI flows to tax rates.

burden on capital. Some preliminary estimations of tax reaction functions show that national tax rates do seem to respond to taxes of neighboring countries, implying that some strategic interaction in tax rates is taking place⁴. Given these findings, we should expect to see a negative relationship between the degree of capital mobility and corporate tax burdens empirically. And it is at this point that the previous empirical evidence falls short of validating tax competition pressures on capital tax rates. Table 1 summarizes the previous empirical literature on correlations between measures of 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), and more recently, Slemrod (2004), find the expected negative correlations between capital mobility and tax burdens. In the former paper, however, the negative correlation only obtains when using a rather problematic measure of capital mobility, namely trade openness. In the latter, the estimated negative correlation does not survive when a fixed effects rather than a pool with a common intercept is estimated.

(Insert Table 1 here)

3. Problems and Remedies

As indicated in the introduction, there are a number of problems in previous studies of the relationship between the degree of capital mobility and capital tax burdens, which might be the reason for the lack for the unexpected results. Six such problems, and how they are taken into account in the following empirical analysis, are discussed here. First, and probably most importantly, is the problem of measuring the tax burden on mobile capital. As argued in Devereux and Griffith (2003), the appropriate measure to use when evaluating tax competition

⁴ See for example Devereux et al. (2004).

pressures is an average effective tax rate on capital. It is the average rather than the marginal tax rate which matters for the discrete locational decision of a firm. While using measures of the average tax rate has also been the manifest strategy followed in the previous empirical literature, there are two overall problems related to such measures which could lead to bias or substantial inaccuracy. Consider first the problem of the tax base effect when looking at corporate tax revenues to GDP – an often used measure of the corporate tax burden in earlier panel regression studies. The EU15 average corporate tax revenues in percent of GDP and the standard deviation are plotted in Figure 1 and show that corporate tax revenues in percent of GDP have been rising on the average in the EU since 1975. Only for a period between the late 1980s and the mid 1990 did this growth temporarily come to a halt. This measure hence initially suggests that there are no tax competition pressures on corporate taxation in the European Union.

(Insert Figure 1 here)

The problem is that corporate tax revenues in percent of GDP do not take into account changes in the tax base on which the tax rate is applied. If the capital income tax base is positively correlated with economic integration, a positive relationship between the tax burden measure and the capital mobility measure, and hence an increase in corporate tax revenues to GDP during the last few decades, should be expected. While it is not straightforward to directly verify, the corporate tax base could for example very well have been increasing during the latter part of the 1990s along with the degree of economic integration and equity prices. Whether or not such a potential tax base effect may have outweighed potential tax competition pressures and hence account for the increase in corporate tax revenues in percent of GDP over the last decades is uncertain, but it certainly cannot be excluded. Hence, the tax base effect may have been responsible for the positive correlations between measures of capital mobility and the tax burden in previous studies. There are additional problems using tax revenues to GDP. 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. For these reasons, corporate tax revenues in percent of GDP should not be used as a measure of the corporate tax burden in empirical tests of tax competition pressures involving a time dimension.

Second, there is the issue of the ex post nature of implicit tax burden measures. 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 data or revenue statistics. Figure 2 plots the EU15 average implicit capital tax rate as computed by Carey and Rabesona (2002). The figure shows a pattern not dissimilar to that of corporate tax revenues in percent of GDP, although the tax burden increase implied by the implicit capital tax rate has been less pronounced.

(Insert Figure 2 here)

Implicit capital tax rates lump all categories of capital income and capital tax revenues together in one measure, and this lumping together creates potentially important sources of inaccuracy. First, note that the implicit tax rate measures ex post tax burdens, in the sense that they do not take into account the effect that a change in the tax of a specific category of capital income would have on that particular category of the capital tax base, and hence in turn on collected tax revenue from that category. If taxes on a particular category of economic activity increase, this particular category of economic activity – and hence the associated tax base – may fall. In turn, the weight of this activity in the overall implicit tax rate falls. The net effect of an isolated tax increase on a

particular category of capital income could hence be a fall in the implicit capital tax rate due to a behavioral response, contrary to what happens to the capital tax burden⁵. Since it is a prerequisite for tax competition to take place that there is a behavioral response to changing tax rates, this inaccuracy is particularly problematic in a tax competition context. There are several additional potential problems relating to implicit capital tax rates. The computation of the capital tax base is very crude and involves a high degree of approximation, suggesting that it is likely that the tax base problem discussed above is not entirely solved by the implicit tax rate measure. Moreover, implicit capital tax rates include taxes on bases such as savings and wealth, which are not taxed at the source, and more importantly, include taxes on tax bases which are not mobile, such as property income and profits from natural resource extraction activity. Attempts at solving some of these problems by constructing a narrower implicit *corporate* tax rate have largely been abandoned due to the problem of measuring corporate tax bases on the macro level, which to date has not been solved satisfactorily. For these reasons, it is not sensible to use implicit tax rates as measures of the corporate tax burden in a tax competition analysis.

While having other shortcomings, a third measure of the corporate tax burden, referred to as average effective corporate tax rates in the following, is directly targeted to the cost of capital of a firm, and provides remedies for both the tax base effect and the problem of the ex post nature of the implicit tax rate described above. 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.. A drawback of the average effective tax rate

⁵ If capital taxes are changed uniformly across different capital income categories this should be less of a problem.

measure is that it does not take into account enforcement issues, specially granted tax holidays and so forth, and might hence overestimate the actual effective tax burden somewhat. This would be a problem in the present analysis if tax competition is manifested mainly in such types of special tax reductions rather than changes in tax code, in which case it would tend to reject the tax competition hypothesis when it might in fact be taking place. Another and more serious drawback of average effective corporate tax rates is that they are found to be highly sensitive to the underlying assumptions. But robustness of results to changes in these underlying assumptions can be tested. 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 is changed with the data produced by Devereux, Griffith and Klemm (2002) on average effective corporate tax rates from 1979⁶ to 2003 for a group of countries which includes all EU15 countries less Denmark and Luxembourg, and provide alternative series using different underlying assumptions. The EU mean of the average effective corporate tax rate is plotted in Figure 3 and shows a downward trend since 1979.

(Insert Figure 3 here)

The difference between the evolution of the average corporate tax revenues in percent of GDP plotted in Figure 1 and the average implicit capital tax rate plotted in Figure 2 on the one hand, and the average effective corporate tax rate plotted in Figure 3 on the other hand, is remarkable. Some combination of the abovementioned sources of inaccuracy of the former are likely to provide an explanation of this divergence. In particular, and as pointed out above, the increasing trend of the former two measures suggests that the tax base effect mentioned above is not

⁶ With the exception of Austria, Belgium, Portugal and Sweden, for which the series start in 1982.

appropriately dealt with in the average implicit tax rate measure. The average effective corporate tax rate is used here as a measure of the corporate tax burden for testing the race to the bottom hypothesis, and the series with alternative underlying assumptions are used for carrying out robustness checks.

A second problem in previous studies is the use of imprecise or poor measures of capital mobility. Take first the use of total cross border capital flows, or foreign direct investment (FDI) flows in percent of GDP as a proxy for the degree of capital mobility in a few earlier studies. There are a number of reasons why this measure is problematic and should not be used. For one, taking an optimal portfolio diversification view, stocks rather than flows should be used as a proxy for the degree of capital mobility, since changes in capital mobility should be expected to lead to stock adjustment rather than a sustained change in flows. But using stocks in percent of GDP rather than flows would also be problematic. Changes in capital mobility might not trigger changes in the optimal cross country diversification of portfolio, and if it does, the reaction to a change in capital mobility may take a long time to be present in the data when FDI stocks are concerned. But most problematic is the scaling of the capital stock variable with GDP. If the world capital stock is growing faster than GDP, cross border holdings of capital stock in percent of GDP should also be expected to be increasing, even as there is no change in capital mobility. It would hence be more correct to scale cross border capital stocks with a total or per country capital stock or wealth measure, but data which is consistent across years and countries and is up to date is not readily available. For these reasons, cross border capital stocks and flows are not appropriate measures of capital mobility. Another measure frequently used in the previous literature is the absolute deviation from covered interest parity (henceforth CIP) on 3 year inter-bank deposits vis-à-vis some country considered to have a perfectly liberalized capital account.

The CIP is based on the assumption that when the price differential net of currency risk premium between two identical assets of different nationality is higher, restrictions on 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, covered interest parity should hold while an imperfect degree of capital mobility should allow a differential from covered interest parity without triggering arbitrage activity. There are two problems with this measure. First, it does not seem possible to obtain data on three month inter-bank deposit rates and spot and forward exchange rates observed at exactly the same time of the day on the same day of the month or even year. As these three variables fluctuate substantially in the short term, observations at different times of a day are not very useful. For the same reason, CIPs based on average daily or monthly data, which is often used, is not accurate either. Another problem of the CIP is that it is not measuring the type of capital mobility in focus here. The CIP measures the international mobility of short term financial capital rather than the mobility of corporate taxable income. Expanding the CIP to include deviations from interest parity on a broader range of longer term financial assets is not possible, since identifying such assets with a sufficient degree of comparability across countries is not (yet) possible. A third measure of capital mobility, trade openness computed as the sum of exports and imports in percent of GDP, has been used by Bretschger and Hettich (2002)⁷. This proxy is quite crude and measures current account rather than capital account openness. While current account openness is clearly important for capital mobility, the two are far from being the same. One reason is that current account openness is clearly more influenced by geographical location than capital account openness, as indicated in Slemrod (2004). Moreover, using trade openness as a proxy for capital mobility can be suspected to lead to systematic bias toward rejecting the tax competition hypothesis. This is because trade

⁷ Their measure of trade openness has been corrected for country size effects, see appendix.

openness is argued to affect the demand for social insurance, and is often included in tax and public expenditure regressions to take into account the corresponding positive empirical relationship between degree of trade openness and the size of the public sector (see Rodrik, 1999, on this issue). Trade openness should hence be included as a control variable in the analysis rather than as a measure of capital mobility.

Finally, the previous literature has used different measures based on the number of capital controls legally in place as measures of capital mobility. Such measures go closer to the actual phenomenon that we want to measure, but have the drawback of being discrete in nature and crude. In particular, capital control indices based on legal code do not measure the intensity of capital controls, only whether they are formally in place or not. Moreover, the crudeness of such indices, for example a simple dummy which takes the value one when any capital control is in place and zero otherwise, do not provide enough time variation to be meaningful in a panel regression analysis. A more sophisticated index measure of capital mobility is Quinn's 14 point index of financial liberalization (Quinn, 1997). Quinn's 14 point index (henceforth Quinn14) 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 the existence of agreements limiting the future use of capital controls, into a quantitative measure ranging from 0 (financially closed) to 14 (financially open). As such, it provides a substantial amount of time variation, and is as accurate as possible while still suffering from the problem of not capturing the intensity of controls. Figure 4 shows the average and standard deviation of Quinn14 for EU countries. 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 4 here)

Considering the shortcomings of the various measures described above, the drawback of Quinn14 seem to be the least problematic, and Quinn14 is hence used as proxy for capital mobility in the analysis below.

A final remark concerning the use of Quinn14 as a measure of capital mobility is that Quinn14 and the average effective corporate tax rate, which both are based on national laws governing capital transactions, are based on strictly different information sets (national tax code on the one hand, and exchange restrictions on the other), i.e. without overlaps. There should therefore be no risk that correlations between the measures will be capturing some hidden identity between the underlying data of the two measures.

Thirdly, a positive correlation of measures of capital mobility and tax burdens could be due to an omitted variables bias, in that previous studies do not control for a number of potentially important factors. As noted in the introduction, the presence of increasing returns may reverse the race to the bottom result entirely, and agglomeration economies could be correlated with the degree of capital mobility. The relative economic size of the countries is also predicted to affect the outcome of the tax competition game, and political economy considerations may mitigate if not reverse the standard tax competition results. The robustness of the results to controlling for such factors is therefore checked in the analysis below.

A fourth issue which is not addressed in earlier studies is that of unit roots. Most of the variables used in the regressions are likely to exhibit 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 analysis. The stationarity of included variables is therefore checked, and the regressions are estimated in first differences.

Fifth, it is possible that the effect of tax competition pressures on capital tax burdens varies across countries, and across time. The impact of tax competition could for example be suspected of depending on institutional factors or differences in preferences across countries. If this is the case, then the parameter estimates for capital mobility variables in tax burden regressions give an average of the individual country parameter estimates. The panels studied in the previous literature use OECD countries, with the exception of Slemrod (2004), who includes developing countries in addition to OECD countries. The analysis below is carried out using only EU countries, which are probably a more homogenous group. The drawback of this approach is of course that it implies using a smaller sample of countries and hence fewer observations than in previous studies.

Finally, there is the issue of endogeneity. Capital taxes may have an effect on economic activity, and in turn, on some of the explanatory variables included in the test regression. This has not been taken into account in previous studies, but will be corrected for – as far as this is possible – in the analysis below.

4. Methodology

Specification and Estimation

Standard tax competition models such as that of Zodrow and Mieszkowski (1986) do not include a measure of the degree of capital mobility, but rather compare the situation of zero capital mobility with that of perfect capital mobility. As it is found that the equilibrium tax rate is lower

under perfect capital mobility, it is usually taken to imply that the equilibrium tax rate resulting from the tax competition game will depend on the degree of capital mobility, as increasing capital mobility will intensify the competitive pressures from other governments. This can in fact be formally shown to be the case in a model where the degree of capital mobility is modeled explicitly, as a quadratic mobility cost of capital, as done in Persson and Tabellini (1992) for the two-country case. Rasmussen (2001) carries this approach a step further in allowing for N countries, and shows that using a linear quadratic approach, the equilibrium tax rate resulting from the tax competition game in the non-cooperative case indeed depends negatively on the degree of capital mobility, as well as the parameters of the model^{8,9}. Theory hence suggests that the corporate tax burden should be related negatively to the degree of capital mobility. This theoretical framework is of course highly simplified and does not provide a fully-fledged structural framework from which an estimating equation with adequate control variables can be derived. Instead, in order to allow a degree of comparison with the results of the previous empirical literature discussed above, the basic specification is proposed:

$$CORPTAX_{it} = \alpha + \beta \cdot Quinn14_{i,t-1} + \gamma \cdot [GDP_C_{i,t-1}, INFL_{i,t-1}, OPEN_{i,t-1}, PART_{i,t-1}, UN_{i,t-1}] + v_i + \varepsilon_{it} \quad (1)$$

⁸ Note that this equilibrium tax rate is the outcome of the tax competition game, not the tax reaction function of each government participating in the tax game. The latter is what is estimated by, among others, Devereux et al (2004). Taking this approach requires an assumption that the game reaches equilibrium in each period under investigation.

⁹ The equilibrium tax rate is also found to be negatively related to the number of countries competing in the tax game. For the empirical specification of a model for the EU, this number poses a problem. EU countries also compete with non-EU countries, so it should in a sense refer to the number of countries in the world with strictly positive degrees of capital mobility. But if we assume that tax competition within the EU is so strong within the EU that it renders the tax competition between the EU and the rest of the world insignificant, this number could also refer to the number of EU countries and any given moment, and data for each country in the sample should only be included from the date of entry into the EU. Such an approach would exclude too many observations, however, and has hence not been followed here. In regressions not shown here, the number of EU countries at any given point in time has been included in the model, but while this inclusion does not change the significance and parameter estimate of the capital mobility term, it inflates the standard errors in general due to increased multicollinearity, and has hence been left out.

Where *CORPTAX* measures the corporate tax burden, u_i is a country specific error term, and ε_{it} is the country and time specific error term. Real gross domestic product per capita (*GDP_C*) is included to capture the proposition that higher income leads to a higher demand for public goods, also called “Wagner’s Law”, and is expected to be positively related to overall taxation in the country, and therefore also to the tax burden on capital. Inflation (*INFL*) proxies for money growth and hence controls for monetary financing of the budget, and is expected to be negatively related to the corporate tax burden. The participation rate (*PART*) is included to account for the effect of demographic changes on the government budget. *PART* is defined as the labor force divided by the population between 15 and 65 years old, and expected to be negatively related to the tax burden. Openness (*OPEN*) of the country to trade (the imports and exports to *GDP* ratio) is included to take into account changes in preferences for public good provision and taxes as a response to changes in the degree of openness, and is expected to be positively related to the degree of trade openness of the country. *OPEN* is cleaned of country size effects as proposed by Bretschger and Hettish (2002) by using the residuals from a regression of trade openness on country size as explained Table 4 in appendix. The unemployment ratio (*UN*) is included to capture discretionary countercyclical fiscal policy measures, and is therefore expected to have a negative effect on corporate income taxes.

On the basis of both visual inspection and formal (but not very powerful) tests, it cannot be rejected that most of the included variables have unit roots¹⁰. Hence, equation (1) is estimated in first differences, which also has the advantage of eliminating the fixed effects. The regressions are estimated using OLS with White robust standard errors, with the explanatory variables

¹⁰ The results of Dickey Fuller tests for all country specific time series are not shown, but can be obtained from the author.

entered with a one year lag. Even though the regression is estimated in first differences with lagged explanatory variables, it cannot be entirely excluded that causality runs on both directions with the result that regressors are correlated with the error terms. This may particularly be the case if the first differences exhibit some degree of persistence. In an attempt to correct for this potential remaining endogeneity, the regressions are also estimated using two stage least squares instrumental variable estimations (henceforth IV)¹¹. The notes under Table 2 provide information on the instruments used.

The Data

The dataset used for the panel regression analysis contains data for 13 EU countries (EU15 less Denmark and Luxembourg) from 1980 to 2001⁶. Average effective tax rates (CORPTAX) are computed by Devereux, Griffith and Klemm (2002), and data on Quinn's 14-point index (henceforth Quinn14), are computed by Quinn (1997). The larger part of the control variables are from OECD revenue statistics and OECD Economic Outlook, with a few exceptions. Details on sources are given in Table 4 in Appendix.

5. Results

The basic regression results are shown in the first column of Table 2. The parameter estimates of the control variables of the basic regressions are insignificant, with the exception of gross domestic product per capita, and the participation ratio. Both come out significant, but with a sign which is opposite to expectation. The R^2 of the regressions are rather low, and this as well as the few significant explanatory variables relative to the findings of previous studies is due mainly to the fact that the estimations are carried out in first differences and with lagged regressors¹². The

¹¹ 2SLS rather than the more general GMM has been used due to too few degrees of freedom to start iterating over the weighting matrix.

¹² Carrying out the regressions in levels with contemporaneous regressors (not shown) substantially increases the R^2 and the significance of the control variables.

regressions are found to be significant however, and the main variable of interest, Quinn14, is significantly negative in all regressions as the only one of the explanatory variables.

(Insert Table 2 here)

The hypothesis of a negative relationship between the corporate tax rate and Quinn14 is supported by the data, irrespective of whether OLS or IV is used to estimate the regression. The effect of capital mobility on the corporate tax rate is, however, found to be substantially more important when IV is used, implying that endogeneity is an issue¹³. The IV estimation method is therefore kept in the following. The parameter estimate implies that a one point increase in Quinn14 leads to a reduction in the corporate tax rate of 2.031 percentage points. Since the EU average of Quinn14 increased by approximately 4 points between 1980 and 2001 and the EU average of the average effective corporate tax rate was 40 percent in 1980, a back-of-the-envelope calculation implies that the EU average effective corporate tax rate has fallen by about 8 percentage points, or about 20 percent of the average EU effective corporate tax rate between 1980 and 2001, due to tax competition pressures. While 20 percent might not constitute a “race to the bottom”, it implies that capital mobility has been an important factor shaping corporate taxes in the last two decades. The average corporate tax burden for the EU actually fell by 30 percent between 1980 and 2001 according to the Devereux et al (2002) data, implying that not the entire fall in corporate income taxes during this period could be attributed to rising capital mobility.

6. Sensitivity

The significantly negative tax competition effect is robust to a variety of sensitivity tests. The third column of Table 2 shows the regression results when taking into account additional control

¹³ A higher parameter estimate on Quinn14 in the IV regression than in the simple OLS regression does not necessarily mean that the reverse relationship between CORPTAX and Quinn14 is positive – which would be rather unintuitive. The endogeneity captured may also derive from reverse causality of other explanatory variables, which are correlated with Quinn14. A panel VAR approach would give more information on this issue, but such an approach is prevented by data constraints.

variables which may have an influence on the corporate tax rate, namely political economy influences and agglomeration variables on the tax rate. Concerning political economy variables, Persson and Tabellini (1992) illustrate how the tax competition outcome may be mitigated when allowing for elections and changing preferences for social security in a tax competition model. The robustness of the results to political economy influences is therefore checked by including a dummy for partisanship, which takes the value one when the government in power is defined as being to the left in the political spectrum. This dummy is called LEFT (see details on construction in appendix). A leftwing government is a priori expected to prefer higher capital taxes, all else equal, thus implying that the expected sign of LEFT is positive. Moreover, the contemporaneous values of a dummy for parliamentary election years (referred to as ELEC) is included to account for election year cycles. The sign of ELEC is expected to be negative.

Regarding the control variables for agglomeration economies, Baldwin et. al (2003) show that 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 factor¹⁴. Allowing for agglomeration forces hence has the potential to reverse the results of the standard tax competition model. More importantly, the degree of agglomeration economies may be correlated with capital mobility, and hence, may be a source of unobserved heterogeneity which is directly correlated with the central explanatory variable (which should be expected to downwardly bias the parameter estimate, however). Whether or not a reversal of the standard tax competition result will take place in a model including agglomeration economies depends on the discrete cross country differential in the returns to capital employed in the corporate sectors.

Since including a measure of the return to capital would give rise to substantial endogeneity

¹⁴ See Baldwin et.al., 2003, chapter 16, for a thorough overview of tax competition in the presence of agglomeration forces.

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, another measure of agglomeration economies is also included, namely that of market size (henceforth MS) measured as total real GDP. The results show that none of the two agglomeration variables are significant, and their presence in the regression does not change the finding of a significantly negative effect of capital mobility on the corporate tax burden in European Union countries.

The robustness of the results to changes in the underlying assumptions of the average effective corporate tax measure is also tested. Devereux et al. (2002) provide six alternative series for the average effective corporate tax rate measure, each with different underlying assumptions regarding type of financing (debt or equity and retained earnings), inflation (fixed or country and time specific), type of investment project (industrial buildings or plant and machinery) and economic rent of the investment project (10, 20, 30 or 40 percent). Table 4 in appendix spells out the change in underlying assumptions carried out when computing each of the six alternative series. The six series have been used as dependent variable in turn, and the resulting parameter estimates for the capital mobility index in the resulting regressions are given in Table 3. While the effect of capital mobility on the corporate tax burden varies slightly across the different measures, the support for tax competition effects is robust to at least the specific changes in the underlying assumptions tested here.

(Insert Table 3 around here)

The few robustness tests carried out here suggest that the support of the tax competition hypothesis found in the data is quite robust. There still remains the possibility that the

significantly negative parameter estimate is driven by a simultaneous capital market liberalization and reduction in business taxes due to more market and business friendly policies rather than actual tax competition¹⁵. Since the regressions are estimated in first differences with lagged regressors, and using two stage least squares on the lagged first differences, the likelihood of this seems lower than in previous papers which have used uninstrumented, and often contemporaneous, levels of the regressants. But it cannot be dismissed entirely, and further research on this issue is therefore needed.

7. Conclusions

Despite a widespread acceptance that a race to the bottom in capital tax rates in the European Union is taking place, the empirical support for this has not been strong. Several studies have even come to the opposite conclusion that capital mobility is positively correlated with capital taxation. This paper highlights some of the potential problems and pitfalls which should be addressed 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 earlier literature. A new and more appropriate dataset for corporate tax burdens is employed, and the first panel regression analysis including only European Union countries is carried out.

The empirical analysis gives rather robust support for increased capital mobility to have resulted in a downward pressure on corporate tax burdens in the European Union since the early 1980s. The results moreover allow an assessment of the quantitative importance of tax competition pressures. Estimates suggest that increases in capital mobility has led to a reduction in corporate tax burdens of about one fifth between 1980 and 2001 on the average in the European Union.

¹⁵ This possibility is pointed out in several other studies. See for example footnote 13 in Slemrod (2004).

Whether tax competition pressures, such as those found in this paper, imply that corporate income taxes ought to be coordinated or harmonized in the European Union depends on several other factors which remain uncertain. Most importantly, the jury is still out on whether or not tax competition is harmful or improves efficiency. Tax harmonization, rather than competition, may be harmful if the latter is the case. Theory suggests that both effects are possible, and there is no consensus, nor any consistent empirical evidence for either. It is also worth keeping in mind that it is unclear what the optimal form of tax coordination or harmonization would be.

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Appendix

Data Sources and Descriptive Statistics

(Insert Table 4 and

Table 5 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 ^{/g}
Garrett (1995)	-Capital taxation ^{/d}	-Index, 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 (1998)	-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)	-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}	-Openness (exports plus imports over GDP cleaned of country size effects) -Index, number of capital controls	14 OECD Countries, 1967-1996	-Effect of openness (capital controls) on implicit corporate tax: between -13 and -20 (0 and -2.96, not robust). -Effect of openness (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).
Slemrod (2004)	-Statutory corporate tax rates -Corporate tax revenues % of GDP	-Trade openness Sachs and Warner index policy openness measure ^{/e}	Broad pool of countries (OECD+) ^{/f} , 1980-1995	-Effect of trade openness on corporate tax revenues in % of GDP: 0.027, not robust to inclusions of fixed effects. -Effect of Sachs Warner on statutory tax rate: -0.055, not robust to inclusion of fixed effects.

/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 their measure of capital taxation. /e: This is a zero-one dummy for when policy is considered open or not. See Slemrod (2004) for further details and references. /f: Slemrod (2004) does not list the countries in his sample, but refers several times to both developing and developed countries. /g: Only significant parameter significant on a 10% level or below are reported here. "Not robust" implies that the significance did not pass robustness tests conducted by the respective authors.

Table 2: The impact of capital mobility on the average effective corporate tax rate

	OLS ^a	IV ^{a/b}	IV ^{a/b} (additional controls)
Q14 ₋₁	-0.842** (0.392)	-2.031*** (0.732)	-1.939** (0.875)
GDP_C ₋₁	-0.724* (0.395)	-1.466* (0.863)	-1.883 (1.402)
INFL ₋₁	-0.017 (0.114)	-0.318 (0.247)	-0.269 (0.275)
OPEN ₋₁	-0.019 (0.014)	0.136 (1.080)	0.204 (0.148)
PART ₋₁	0.464** (0.228)	0.390* (0.234)	0.403** (0.157)
UN ₋₁	-0.333* (0.196)	-0.758 (0.465)	-0.821 (0.570)
ELEC			-0.114 (1.486)
LEFT ₋₁			0.848 (0.563)
AGGL ₋₁			-0.076 (0.142)
MS ₋₁			0.009 (0.011)
Obs.	241	195	182
R ²	0.02	-0.23	-0.45
DW	1.98	2.03	2.07
J-test ^c		18.5 (p=0.61)	14.5 (p=0.69)

*** (***) (): Parameter estimate equal to zero rejected on 1% (5%) (10%) significance level.

/a: Estimation carried out in first differences with White robust standard errors

/b: IV regressions are carried out using 2SLS. Instruments: 2nd and 3rd lag of first differences, 3rd lag of levels, and 1st and 2nd of the election year, a total of 27 instruments.

/c: J test for overidentifying restrictions, adapted from GMM to the 2SLS case by imposing the weighting matrix of 2SLS and no iterations. Under the null of no overidentification, J is chi-square distributed with 21 (17 in the last column) degrees of freedom

Table 3: Robustness of CORPTAX parameter estimates to using alternative underlying assumptions for the effective average corporate tax rate^c

	OLS ^a	IV ^{a/b}
CORPTAX1	-0.548** (0.273)	-1.331** (0.584)
CORPTAX2	-0.962** (0.432)	-2.058** (0.824)
CORPTAX3	-0.831** (0.413)	-1.900** (0.835)
CORPTAX4	-0.805* (0.416)	-1.973** (0.836)
CORPTAX5	-0.826** (0.414)	-1.845** (0.849)
CORPTAX6	-0.823** (0.415)	-1.815** (0.857)

*** (***) (): Parameter estimate equal to zero rejected on 1% (5%) (10%) significance level.

/c: The assumptions underlying the 6 alternative measures of CORPTAX are laid out in appendix. Only parameter estimates for CORPTAX are reported. The complete regression output can be obtained from the author upon request.

/a: Estimation carried out in first differences with White robust standard errors

/b: IV regressions are carried out using 2SLS. Instruments: 2nd and 3rd lag of first differences, 3rd lag of levels, and 1st and 2nd of the election year, a total of 27 instruments.

Table 4: Definitions and sources of data used in the panel regression analysis

Variable	Definition and Sources
AGGL	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
CORPTAX	Average effective corporate tax rate are computed by and described in Devereux, Griffith and Klemm (2002) and downloaded from the Institute of Fiscal Studies Homepage: http://www.ifs.org.uk/publications.php?publication_id=3210 .
CORPTAX1	Alternative average effective corporate tax rate. Computed as CORPTAX, but debt financed investment instead of finance through equity of retained earnings. Source: Same as that of COPRTAX.
CORPTAX2	Alternative average effective corporate tax rate. Computed as CORPTAX, but country and time specific inflation rates are assumed instead of a fixed uniform inflation rate. Source: Same as that of COPRTAX.
CORPTAX3	Alternative average effective corporate tax rate. Computed as CORPTAX, but with an assumed 20% instead of 10% rent. Source: Same as that of COPRTAX.
CORPTAX4	Alternative average effective corporate tax rate. Computed as CORPTAX, but the investment is assumed done in industrial buildings instead of plant and machinery. Source: Same as that of COPRTAX.
CORPTAX5	Alternative average effective corporate tax rate. Computed as CORPTAX, but with the assumption of 30% rent instead of 10% rent. Source: Same as that of COPRTAX.
CORPTAX6	Alternative average effective corporate tax rate. Computed as CORPTAX, but with the assumption of 40% rent instead of 10% rent. Source: Same as that of COPRTAX.
ELEC	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/
GDP_C	Real GDP per capita. Source: Computed on the basis of data from OECD Economic Outlook
INFL	Yearly percentage change in the consumer price index. Source: OECD Economic Outlook
LEFT	Dummy for the ideology of the government in power, based on data provided by Woldendorp et. al (2000), which classifies ideology of government into five cases based on the number of fraction of parliament and government made up by left and right wing parties. First case is when right wing parties dominate both government and parliament, and in the fifth case, left wing parties dominate government. The left wing dummy (<i>LEFT</i>) takes the value one in case 4 and 5.
MS	Market size: Constant GDP measured in US dollars. Source: OECD Economic Outlook
OPEN	Residuals of a regression of the sum of exports and imports divided by $1.000.000 * GDP$ (all in current local currency) on the relative size of the country (size is measures as real GDP in percent of sum of real GDP of the panel countries). Own calculations based on data from 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.
Quinn14	Quinn's 14 point index of financial liberalization as described in Quinn (1997). Source: Kindly provided by Dennis Quinn.
UN	Unemployment rate, percent. Source: OECD Economic Outlook

Table 5. Descriptive statistics

Variable	Mean		Std. Dev		Observations ^a		
	Overall	Overall	Between	Within	N	n	T
AGGL	0.007	86.46	87.44	18.80	433	14	31
CORPTAX	33.417	11.43	8.78	7.47	309	13	24
CORPTAX1	12.241	6.59	4.64	4.77	309	13	24
CORPTAX2	33.607	11.95	9.06	8.03	300	13	23
CORPTAX3	35.735	11.89	9.08	7.83	309	13	24
CORPTAX4	36.839	12.31	9.77	7.74	313	13	24
CORPTAX5	36.774	12.05	9.22	7.98	313	13	24
CORPTAX6	37.393	12.17	9.30	8.06	313	13	24
ELEC	0.280	0.45	0.04	0.45	446	14	32
GDP_C	33272	488719	128270	473243	413	14	31
INFL	7.189	5.87	3.18	5.01	448	14	32
LEFT	0.534	0.52	0.27	0.45	379	14	27
MS	10486.32	211032	38356	207851	447	14	32
OPEN	4.880	31.95	28.04	17.05	433	14	31
PART	64.862	2.83	1.88	2.17	432	14	31
Quinn14	11.208	2.75	1.66	2.24	434	14	31
UN	7.272	7.28	2.83	6.75	447	14	32

a/: N is the total number of observations for the given series, n is the number of cross sections for which the series exists, and T is the maximum number of years for which the series is available. Thus, the total number of observations can be smaller than n*T when some countries have a shorter time series dimension than the maximum.

9. Graphs

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

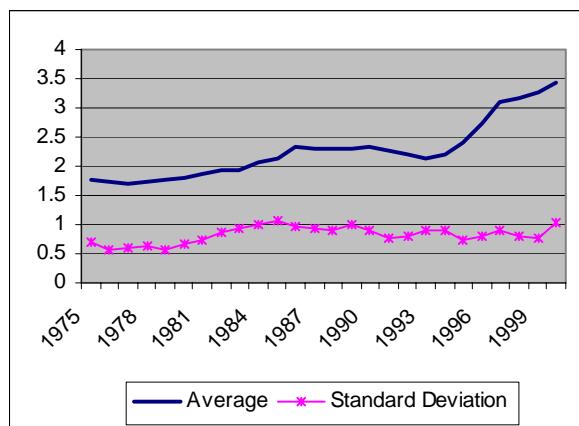


Figure 2: EU average and standard deviation of implicit capital income taxes, 1975 – 2000

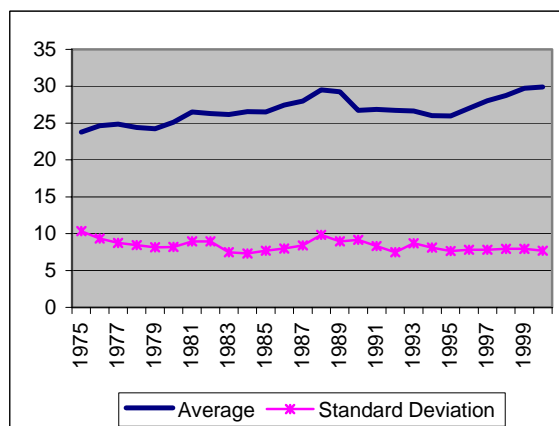


Figure 3: EU average and standard deviation of the effective average tax rate, CORPTAX, 1979 – 2003

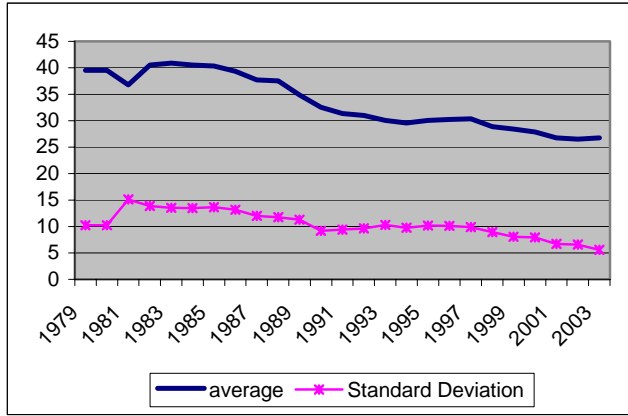


Figure 4: EU average and standard deviation of Quinn's 14 point index, 1975 – 2000

