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Country Size and Corporate Tax Rate: Rationale and Empirics*

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Abstract

This paper investigates whether the differences in corporate tax rates set by countries can be explained, in part, by the size of national home markets. We set up a simple model in which multinational firms within an industry choose where to invest, given the levels of corporation tax rates in each location. This model yields predictions with respect to the influences of the relative size of countries on the differences in corporate tax rates that should arise in equilibrium. We then test these predictions using data from 27 European Union member-states for the period 1981-2005. Consistent with our model, we find that large countries set higher corporate tax rates than their smaller competitors for FDI. Our rationale for the existence of this effect, the market access, withstands the test of alternative explanations.

Keywords: country size, corporate tax rate, foreign direct investment, tax competition.

JEL classification: E62; F23; H25.

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1 Introduction

Tax competition models suggest that national corporate tax rates are strongly influenced by country size (Bucovetsky, 1991; Wilson, 1991; Haufler and Wooton, 1999). While these models share the prediction that larger countries set higher taxes than smaller countries, they propose different theoretical explanations for this positive relationship. Bucovetsky (1991) and Wilson (1991) consider that small countries face a more elastic capital supply with respect to changes in corporate tax rates (as they are price takers in the world capital market) than larger countries, leading them to set a lower corporate tax rate. Devereux et al. (2008) argue that larger countries have a higher proportion of domestic and consequently less mobile activity that governments prefer to tax at higher rates than foreign activity. Lastly, Haufler and Wooton (1999) highlight that a large country is a more attractive location for investment than a smaller country, allowing the former to set a higher corporate tax rate than the latter.

Empirically, robust evidence on the relationship between country size and national corporate tax rates is largely absent from the literature. Empirical papers considering the determinants of corporate tax rates focus mainly on two aspects of tax competition. Some look at the strategic interactions between countries, resulting in interdependent corporate tax rates (Devereux et al., 2008; Overesch and Rincke, 2011), while others examine the effect of globalisation (proxied by measures of economic and financial openness or capital mobility), which is expected to increase competitive pressures on corporate tax rates (Rodrik, 1997; Bretschger and Hettich, 2002; Swank and Steinmo, 2002; Slemrod, 2004; Winner, 2005). Country size is not the main focus of these empirical analyses, although it is generally included in the econometric models as a control variable. The coefficient estimated on country size exhibits a positive sign, but its statistical significance is not consistently established.

Given the various ambiguities present in the existing literature, the purpose of this paper is to analyse the theoretical and empirical effects of country size on the level of corporate tax rates and to determine whether the data can distinguish between competing theoretical explanations for a positive relationship between both variables.

We start with an m-country variant of the regional tax-competition model of Haufler and Wooton (2010). The focus of our analysis is to consider the differences between potential host countries that might influence a firm's choice of location. More specifically, we shall determine the difference in corporate tax rates between two dissimilar hosts that would make a firm indifferent as to where it might locate.[1] In our model, we show that, in addition to the prediction that larger countries set a higher corporate tax rate on firms in equilibrium

[1] An optimising country will not reduce its tax below what is necessary to attract a firm, so the equilibrium of a tax-competition game will be characterised by firms having no incentive to relocate their production activities.

as compared to the corporate tax rate set by smaller countries, the tax rate depends upon other aspects of its "geographical advantage", including product market competition and the ease of access to foreign markets.

We then take these predictions to the data by considering 27 European Union member-states for the period 1981-2005. We find evidence consistent with our theoretical prediction that countries set their statutory tax rates in accordance with their market size, such that large countries set higher corporate taxes than their smaller competitors for FDI. Our baseline equation indicates that doubling GDP increases the statutory tax rate by 12 percentage points. This relationship has not diminished in recent years despite increased international pressures for tax competition. Furthermore, we find that market size mitigates government responsiveness to the statutory tax rates of competitor countries belonging to the same region. The response of an average size country to a one percentage point change in foreign statutory tax rates is a change of 0.80 percentage point, while it is 0.15 percentage point for the largest EU countries. Through the estimation of a dynamic model, we show that the effects of market size we identify using static models can be interpreted as long-run effects. Finally, we attempt to discriminate empirically between the alternative theories that propose a positive relationship between country size and the corporate tax rate. We introduce variables in our model related to the extent to which a country is price-maker in the world capital market or the share of economic activity carried out by domestic firms. Our results support our market access rationale.

The paper is organised as follows. Section 2 provides an analytical framework. Section 3 presents the empirical specification and the data, and Section 4 presents the results. Section 5 offers concluding remarks.

2 Analytical Framework

Our starting point is a multi-country variant of the model of tax competition by Haufler and Wooton (2010) in which m nations within a region compete to attract a fixed number of firms from an oligopolistic industry.[2] Our focus is on the differences in national corporation taxes that are consistent with the equilibrium allocation of firms across the region. We are especially interested in comparing the differences in corporation taxes to the differences in market opportunities offered by competing nations in order to determine whether larger countries might be expected to have higher taxes.

We assume that the firms produce an homogeneous good, labelled x. A second, private good, the numeraire commodity z, is produced under conditions of perfect competition. Every household in the region supplies a single unit of labour. We assume that the wage in each country is exogenously determined, where the wage in country i is w_i.[3]

[2]We assume that the number of firms is fixed in order to ensure that the industry generates positive profits.

[3]We assume that the national wage rate is determined exogenously to the model.

The region has *m* countries, each represented by a government that uses taxation policy to improve the economic wellbeing of its residents. The countries may differ in size such that there are n_i consumers in country i . The population of the region is normalised to unity and so

$$\sum_{i}^{m} n_i = 1. \tag{1}$$

2.1 Consumers

Consumers in all countries are assumed to have identical preferences for the goods, given by

$$u_i = \alpha x_i - \frac{\beta}{2} x_i^2 + z_i, \qquad i \in M = \{1, 2 \dots m\} \tag{2}$$

In order to simplify the analysis and without loss of generality, we choose the size of unit of x such that β=1. Moreover, total corporation tax revenue, denoted by R_i, is redistributed equally and in a lump-sum fashion to the consumers in each country. The budget constraint for a representative consumer in country i is then

$$w_i + \frac{R_i}{n_i} = z_i + p_i x_i, \tag{3}$$

where p_i is the price of good x in country i. Utility maximisation leads to inverse-demand curves $\alpha - \beta x_i$, $\forall i$.

Aggregating the demand for good x over all consumers yields market demand curves for each country, denoted X_i:

$$X_i = n_i(\alpha - p_i). \tag{4}$$

2.2 The Oligopolistic Industry

There are k firms that are prepared to invest in the region.[4] Each of these firms possesses one unit of "knowledge capital" (such as a license or patent) that can be profitably employed in the imperfectly competitive industry i. This factor is indispensable for the production of good x but limited in availability such that, at most, k firms can engage in production. In addition, each firm faces fixed and identical costs of setting up a production facility in any of the countries. These costs are assumed to be sufficiently large to ensure that each firm will set up, at most, one production plant in the region. Thus each firm will serve the regional market from one of the countries in the region.[5] Firms are assumed to be identical except with respect to the location of their

[4]We ignore the ownership of the firms, assuming that any after-tax profits are spent outside the region.

[5]If trade costs were sufficiently high relative to these fixed costs, the firm might choose to "jump" the trade barrier and produce in both markets. We assume that this is not the case. We further assume that the trade costs between the region and the rest of the world are sufficiently high that no firm would choose to service the region's national markets from a third country outside the region. For notational simplicity the fixed costs are suppressed in the equations below.

production facilities. Location matters because, while all firms can sell their products in both countries, there are trade costs associated with exports to a firm's foreign market. Thus each country's market may be served by both "local" firms that produce domestically and "foreign" firms that are based in one of the other countries.

Labour is the only variable input in good *x* production. Each unit of good *x* requires the efforts of γ workers, where γ is chosen so that production of *x* does not exhaust each country's labour supply. Given this, the marginal cost of production can be defined as $\omega_i \equiv \gamma w_i$. The cost of exporting a unit of output is τ_i, which raises the marginal cost of serving the foreign market to $(\omega_i + \tau_i)$. We are assuming that all of the trade costs are "real", taking the form of, say, transport costs or administrative barriers to the free movement of goods between countries. There are no (endogenously determined) tariffs between the countries as we assume that the region is a free-trade-area.[6]

Firms are assumed to behave as Cournot competitors and are able to segment their markets, choosing the quantities to sell on their domestic and export markets independently.[7] The total operating profit of each firm, which equals the return to the required unit of knowledge capital, is thus defined as

$$\pi_i = (p_i - \omega_i)\, x_{ii} + \sum_{h \neq i}^{M} (p_h - \omega_i - \tau_i)\, x_{hi}, \tag{5}$$

where π_i is the pre-tax profit of a firm based in country i and x_{hi} represents sales in country h by a firm based in country i. A firm based in country i will be at a disadvantage in export market h compared to local producers if its costs of serving the market are higher than those of its rivals, that is if $\delta_{hi} > 0$, where

$$\delta_{hi} \equiv (\omega_i + \tau_i) - \omega_h. \tag{6}$$

Suppose that country i has k_i "local" firms, that have located their production facility in the country, while the remaining $(k - k_i)$ firms service country i's market from other countries within the region. Maximising profits (5), taking into account demand (4), Cournot competitors will produce the following quantities for each market:

$$x_{ii} = n_i\,(p_i - \omega_i)\,, \quad x_{ji} = n_j[p_i - (\omega_i - \tau_i)]. \tag{7}$$

Total sales in the market of country i are found from aggregating the outputs in (6):

[6] Unless country i sits equidistant from all other countries, the costs associated with exporting goods to foreign consumers will differ across the destination markets (and this will also be the case for the costs of importing goods from different sources). For simplicity, we ignore this issue and work with the average cost. This could be rationalised by assuming that all goods that are traded in the region pass through a central warehouse and it is the distance from that warehouse that determines a country's trade cost.

[7] In equilibrium, firms will receive a lower producer price for their exports than for goods destined for the domestic market. The trade structure is simply a generalisation of the "reciprocal dumping" model of Brander and Krugman (1983).

$$X_i = k_i x_{ii} + \sum_{j \neq i} k_j x_{ij}. \tag{8}$$

In order to simplify the notation, we introduce two new terms that capture elements of firms' marginal costs of serving a market. Let $\Omega \equiv \sum_i k_i \omega_i$ be a measure of aggregate production costs across all firms in all locations. Ω/k is the mean marginal cost of firms operating in the region. We can also have a measure of aggregate trade cost, where $\mathrm{T}_i \equiv \sum_{j \neq i} k_j \tau_j$ accounts for the trade costs of foreign firms in getting goods to country i's market. Using these terms and substituting (8) into the demand curve (4), yields expressions for the price and total quantity sold in country i:

$$p_i = \frac{\alpha + \Omega + \mathrm{T}_i}{(k+1)}, \quad X_i = \frac{n_i \left(k\alpha - \Omega - \mathrm{T}_i\right)}{(k+1)}, \tag{9}$$

Substituting the equilibrium price into firm outputs (7), yields the quantities supplied by domestic and foreign firms to country i's consumers:

$$x_{ij} = n_i \Gamma_i, \quad x_{ij} = n_i [\Gamma_i - \delta_{ij}], \tag{10}$$

where Γ_i is a measure of the (lack of) competitiveness in the market:

$$\Gamma_i \equiv \frac{\alpha - \Omega - \mathrm{T}_i}{(k+1)} - \omega_i. \tag{11}$$

The market share of a domestic firm will clearly be higher than that of a foreign firm if the additional trade cost faced by the exporter is not offset by lower production costs in its location.

Substituting (10) and (11) into (5) yields the pre-tax profits of a firm that is based in country i:

$$\pi_i = n_i \Gamma_i^2 + \Sigma_{j \neq i} n_j [\Gamma_i - \delta_{ij}]^2, \tag{12}$$

We assume that profits are taxed at source by the host countries of the firms. Let t_i be the proportional corporate tax imposed on each firm by country i.[8] In deciding upon where to invest, firms will compare profits net of taxes and locate in the most profitable country. The locational equilibrium for the industry is characterised by

$$(1 - t_i)\, \pi_i = (1 - t_j)\, \pi_j \tag{13}$$

for every pairwise combination of countries, i, $j \in M$. In other words, a more profitable investment location

[8]Other variants of the simple of regional tax competition have made the analytically convenient assumption that corporate taxes are lump-sum in nature (see, for example, Haufler and Wooton (1999, 2010)).

can capture the difference in profits (its "geographical advantage") by charging a higher tax.

From (12) and (13) we can find an expression for this tax differential:

$$\frac{1-t_j}{1-t_i} = \frac{n_i\Gamma_i^2 + n_j\left(\Gamma_j - \delta_{ji}\right)^2 + \sum\limits_{h\neq i,j} n_h\left(\Gamma_h - \delta_{hi}\right)^2}{n_i\left(\Gamma_i - \delta_{ij}\right)^2 + n_j\Gamma_j^2 + \sum\limits_{h\neq i,j} n_h\left(\Gamma_h - \delta_{hj}\right)^2}. \tag{14}$$

The left-hand side of equation (14) is the ratio of shares of profits that are retained by firms in country j relative to those in country i. This ratio is always positive as both numerator and denominator must be positive. If country i imposes a positive corporate tax then this cannot expropriate more than the total profits generated by the firm, giving a lower bound to $(1 - t_i)$ of zero. Should the host country subsidize the firm (as is the outcome of some analytical experiments) then $(1 - t_i)$ will exceed unity. The larger the ratio on the left-hand side, the higher the tax rate being levied on corporate profits in country i compared to that being charged in country j. This will be consistent with an equilibrium if corporate profits in country i are larger than those in country j by the same proportion.

2.3 Determinants of Firm Location

Let's consider the components of equation (14) in more detail. This expression holds if the difference between any two countries' corporate taxes exactly compensates for the difference in the returns offered to a firm by production facilities in each location. It reflects an equilibrium relationship, so is consistent with bilateral comparisons across countries at a single point in time. There is no explanation of an individual country's strategy or incentives in choosing its taxes - we are simply assuming that no country offers a lower tax than is necessary to attract the firms that it is successful in capturing. We are therefore not intending to explain the evolution of taxes over time and we have nothing to say about whether countries are becoming increasingly competitive with each other.

If the equation were not to hold, what would this mean? Given that the expression represents an equilibrium in which a potentially footloose firm has no incentive to relocate its production facilities from one country to another, a violation of the equality would indicate that there is some omitted factor that also influences the firm's choice of location and/or its ability to move. One explanation might be the existence of sunk costs that are sufficiently large that, despite a firm having higher variable costs in its present location compared to those in an alternative host, the firm's present value of after-tax profits is higher if it stays where it is. This explanation would not hold for new investment but there may be international differences in the fixed cost of investment (or externalities arising from production in one location compared to another) that make a profit-maximising firm willing to choose a location with higher marginal costs.

The right-hand side of equation (14) can be examined in two parts. The first two terms in both the numerator and the denominator provide a comparison between countries i and j with respect to each being the location of production for the two markets.[9] Whether it is more profitable to locate in one country as compared to the other would depend upon the relative size and competitiveness of the two markets, as well as the relative cost of servicing the markets by domestic production as compared to exports. The final terms in the numerator and denominator of equation (14) reflect the relative advantages of the two locations as production bases to service the other countries in the region. The importance of these terms depends upon the size of these common export markets and the relative cost of producing for these markets.

We now consider a little more closely some of the terms in equation (14), in order to inform the empirical exercise that follows.

2.3.1 Population

This is pretty straightforward, as n_i is the share of the region's population living in country i. It seems clear from equation (14) that Haufler and Wooton (2010)'s central result holds in this multi-country setting, in that a country with a relatively larger share of the region's population will be associated with a higher rate of corporate tax.

2.3.2 Market competition

Γ_i is composed of general terms and elements specific to country i and, as previously suggested, provides a measure of market competition. Specifically, it is inversely related to the competitiveness of country i's market. A little rewriting of (11) yields an expression that is clearer to interpret:

$$\Gamma_i = \frac{\alpha + \sum_{j \neq i} k_j \left(\omega_j + \tau_j\right) - \left[(k+1) - k_i\right] \omega_i}{k+1}. \tag{15}$$

The first term in the numerator, α, is a measure of the demand for the product. This is assumed to be the same across all markets in the region. The next term is an aggregate expression that combines the number of firms serving the market of country i from abroad and their marginal costs of producing these exports. Taking this and the final term together, we can determine that having fewer local firms and higher costs for foreign firms in serving the home market, makes the market less competitive and hence more profitable to a firm that chooses to locate in the country.[10]

[9] In previous analytical work such as Haufler and Wooton (2010), the focus has been on a region with only two countries and consequently the first two terms in the numerator and denominator would be the only determinants of firms' choices of location.

[10] To see this most clearly, assume more symmetry in the model, such that ω_i and τ_i are the same across the region. This results in $\Gamma_i = \frac{(\alpha-\omega)(k+1)\tau}{k+1}$. As the number of local firms k_i increases Γ_i declines.

2.3.3 Market access

δ_{hi} compares the marginal cost of producing goods locally in country h with that of producing them in country i, taking into account trade costs of importing to country h from country i. A firm would find it more attractive to locate in a peripheral country (away from the core of the region's consumers) if the cost differential of production in the host was sufficiently great (compared to production in the core) such that it more-than-offset the greater trade costs of servicing markets in the core. The better the market access enjoyed by a firm located in country i in serving consumers in country h, the smaller is δ_{hi}.

2.3.4 Analytical predictions

In summary, our analytical model predicts that a country is relatively more attractive for FDI and consequently is able to charge a relatively larger rate of corporate tax, when (i) it has a relatively large domestic population; (ii) its domestic market is relatively uncompetitive; and (iii) it has good access to consumers in surrounding markets.

3 Testing the Theory

3.1 The Sample

Corporate tax competition takes place when countries strategically use their tax instrument to compete for mobile capital. For the purpose of this analysis - which is to shed light on the role played by market size on this tax competition process - the sample considered in the paper should contain countries that are expected to compete against each other for multinational firms. As emphasised by Winner (2005), tax competition pressures increase with the integration of economies. Thus, we decide to focus first on the 27 European Union (EU) member-states,[11] as their geographical proximity, their economic and political union, and their increased interdependence make them highly integrated economies. In a second step, we extend the sample by considering non-EU OECD countries.[12] This allows us to test whether our assumption of regional tax competition is correct.

3.2 The Econometric Model

The analytical framework in Section 2 assumed a bilateral setting of corporate tax rates, where for every pair-wise combination of countries $i, j \in M$, the larger country charges a higher tax. In principle, each country could respond differently to the market size and the corporate tax rate in every other country. However, as noted by

[11] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom.

[12] Australia, Canada, Chile, Iceland, Israel, Japan, Korea, Mexico, New Zealand, Norway, Switzerland, Turkey, United States.

Devereux et al. (2008), empirically such a bilateral approach cannot be implemented because it would entail the estimation of a very large number of parameters. We therefore follow the empirical literature by adopting a multilateral approach.

Our econometric model relates the corporate tax rates of 27 EU countries to their market size and to a range of country-level variables, for the period 1981-2005. Our baseline equation is:

$$t_{it} = \beta_1 n_{it} + x_{it}\gamma + \theta_t + C_i + \epsilon_{it}, \tag{16}$$

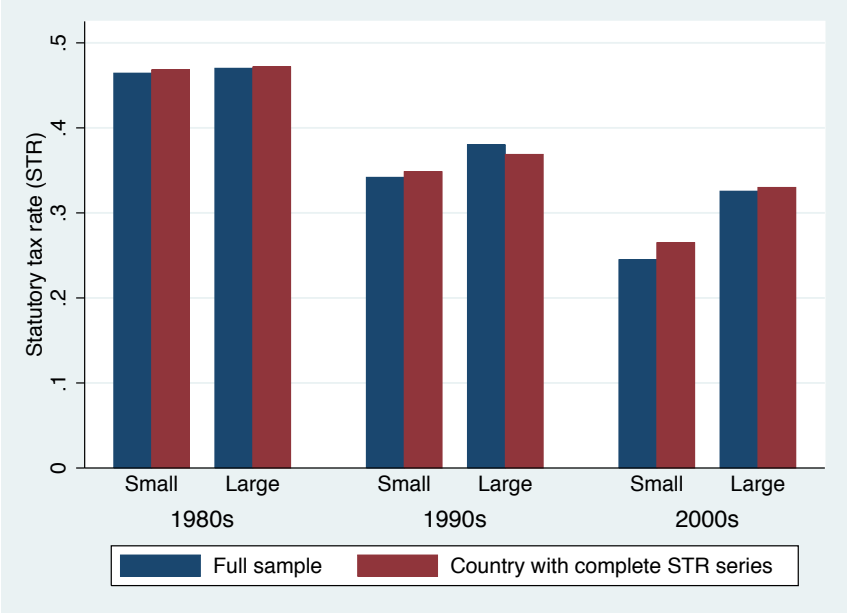
where t_{it} denotes the corporate income tax rate of country i in period t, n_{it} denotes the market size, x_{it} represents a vector of explanatory variables, θ_t and C_i are time and country fixed effects respectively, and ϵ_{it} is the error term.

The corporate tax rate is measured by the *statutory tax rate* (STR). This measure presents a number of advantages. As emphasised by Overesch and Rincke (2011), it is the simplest indicator of expected tax payments for firms and it is readily available across countries and years. However, while the statutory tax rate is the most relevant variable for the determination of income shifting, it neglects the tax base, and thus, it is an imperfect indicator for investment and the location of firms. More complex measures of effective tax rates take into account the role of the base of the corporation income tax but, as emphasised by Swenson (1994) and Slemrod (2004), these measures rely on a number of arbitrary assumptions about economic parameters and do not consider some characteristics of the tax system that can influence the decision of the firms such as the degree of enforcement of the tax system. The existing empirical literature provides some evidence about how meaningful the statutory tax rate is for the decision of the firms and for government strategies to compete for firms and investment. Most papers working on the relationships between the statutory tax rates and FDI find a negative and statistically significant elasticity between both variables. This is to some extent summarised by the meta-analysis of De Mooij and Ederveen (2003), with a tax elasticity of -1.2. In addition, Devereux et al. (2008) and Overesch and Rincke (2011) findings suggest that governments compete only over the statutory tax rates, supporting "the view that countries compete for paper profits and profitable firms rather than marginal investments", (Overesch and Rincke, 2011, p600).

The variable of interest, *market size*, is measured by GDP in constant 2000 $US. Figure 1 presents the average statutory tax rate of small countries (with a GDP lower than the sample average) and large countries (with a GDP higher than the sample average) for the 1980s, 1990s and 2000s. Small countries exhibit a lower statutory tax rate on average than large countries. It is interesting to note that there is a decrease in statutory tax rates for both group of countries and that the tax differential between small and large countries substantially increases during these three decades. Figure 2 presents a scatter plot of the variables country size and statutory tax rate

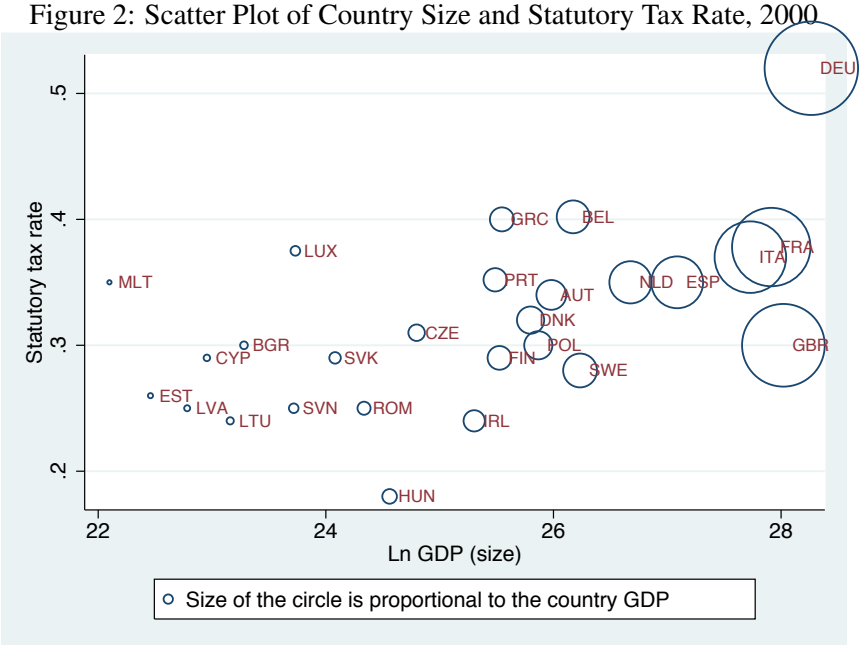
for the year 2000, with the size of the circle for each country being proportional to its GDP. In line with our theoretical predictions, the scatter plot indicates a positive relationship between both variables.

Figure 1: Country Size and Statutory Tax Rate



Notes: Small countries: countries with a GDP lower than the GDP average. Large countries: countries with a GDP higher than the GDP average.

Figure 2: Scatter Plot of Country Size and Statutory Tax Rate, 2000



3.3 Control Variables

The choice of the control variables is based on the existing literature, e.g. Slemrod (2004), Devereux et al. (2008). The age and the geographical distribution of the population could influence national tax policies. We therefore include as control variables the *proportion of young*, corresponding to the proportion of the population below 14 years old, the *proportion of old*, corresponding to the proportion of the population above 65 years old, and the *proportion urban*, corresponding to the proportion of the population living in urban areas. As argued by Gordon and Slemrod (2000) and Slemrod (2004), the corporate income tax serves as a "backstop" for the personal income tax, since it ensures that individuals do not have an incentive to escape personal income taxes by reclassifying their income as corporate income. We take into account this backstop role of the corporate income tax by including the *top personal income tax rate* among the control variables. Finally, we control for the revenue needs of a government by including a measure of *government spending*, corresponding to the general government consumption expenditure in percentage of GDP.

3.4 Additional Variables

In line with the predictions of our model, we consider additional variables. These variables take into account governments' strategic interactions, desire to attract FDI, foreign market potential, trade accessibility, and product market competition.

As in the rest of the literature, we proxy governments' strategic interactions in competing over the statutory tax rate with the *average statutory tax rates* of other countries. Following Devereux et al. (2008), we use a simple average to construct this spatial lag term.

When setting the corporate tax rate, a government's consideration of its market size ought to be affected by its willingness to attract FDI. At the extreme, countries which do not compete to attract FDI would set a corporate tax rate depending purely on their domestic needs. The willingness to attract FDI is proxied by a measure of *capital openness* which is then interacted with the market size. From a broader perspective, introducing a measure of capital openness to the empirical model allows us to assess the effect of globalisation on corporate tax rates. As summarised by Slemrod (2004), there is no consensus in the literature on tax competition about the effect of globalisation (often proxied by trade or capital openness) on corporate tax rates. We use the index created by Chinn and Ito (2008), which measures the degree of openness in capital account transactions by considering the extent and intensity of capital controls.[13]

[13]The index is a principal component of four variables summarising the restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions: a variable indicating the presence of multiple exchange rates (k1); a variable indicating restrictions on current account transactions (k2); a variable indicating restrictions on capital account transactions (k3);[14] and a variable indicating the requirement of the surrender of export proceeds (k4). This variable is a *de jure* measure of capital openness as it is coded on the basis of regulatory restrictions on capital.

A country which is located close to large foreign markets should be able to set a higher tax rate than other countries. We test two measures of foreign market potential. The first proxy is the *Harris (1954) market potential*. This variable is the sum of foreign GDPs weighted by the inverse of bilateral distance. The second proxy is the *Redding and Venables (2004) foreign market access*. It can be interpreted as the sum of countries' propensities to demand imports weighted by the inverse of bilateral trade costs.

We also include the sum of the inverse of bilateral trade costs, because greater trade accessibility can induce a country to lower its tax rate. This measure of *trade accessibility* varies over time. It includes, in addition to the effects of time-invariant geographic characteristics (e.g. distance, common language) on international trade, those of time-varying memberships in free trade and common currency associations.[15]

We finally consider the theoretical prediction that a less competitive market is more profitable to firms choosing to locate in the country by adding a proxy for the *Intensity of local competition*. This measure is based on a survey conducted by World Economic Forum (2013) and provided by Teorell et al. (2013), in the Quality of Government Standard Dataset. Randomly selected firms representing the main sectors of the economy, were asked to assess, on a scale of 1 (limited) to 7 (intense), the intensity of competition in the local markets in which they operate. We use the country score for the period 2011-2012. To deal with a potential endogeneity bias, the variable *Effectiveness of anti-monopoly policy* from the same source will be used as an instrumental variable. Respondents had to evaluate, to what extent anti-monopoly policy promotes competition in their country, on a scale of 1 (does not promote) to 7 (effectively promotes competition).

Description and summary statistics for all variables are available in Tables 1 and 2.

[15] We assume symmetry of trade costs.

Table 1: Description of variables

Variable	Description	Source
Statutory Tax Rate	Statutory Corporate Income Tax Rate	Tax rates were compiled primary from the OECD Tax Database, and were supplemented with PriceWaterhouseCoopers: a Worldwide Summary, when overlapping data was consistent.
Size (ln gdp)	GDP in constant 2000 $US	World Bank - World Development Indicators
Population proportion young	proportion of the population below 14 years old	World Bank - World Development Indicators
Population proportion old	proportion of the population above 65 years old	World Bank - World Development Indicators
Population proportion urban	proportion of the population living in urban areas	World Bank - World Development Indicators
Individual tax rate	Top statutory marginal personal income tax rate	Sabirianova Peter et al. (2009)
Government spending	General government consumption expenditure (% of GDP)	World Bank - World Development Indicators
Capital openness	Index: degree of openness in capital account transactions	Chinn and Ito (2008)
Ln Harris foreign market potential	Estimated with measures of bilateral distances and foreign GDPs	Harris (1954)
Ln Redding&Venables (R&V) foreign market potential	Estimated using time-specific coefficients from a gravity model for trade	Redding and Venables (2004)
Ln Bilateral trade costs	Measure of time-varying bilateral trade costs	Head and Mayer (2011)
Product market competition	Index: intensity of competition in the local markets	Teorell et al. (2013)
Effectiveness of Anti-Monopoly Policy	Index: to what extent anti-monopoly policy promotes competition in the local markets	Teorell et al. (2013)
Financial assets/world financial assets	Stock of financial assets (portfolio investment, FDI, debt, financial derivatives), over world total	Lane and Milesi-Ferretti (2007), updated and extended version.
Domestic activity/GDP	Gross fixed capital formation minus FDI and portfolio investment	World Bank - World Development Indicators
Inward FDI/GDP	Stock of inward FDI over GDP	Lane and Milesi-Ferretti (2007), updated and extended version.
Financial liabilities/GDP	Stock of financial liabilities (FDI, portfolio investment, financial derivatives) over GDP	Lane and Milesi-Ferretti (2007), updated and extended version.

Table 2: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Statutory tax rate (STR)	0.37	0.10	0.10	0.62	550
Size (ln GDP)	25.29	1.77	21.23	28.3	550
Population proportion young	19.06	2.99	13.73	30.18	550
Population proportion old	14.1	2.18	9.41	19.62	550
Population proportion urban	71.52	11.9	43.29	97.29	550
Individual tax rate	0.46	0.14	0.10	0.80	550
Government spending	19.83	3.76	5.69	29.59	550
Other countries' STR	0.37	0.07	0.25	0.49	550
Capital openness	1.05	1.47	-1.86	2.46	517
ln(Harris foreign market potential)	26.23	0.24	25.61	26.8	550
ln(R&V foreign market potential)	15.84	1.22	13.73	19.8	550
ln(sum bilateral trade costs)	-5.19	0.67	-6.87	-2.72	550
Intensity of local competition	4.45	0.63	3.41	5.66	27

4 Results

4.1 Baseline Regression Results

Table 3 presents our baseline regression results, in which the statutory corporate tax rate is regressed on country size and a set of control variables. All estimations have heteroskedasticity-consistent standard errors and include (unreported) country-specific and time-specific effects.[16] Starting with the control variables, Column [1] indicates that the age distribution of the population influences tax policy. Both demographic variables - proportion of population below 14 years old and proportion of population above 65 years old - have a statistically significant positive effect on the statutory tax rate. However, the geographical distribution of the population between urban and rural areas is not significantly different from zero. The top individual income tax rate has a positive and statistically significant effect on the statutory tax rate. This is consistent with the idea that the corporation income tax serves as a "backstop" to the personal income tax. Finally, in line with the empirical results of Slemrod (2004) and Devereux et al. (2008), government spending does not seem to have a systematic relationship with the statutory tax rate. As indicated by Slemrod (2004), the absence of correlation suggests that the setting of the corporate income tax rate is disconnected from fiscal receipts collection.

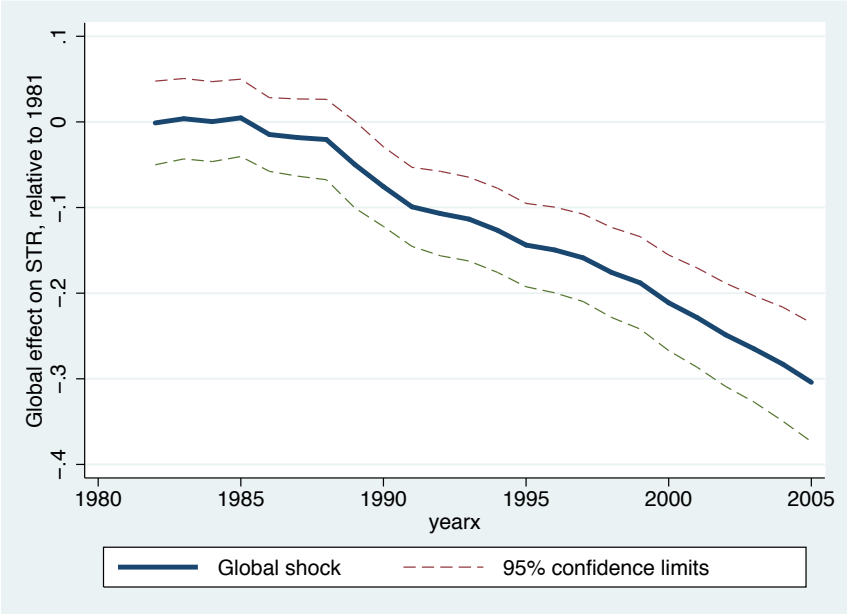
In agreement with our theoretical predictions, there is clear evidence of a positive relationship between country size and the statutory tax rate. In Column [1], the coefficient of 0.175 indicates that doubling market size increases the statutory tax rate by about $ln(2) \times 0.175 = 12$ percentage points.[17] This is a large effect. The

[16] We have not used clustered standard errors for three reasons. First, we did not find evidence of serial correlation. Second, our number of clusters is too small. Finally, our time period appears long enough for not being concerned by the bias in the conventional heteroskedasticity-robust (HR) variance matrix estimator highlighted by Stock and Watson (2008). Similar estimates for the standard errors are obtained when their bias-adjusted HR estimator is applied.

[17] For illustration purposes, in our sample, Belgium has twice the GDP of Ireland, Portugal has twice the GDP of Hungary, and Germany almost twice the GDP of Italy, in 2005. Between 1981 and 2005, the United Kingdom has doubled its market size and Ireland has more than tripled its market size.

coefficient estimated is an average obtained with three decades of data, 1981-2005, which have witnessed an increase in international pressures for tax competition and a decrease in corporate tax rates within Europe over time. The latter stylised fact is clearly supported by Figure 3, which plots the coefficients on our time dummies. Their coefficients can be interpreted as capturing yearly global shocks to corporate tax rates, relative to the year 1981. Since the mid-eighties, the overall trend in corporate tax rates has been downward. In Column [2], we test whether there has been a secular decrease or increase over time of the effect of country size on its corporate tax rate, that could be related to the two patterns mentioned. To do so, the variable country size is interacted with a time trend. The interaction term is not statistically significant, suggesting that the effect of country size has not diminished over time. In Column [3], the variable country size is interacted with dummies for the 1990s and for the 2000s, in order to capture potential non-linear effects. The omitted category is the 1980s and thus the coefficients estimated correspond to the difference in the relationship between size and corporate tax rates relative to this decade. None of the interaction terms are statistically significant, indicating again that the effect of country size on corporate tax rate is constant over time, even in the most competitive era.

Figure 3: Global Shocks to Corporate Tax Rates, Relative to Year 1981



An important question is whether the effect of country size on corporate income taxes observed in Column [1] can be attributed to the effect described in the theoretical model. An alternative explanation could be that large countries are located close to countries with high corporate tax rates and thus can offer a high statutory tax rate without losing in attractiveness. The strategic interactions between governments are well documented by Devereux et al. (2008) and Overesch and Rincke (2011), who both find that countries strongly compete over the statutory tax rates. In Column [4] we include in the estimation a measure of other countries' statutory

rates. Following Devereux et al. (2008), we calculate it as the simple average of other countries' tax rates that we instrument using simple averages of other countries' tax determinants.[18] The coefficient on the measure of other countries' statutory rates, which is positive and statistically significant, is in line with the results of Devereux et al. (2008) and Overesch and Rincke (2011) and suggest that governments take into account the tax rates of other countries when setting their own corporate tax rate. The instrument diagnostics indicate that our instruments are relevant and exogenous.[19] The coefficient on country size is not qualitatively affected by the inclusion of this variable. It remains large, positive and statistically significant, indicating that the setting of corporate income tax rate is truly related to country size. As an alternative to control for a potential omitted variable bias related to spatial interdependence or unobserved common factors, we employ the Common Correlated Effects (CCE) method (Chudik et al., 2011; Pesaran and Tosetti, 2011) in Column [5]. This method, which consists in including the annual cross-section averages of each variable of the model, presents the advantage that we can control for cross-section dependence of any kind (e.g. global shocks affecting countries with different degrees or spatial spillovers) without having to model this process explicitly. Column [5] shows that using this approach does not change our previous results.

We also consider a potential endogeneity bias between the level of the statutory tax rate and country size. In line with basic economic theory, empirical work such as Djankov et al. (2010) finds that corporate taxes have a large negative effect on aggregate investment, FDI, and entrepreneurial activity. This detrimental effect on investment can in turn affect economic growth. To allow for this potential endogeneity between corporate taxes and country size, we re-estimate equation (15) using an Anderson and Hsiao (1981) style IV approach. To keep consistent with our fixed effects approach, we apply the forward orthogonal deviations transformation to the data[20] and use as instruments the second and third lags of GDP in Column [6].[21] Values for the first-stage F-statistic and for the test of overidentifying restrictions suggest that the instruments are relevant and exogenous. Our IV results are in line with our previous results: the coefficient on market size is positive and statistically significant determinant at the 10% level.

4.2 Additional Determinants

We consider additional determinants in Table 4. The role of capital openness is tested in Columns [1] and [2]. In Column [1] it is simply added to the econometric model to see whether the opening up of an economy increases tax competition pressures. More open economies should face a larger elasticity of the tax base with respect

[18] An instrumental variable (IV) approach is necessary because corporate tax rates are expected to be jointly determined, creating a simultaneity bias. To allow identification of the spatial lag term, time dummies are replaced with country-specific time trends.

[19] Similar results are obtained when omitting the average of other countries' GDP as an instrument.

[20] This transformation gives the same estimates as a fixed effects estimator when using OLS and, contrary to the within transformation, allows us to use lagged values of our explanatory variables as potential instruments in an IV context. For more information, see Arellano (2003).

[21] We construct our instruments "collapsed GMM-style" in the sense that missing values are replaced by zero. See Roodman (2009).

Table 3: Market Size and Corporate Income Taxes

	Dependent variable: Statutory tax rate					
	Baseline equation [1]	Size and time trend [2]	Size and decade dummies [3]	Size and Neighbours STR [4]	Common correlated effects [5]	Endogeneity IV [6]
Size	0.1750***	0.1951***	0.1926***	0.1419**	0.1553**	0.0914*
	(0.0330)	(0.0394)	(0.0412)	(0.0575)	(0.0715)	(0.0540)
Population proportion young	0.0113***	0.0114***	0.0109***	-0.0078**	-0.0246**	0.0085***
	(0.0026)	(0.0026)	(0.0026)	(0.0037)	(0.0097)	(0.0032)
Population proportion old	0.0335***	0.0332***	0.0332***	-0.0061	-0.0119	0.0278***
	(0.0050)	(0.0051)	(0.0055)	(0.0070)	(0.0169)	(0.0055)
Population proportion urban	-0.0029	-0.0031	-0.0032	0.0028	-0.0096	-0.0017
	(0.0022)	(0.0022)	(0.0023)	(0.0047)	(0.0094)	(0.0023)
Individual tax rate	0.2114***	0.1896***	0.2017***	0.2231***	0.1742**	0.2130***
	(0.0501)	(0.0550)	(0.0534)	(0.0481)	(0.0683)	(0.0601)
Government spending	0.0019	0.0026	0.0022	-0.0016	0.0028	0.0012
	(0.0018)	(0.0018)	(0.0018)	(0.0017)	(0.0024)	(0.0023)
Size x time trend		0.0004				
		(0.0004)				
Size x 1990s			0.0007			
			(0.0045)			
Size x 2000s			0.0051			
			(0.0062)			
Other countries' statutory tax rates				0.6013**		
				(0.2356)		
Observations	550	550	550	550	550	520
R-squared	0.6101	0.6115	0.6115	0.7858	0.9593	0.6048
Weak identification test (F statistic)				231.637		25.789
Overidentification test (P value)				0.8228		0.8021

Notes: "***", "**" and "*" indicate respectively a significance level of 1, 5 and 10 percent. Robust standard errors are in parentheses. Country fixed effects are included in all regressions. Time fixed effects are also included, except in Column [4], where they are replaced with country-specific time trends. In Column [4], the instruments correspond to the simple averages of other countries' tax determinants. In Column [6], the instruments correspond to the second and third lags of GDP.

to corporate tax rate differentials as capital is more mobile. Consistent with this view, the results indicate that countries that have become more open to capital have made larger reductions in their corporate income tax rates. The magnitude of the coefficient implies that a one point increase in capital openness decreases the statutory tax rate by one percentage point. In Column [2], capital openness is interacted with country size to assess whether the effect of country size on corporate taxes depends on a country's willingness to attract FDI. The interaction term is positive and statistically significant. Thus, the effect of country size on corporate taxes is greater for countries that are more open to capital. However, the magnitude of the results indicates that market size is a determinant of corporate taxes even in an economy deemed to be relatively "closed" to capital flows. Indeed, using the minimum and maximum values of the capital openness index, doubling country size increases the statutory tax rates between 10 (for relatively closed countries) and 12 percentage points (for open economies).

Measures of foreign market potential and trade accessibility are included in columns [3] and [4]. Coefficients on these variables are statistically significant and, as expected, a larger foreign market potential is associated with a higher statutory tax rate whereas the opposite is true for trade accessibility. In column [5] we investigate whether the influence of these variables operates primarily through the determination of other countries' statutory tax rates. This appears to be the case. Once we include the spatial lag term, the estimated coefficients on the

Table 4: Country Size and Corporate taxes: Additional Determinants

	Dependent variable: Statutory tax rate						
	Capital openness and size		FMP/Trade acc.			Product market comp.	
						OLS	IV
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Size	0.1422***	0.1593***	0.1151***	0.1498***	0.1431**		
	(0.0458)	(0.0466)	(0.0315)	(0.0306)	(0.0572)		
Population proportion young	0.0069*	0.0058	0.0147***	0.0123***	-0.0077**		
	(0.0037)	(0.0038)	(0.0024)	(0.0025)	(0.0037)		
Population proportion old	0.0324***	0.0283***	0.0358***	0.0390***	-0.0057		
	(0.0057)	(0.0065)	(0.0050)	(0.0050)	(0.0071)		
Population proportion urban	-0.0033	-0.0032	-0.0061**	-0.0048*	0.0027		
	(0.0023)	(0.0022)	(0.0025)	(0.0025)	(0.0047)		
Individual tax rate	0.1960***	0.1546***	0.2521***	0.2288***	0.2229***		
	(0.0521)	(0.0573)	(0.0508)	(0.0517)	(0.0501)		
Government spending	0.0021	0.0029	0.0013	0.0004	-0.0016		
	(0.0020)	(0.0019)	(0.0016)	(0.0016)	(0.0017)		
Capital openness	-0.0102**	-0.1752*					
	(0.0046)	(0.0893)					
Size x Capital openness		0.0065*					
		(0.0035)					
Ln(Harris foreign market potential)			0.5455***				
			(0.1140)				
Ln(R&V foreign market potential)				0.0422**	-0.0017		
				(0.0178)	(0.0133)		
Ln(trade accessibility)			-0.0456***	-0.0806***	0.0002		
			(0.0126)	(0.0172)	(0.0058)		
Other countries' statutory tax rates					0.6123**		
					(0.2563)		
Product market competition						-0.1876*	-0.3249**
						(0.1087)	(0.1554)
Observations	517	517	550	550	550	27	27
R-squared	0.6092	0.6164	0.6501	0.6316	0.7856	0.0838	0.0389
Weak identification test (F statistic)					150.711		12.355
Overidentification (P value)					0.481		

Notes: "***", "**" and "*" indicate respectively a significance level of 1, 5 and 10 percent. Robust standard errors are in parentheses. Country fixed effects are included in all regressions. Time fixed effects are also included, except in Column [5], where they are replaced with country-specific time trends. In Column [5], the instruments correspond to the simple averages of other countries' tax determinants, excluding market size. In Column [7], the instruments corresponds to the stringency of anti-monopoly policy.

measures of foreign market potential and trade accessibility become small and statistically insignificant.

Finally, in columns [6] and [7] we estimate the effect of local market competition on corporate tax rates. Given that this measure is not time-varying, we use a two-stage approach consisting in first estimating the country-specific fixed effects that we regress then on our measure of competition.[22] It is possible that this measure is correlated with other factors which structurally influence corporate tax rates. In addition, corporate tax rate levels can have an impact on local competition by influencing business density and the entry of new firms, as shown by Djankov et al. (2010). Hence in Column [7] an IV approach is used where local market competition is instrumented by the effectiveness of anti-monopoly policy. Anti-monopoly policy should be correlated with the intensity of local competition (the reported F-statistic at the bottom of Table 4 shows that it is a strong instrument) but set independently from the statutory corporate tax rate. In both cases, the coefficient is negative and statistically significant. Consistent with our theoretical predictions, more competitive market which are less profitable to firms set a lower corporate tax rate than less competitive markets.

4.3 Alternative Roles for Country Size

In our theoretical model, we show that a larger country sets a higher tax on firms in equilibrium as compared to tax set by a smaller country. Our central argument is that by offering a bigger market, a larger country is a more attractive location for FDI than a smaller country, allowing the former to set a higher corporate tax rate than the latter. In their empirical analyses of the effect of globalisation on corporate tax rates and of tax competition among OECD countries, Bretschger and Hettich (2002) and Devereux et al. (2008), provide different rationales for controlling for country size.

Following Bucovetsky (1991) and Wilson (1991), Bretschger and Hettich (2002) assume that a smaller country will choose a lower corporate tax rate than a larger country in equilibrium because it faces a more elastic tax base than a large country. Indeed, the large country is a large demander in the capital market and placing a tax on capital in a large economy can decrease the world rate of return. More specifically, the lower domestic after-tax return caused by the implementation of the corporate income tax drives capital abroad. However, with a higher proportion of the world's capital stock, the decrease of the domestic rate of return will generate a worldwide decline in the return to capital. Domestic capital flows abroad until the pre-tax rate of return abroad is reduced, equalising then the rates of return around the world. The mobility of capital from large economies, as compared to small economies, is limited by the fact that capital cannot completely escape the burden of the corporate tax since the decrease of the domestic rate of return will generate a worldwide decline in the return to capital. Therefore, if capital is less sensitive to tax change in the large country - as shown by Bucovetsky (1991)

[22] By definition, these fixed effects include the averages of omitted time-varying variables which influence corporate tax rates.

and Wilson (1991) - the large country will compete less vigorously for capital through tax rate reductions and therefore will set a higher tax rate than the small country.

Empirically, the size of a country, or the extent to which a country is price-maker in the world capital market, can be measured by its position in the international financial integration (Lane and Milesi-Ferretti, 2007). Following Azémar and Hubbard (forthcoming),[23] we use a measure of external financial assets position provided by Lane and Milesi-Ferretti (2007) updated and extended version of External Wealth of Nations Database to capture a country's ability to influence the world return to capital. The *Financial assets/world financial assets* variable corresponds to the ratio of the stock of financial assets of a country i to the stock of the world financial assets. Financial assets are composed by outward portfolio investment (subdivided into equity securities and debt securities), foreign direct investment (equity participations above 10 percent), debt (portfolio debt securities, plus bank loans and deposits, and other debt instruments), and financial derivatives (market value of the outstanding derivatives' contracts). To avoid an endogeneity bias, we lag this control variable by two years. In that way, given the absence of serial correlation of the errors, it should not be correlated with the contemporaneous error term.

Devereux et al. (2008) assume that governments might prefer to tax domestic activities at high corporate tax rates, probably because these activities are less mobile. This relates to the debate of whether all profits should be taxed at the same corporate tax rate or whether some type of capital, such as the most mobile, should benefit from a favorable tax treatment (Keen, 2001; Haupt and Peters, 2005; Janeba and Smart, 2003; Marceau et al., 2010; Wilson, 2005). Since large countries have a higher proportion of economic activity that is domestic, they might have a stronger incentive to tax this activity at a high rate. However, as emphasised by Devereux et al. (2008), if domestic activities are taxed more heavily than foreign activities, large countries will be constrained by pressures from competitive countries.[24] Thus, they assume that the higher the domestic part of the economy, the higher the country would set the "overall" corporate tax rate.

Different measures of the share of domestic or foreign activities in total economic activity can be used: *domestic activity/GDP*, *inward FDI/GDP*, and *financial liabilities/ GDP*. *Domestic activity/GDP* corresponds to the gross fixed capital formation minus foreign direct investment and portfolio investment in country i, as a share of GDP. Foreign activities, *inward FDI/GDP*, and *financial liabilities/ GDP*, correspond to the stock of inward foreign direct investment and the stock of financial liabilities, which are composed by the inward stock of portfolio investment, foreign direct investment and financial derivatives. These data come from Lane and

[23] Using this measure, Azémar and Hubbard (forthcoming) finds that the shift of the tax burden from capital to labour in OECD countries decreases with a country's ability to influence the world return to capital.

[24] Note that since the adoption of a *Code of Conduct* to avoid 'harmful tax competition', preferential tax regimes, where a different statutory tax rate is officially applied to all residents and all non-residents and which allow countries to aggressively compete on the most mobile bases, are reproved within OECD countries (see OECD (1998)).

Table 5: Alternative Roles for Country Size

	Dependent variable: Statutory tax rate			
	World capital market (position of country i)	Domestic activity (in country i)	Foreign activity (in country i)	
	[1]	[2]	[3]	[4]
Size	0.1579***	0.1828***	0.1571***	0.1872***
	(0.0415)	(0.0444)	(0.0420)	(0.0441)
Population proportion young	0.0085***	0.0117***	0.0099***	0.0121***
	(0.0031)	(0.0033)	(0.0031)	(0.0033)
Population proportion old	0.0318***	0.0339***	0.0322***	0.0336***
	(0.0052)	(0.0054)	(0.0053)	(0.0053)
Population proportion urban	-0.0025	-0.0029	-0.0029	-0.0027
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Individual tax rate	0.2090***	0.2036***	0.2042***	0.1982***
	(0.0510)	(0.0514)	(0.0513)	(0.0514)
Government spending	0.0018	0.0021	0.0019	0.0020
	(0.0020)	(0.0019)	(0.0020)	(0.0019)
Financial assets/world financial assets	-0.9803**			
	(0.4059)			
Domestic activity/GDP		0.0007		
		(0.0011)		
Inward FDI/GDP			0.0007	
			(0.0017)	
Financial liabilities/GDP				-0.0006
				(0.0004)
Observations	538	525	538	531
R-squared	0.6111	0.6075	0.6069	0.6102

Notes: "***", "**" and "*" indicate respectively a significance level of 1, 5 and 10 percent.
Robust standard errors are in parentheses. Country and time fixed effects are included.

Milesi-Ferretti (2007) and World Development Indicators. These three variables are also lagged by two years.

In Column [1] of Table 5, we test the assumption that the corporate tax rate of a country *i* is positively related to it's ability to influence the world return to capital. The estimated coefficient on the share of financial assets over the world financial assets exhibit an unexpected negative sign and is statistically significant. In Columns [3]-[5], we test the assumption that governments have an incentive to tax domestic activities at a high corporate tax rate. None of the three estimated coefficients is statistically different from zero. On the other hand, the magnitude and statistical significance of the estimated coefficient on market size are not affected by the inclusion of these other characteristics related to the size of countries and which could influence the corporate tax rate. Thus, our explanation for the positive relationship between market size and the corporate tax rate appears to dominate empirically the other arguments related to the elasticity of the tax base and the incentive to tax more a less mobile tax base.

4.4 Government Strategic Interactions and Market Size

We now turn to the role played by market size on the strategic interactions between governments by investigating whether large countries are less responsive to foreign corporate tax rates than smaller countries. The intuition for such a relationship can be inferred from our theoretical model. If a larger country is a more attractive location than a smaller country because of larger pre-tax profits for firms, a decrease in the tax rate of a smaller

country will generate a smaller increase in profits as compared with a comparable decrease in a larger country.

In Column [1] of Table 6, the variable for other countries' statutory tax rates is interacted with the market size.[25] The interaction term is negative and statistically significant suggesting that the responsiveness to foreign countries' tax rates decreases with the market size of a country i. For a country with an average market size, the response to a one percentage point change in foreign corporate tax rates is a corresponding change of 0.80 percentage point. The adjustment to foreign corporate tax rates falls to 0.30-0.15 percentage point for the largest countries (such as the United Kingdom and Germany).

In Column [2], the sample is extended by adding 13 OECD countries to the 27 EU countries. This allows us to investigate the role of market size and government strategic interactions with a sample where competitive forces might be different as it contains more distant non EU member states (Davies and Voget, 2008; Overesch and Rincke, 2011). The coefficient estimated for market size is positive and statistically significant. Its value is close to that of the coefficient estimated in Column [4] of Table 3, using only a sample of EU countries. The spatial lag is positive and statistically significant at the 10 percent level. Its value is one-third smaller than the value estimated with the EU sample, suggesting that tax competition is a regional phenomenon. Such an outcome may be the product of multinational firms following a "sequential location decision" (Davies and Voget, 2008). If firms first decide in which region to locate and then in which country, the corporate tax rates of American and Asian countries are likely to be inappropriate in explaining variations in European countries' corporate tax rates. Note however that the decrease in the effect of the spatial lag can also be due to the fact that its coefficient is estimated with more uncertainty with the full OECD sample countries. As emphasised by Overesch and Rincke (2011) one problem with uniform weights is that the variations in the other countries' corporate tax rates decrease with the number of countries. When N is large, the weighted average is almost the same for all countries. The same problem arises with non-uniform weights if the weighted averages do not decline/increase rapidly enough with the selected weight such as distance or market potential for instance.

To shed greater light on the influence of non-EU corporate tax rates on the setting of corporate tax rate in a EU country, we decompose the other countries' statutory tax variables into two components: one for EU countries and one for the other countries. In line with Davies and Voget (2008), results presented in column [3] indicate that the corporate tax rates of EU member states are not determined by corporate taxes of non-EU member countries. However, the 13 OECD countries considered in the analysis are heterogeneous in terms of size and development as they include middle-income countries (Mexico and Turkey), high-income countries (Australia, Chile, Iceland, Israel, Korea, Norway, Switzerland, and New Zealand) and G7 countries (Canada, Japan, and

[25] For ease of reading, we express market size as deviations from the sample mean value. Instruments for the interactions correspond to the product of market size with the average of other countries' tax determinants. We do not use the interaction involving other countries' personal tax rate because this instrument failed an exogeneity test.

the United States). To investigate whether EU countries are more sensitive to non-EU large countries' corporate tax rates, we only consider large countries in the construction of the non-EU spatial lag term in column [4]; large countries correspond to countries with an average GDP (over the period 1981-2005) that is higher than the median of average GDPs (over the period 1981-2005) of the 13 non-EU countries. The estimated coefficient on this new variable is small and not statistically significant. These results are consistent with governments' awareness of a sequential location decision process adopted by multinational firms. The sign and statistical significance of the coefficient on market size is not affected by the various estimation strategies.

Table 6: Government Strategic Interactions and Dynamics

	Dependent variable: Statutory tax rate				
	EU	OECD	EU	EU	EU
	[1]	[2]	[3]	[4]	[5]
Statutory tax rate $t-1$					0.8283***
					(0.0302)
Size t	0.2842***	0.1227***	0.1439**	0.1416**	0.0355
	(0.0825)	(0.0405)	(0.0577)	(0.0578)	(0.0524)
Size $t-1$					-0.0021
					(0.0529)
Population proportion young	-0.0106***	-0.0076**	-0.0075**	-0.0079**	0.0026**
	(0.0041)	(0.0029)	(0.0037)	(0.0037)	(0.0013)
Population proportion old	-0.0103	-0.0091*	-0.0054	-0.0062	0.0051*
	(0.0072)	(0.0053)	(0.0070)	(0.0070)	(0.0026)
Population proportion urban	0.0015	0.0024	0.0025	0.0028	-0.0005
	(0.0046)	(0.0015)	(0.0047)	(0.0047)	(0.0008)
Individual tax rate	0.1720***	0.2650***	0.2173***	0.2217***	0.1118***
	(0.0510)	(0.0327)	(0.0492)	(0.0485)	(0.0328)
Government spending	-0.0014	-0.0018	-0.0016	-0.0016	0.0003
	(0.0017)	(0.0014)	(0.0017)	(0.0017)	(0.0011)
Other EU countries' STR t	0.7936***		0.6322***	0.6277***	
	(0.2345)		(0.2223)	(0.2307)	
Other countries' EU STR t x Size t	-0.3366***				
	(0.1112)				
OECD countries' STR		0.3898*			
		(0.2136)			
Other non-EU countries' STR			0.1355		
			(0.3065)		
Other non-EU large countries' STR				-0.0407	
				(0.1824)	
Observations	550	855	550	550	543
R-squared	0.7851	0.8013	0.7849	0.7854	0.8901
Weak identification test (F statistic)	64.558	380.710	172.109	303.292	
Overidentification (P value)	0.8307	0.9915	0.7721	0.7732	
Joint-significance: $\text{Size}_{t,t-1}$					0.0333**
					(0.0166)
Estimated long-run coefficient: Size					0.1942**
					(0.0915)

Notes: "***", "**" and "*" indicate respectively a significance level of 1, 5 and 10 percent. Robust standard errors are in parentheses. Each regression include country fixed effects and country-specific time trends. The instruments for other countries' STR correspond to the simple averages of other countries' tax determinants.

4.5 Accounting for Inertia in the Tax Policy Making Process

Policy makers face a number of constraints when altering the corporate tax rate, accommodating for instance economic pressures from international capital mobility and the rising needs of public services with an ageing

population. These constraints can lead to inertia in the tax policy making process. Until now we have considered a static model where any changes of the determinants of corporate tax rates are felt instantaneously without delayed effects. To allow for an adjustment of corporate tax rates over time, we estimate the following dynamic model:

$$t_{it} = \varphi t_{it-1} + \beta_1 n_{i,t} + \beta_2 n_{it-1} + x_{it}\gamma + \theta_t + C_i + \epsilon_{it}, \tag{17}$$

where our model now includes the lagged values of the statutory tax rate and market size. β_0 and β_1 give the short-run effects of market size on corporate tax rates. The long-run effect is given by $\frac{(\beta_0+\beta_1)}{(1-\varphi)}$. In addition to inertia, the lagged dependent variable is likely to partly capture time-varying omitted variables. Given the length (long T) of our panel, our estimates should not be affected by the dynamic bias highlighted by Nickell (1981).[26]

In column [5] of Table 6, the coefficient of the lagged corporate tax rate is positive and statistically significant, indicating that the current statutory tax rate is strongly related to the past statutory tax rate. This result is in line with Winner (2005) and Overesch and Rincke (2011) who both find that time is required by governments to adjust their tax rates to changes in domestic conditions. The estimated coefficients of country size are not individually significant. They are estimated imprecisely due to their strong correlation, and this multicollinearity makes it difficult to estimate the incidence of country size at each lag. The estimated coefficients are jointly significant at the five percent level, with a magnitude of 0.03. Turning to the estimated long-run coefficient, it is statistically significant at the five percent level and its magnitude, 0.19, is very close to the value of the coefficient that we estimated in column [1] of Table 1, using a static model. As shown by Baltagi and Griffin (1984) and Egger and Pfaffermayr (2005), when the current value of a regressor is strongly correlated with its past values and dynamic adjustment is slow -as in our case, the static FE estimator tends to converge towards the long-run effect. This result suggests a moderate short-run effect of market size on corporate tax rates and a substantial long-run effect.

5 Summary and Conclusions

Various explanations have been suggested to explain the positive relationship between a country's size and its corporate tax rate that seems to exist in the developed world. In this paper we set up a simple, analytical model of regional trade and investment where countries can differ in market size from each other. Our strong prediction is that larger countries will set a higher tax on firms in equilibrium as compared to the taxes set by smaller countries. Our empirical results favour this market access rationale, at the expense of other explanations.

[26] This is confirmed by the Monte-Carlo simulations of Beck and Katz (2012).

Furthermore, we provide strong evidence that market size not only determines the level of corporate tax rate, but also influences government strategic interactions, as a country's responsiveness to a change in corporate taxes in competing countries decreases with its market size.

These results provide an important finding for policy debates as they suggest that globalisation and the associated increase in the mobility of capital do not imply a convergence toward zero rates of corporate income taxes across countries. A country's awareness of its competitiveness, notably in terms of market size, provides a simple explanation for why the prediction of standard tax competition models of a complete erosion of corporate tax rates, is not observed empirically.

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