

Trade Integration and Business Tax Differentials: Theory and Evidence from OECD Countries^{*}

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Abstract

Recent contributions to the New Economic Geography literature of tax competition illustrate that trade integration (or decreasing trade costs) reduces the importance of market size differences for corporate tax differences between countries. This paper first develops a foot-loose capital model of tax competition that illustrates these predictions. Then, we provide the first empirical evaluation thereof using a dataset of 26 OECD countries over the period 1982-2004. Our results confirm that market size differences help explain corporate income tax differences across countries and, crucially, that trade integration reduces this effect. These findings are robust to various alternative specifications and robustness checks.

Keywords: Tax competition, Trade integration, New Economic Geography, Tax differentials, OECD.

JEL-Codes: H2, H3, C23, F12

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1. Introduction

Looking at the evolution and distribution of corporate tax rates in developed countries over the last three decades, two central observations stand out. The first is a decline in corporate tax rates. For example, statutory as well as effective corporate income tax rates in OECD countries fell by 20% to 33% on average between 1982 and 2005. The second is the presence of important corporate tax disparities across countries despite this downward movement. For example, in 2006, the average corporate tax rate of the G7 countries (36.5%) was ten points higher than the average tax rate of the EU-27 (25.9%), and the average corporate tax rate of the EU-15 (29.54%) was likewise ten points higher than the average tax rate of the new entrants (19.33%).

Whereas various scholars have provided empirical analyses linking tax differentials to FDI flows (e.g., Bénassy-Quéré *et al.*, 2005; Kammass, 2010) and the decline in corporate tax rates to tax competition (e.g., Devereux *et al.*, 2002, 2008; Redoano, 2007; Cassette and Paty, 2008; Davies and Voget, 2008; Exbrayat, 2009), empirical analyses of the determinants of corporate tax disparities across countries have, to the best of our knowledge, not followed suit.¹ Nonetheless, given the impact of tax differentials on, for example, FDI flows (see above), insights into the reasons for such differentials can have important policy implications. This paper therefore exploits insights from the tax competition literature based on New Economic Geography (NEG) frameworks to take an initial step towards addressing this issue. The NEG literature predicts that in an environment of increasing returns to scale and imperfect trade integration, the most populated countries are able to sustain higher corporate taxes because firms located in this country enjoy an ‘agglomeration rent’ that reduces their sensitivity to countries’ relative corporate tax policies (Ludema and Wooton, 2000; Kind *et al.*, 2000; Baldwin and Krugman, 2004). Trade integration, however, induces convergence in corporate taxes in such framework because the site of production becomes increasingly less relevant (Ottaviano and van Ypersele, 2005; Haufler and Wooton, 2010). Consequently, the NEG literature suggests that tax disparities across countries might in part be explained by the fact that some countries are exposed to tax competition to a different degree than others. This paper’s central contribution lies in assessing the empirical relevance of this proposition.

¹ To our knowledge, Gilbert *et al.* (2005) is the only existing study analysing determinants of tax rate differentials. Compared to that study, we provide a firmer theoretical rationale for the analysis, address potential problems of serial correlation and endogeneity, control for the potential influence of various country-level variables, and employ a wider sample of countries (i.e. 26 OECD countries versus 15 European countries).

We first develop a foot-loose capital model of tax competition in spirit of Haufler and Wooton (2010) in order to characterize empirical hypotheses following from NEG-models in more detail. Specifically, assuming benevolent and independent governments, our theoretical model shows that the tax gap between a big and a small country is increasing with the difference in population between these countries provided that trade costs are positive: i.e. bigger countries are able to fiscally exploit their lower tax base elasticity. The model also shows that bigger countries lose this fiscal advantage with increasing trade integration (or falling trade costs) provided that not all economic activity is clustered in the big country. Hence, our two central empirical questions become: *a)* are tax differentials a function of the coexistence of imperfect trade integration and asymmetric market sizes? and *b)* does increased trade integration reduce the ability of largest countries to set higher taxes?

We then evaluate these theoretical predictions employing data for 26 OECD countries (thus generating up to 325 country-pairs) over the period 1982-2004. Our results are supportive of both propositions. Specifically, we show that the tax gap indeed responds positively to population size differences between countries and, crucially, that this relationship is significantly attenuated by trade integration. These results are robust to a number of alternative specifications (e.g., using different definitions of the central dependent variable) and robustness checks (e.g., accounting for third-country or income effects).

It is important to point out here that addressing the above questions also requires a methodological innovation. Most empirical tax competition studies to date estimate tax reaction functions, where the tax rate in one country is linked a weighted average of competing countries' tax rates (e.g., Devereux *et al.*, 2002, 2008; Redoano, 2007; Cassette and Paty, 2008; Davies and Voget, 2008; Exbrayat, 2009). Still, two drawbacks exist regarding this approach for our purpose. First, the focus of the analysis explicitly lies on absolute levels of taxation. This can be misleading, however, since what matters for firms' location choices – and thus indirectly also for tax competition – is the *difference* in corporate tax rates between countries rather than the absolute level of taxation in each country (see also Bénassy-Quéré *et al.*, 2005). Secondly, while estimation of tax reaction functions allows analysing the decline in corporate taxes rates, it does not provide direct insights regarding the determinants of tax differentials.

The structure of the article is as follows. In the following section, we develop a foot-loose capital model of tax competition, and derive testable hypotheses on the relation between

corporate taxation, trade integration and population differences. The empirical verification of these predictions is described in section 3. The last section concludes and presents some avenues for further research.

2. The model

Consider an economy consisting of two imperfectly integrated countries ($i=H, F$), which compete to attract a fixed number of firms. These firms produce a homogenous good, labelled x , in an oligopolistic market. Another private good, the numéraire z , is produced under perfect competition and is freely traded. There are two factors of production, physical capital and labour, whose total endowments are denoted K and L , respectively. Total factor endowments are equally distributed across individuals in either country. However, we assume that a share $\sigma_H > 0.5$ of the total population lives in country H . While these workers are immobile, they can invest their capital wherever they want. The public sector in each country is represented by a benevolent government, which imposes a lump-sum tax t_i on capital invested in its country. If this tax is positive, the resulting tax revenues T_i are redistributed in a lump-sum way to the workers, while if a government subsidizes capital these expenditures are financed through lump-sum taxation of workers.²

2.1. Consumption

Consumers in both countries share the same quasi-linear utility function:

$$u_i = ax_i - \frac{\beta}{2}x_i^2 + z_i \quad (1)$$

with $a > 0$ and $i \in \{H, F\}$. Every resident in the economy supplies one unit of labour and $\bar{k}$ units of capital. The wage rate in each country is determined in the numéraire industry, which uses labour as the only input. Free trade in the numéraire thus equalizes the wage across countries as

² On the whole, our theoretical model closely follows Haufler and Wooton (2010). Yet, contrary to their model, our benchmark case has capital owners living in both countries, and we interpret mobile capital as physical capital. This generates a framework closer to the standard model of asymmetric tax competition (Bucovetsky, 1991; Wilson, 1991), so that any differences in the model's predictions are only imputable to the assumption of imperfect competition and positive trade costs. Moreover, unlike Haufler and Wooton (2010) we not only solve the tax competition game for interior location equilibrium, but also for the core-periphery equilibrium.

w . Moreover, each resident receives income from capital at the world net return to capital, denoted by r . Thus, the budget constraint for a representative consumer in country i is given by:

$$w + r\bar{k} + \frac{T_i}{\sigma_i L} = z_i + p_i x_i \quad (2)$$

where p_i denotes the price of good x in country i .

Given (1) and (2), the individual demand for the manufactured good in country i is given by $x_i = (a - p_i)/\beta$ so that the total demand for this good in each country is:

$$X_i = \sigma_i L \frac{a - p_i}{\beta} \quad (3)$$

Intuitively, the market demand curve of the larger country H is flatter than that of country F (since $\sigma_H > \sigma_F$), which makes market H more profitable for firms.

2.2. Firms

There are K firms producing a homogeneous product under increasing returns to scale and Cournot competition. The production of the manufactured good requires a fixed amount of one capital unit and γ units of labour. Moreover, good x is traded at a cost of τ units of the numéraire per unit shipped between the two countries, which raises the marginal cost of serving the foreign market to $(\gamma w + \tau)$.³

Firms are able to segment their markets by choosing the quantities to sell on the domestic and the foreign market independently. Therefore, the total gross profit of each firm in country i is given by:

$$\Pi_i = (p_i - \gamma w)x_{ii} + (p_j - \gamma w - \tau)x_{ij} \quad (4)$$

where x_{ij} denotes sales in country j . Maximizing profits taking into account demand (equation 3) yields the following output levels for a firm located in a country i :

$$x_{ii} = \frac{\sigma_i L}{\beta} \frac{a - \gamma w + \tau k_j}{K + 1}, \quad x_{ij} = \frac{\sigma_j L}{\beta} \frac{a - \gamma w - \tau(k_j + 1)}{K + 1}$$

where k_j stands for the number of firms in country j (with $k_H + k_F = K$). Intuitively, everything else equal, an exporter sells less in a market than an indigenous rival ($x_{ji} < x_{ii}$) due to the

³ The term trade costs must be understood in a general sense, as including non-tariff barriers and transportation costs.

existence of trade costs (although we focus here on the case where trade costs are low enough to ensure that x_{ij} and x_{ji} are positive).⁴

The resulting equilibrium price in country i is the following:

$$p_i = \frac{a + \tau k_j + \gamma w K}{K + 1}.$$

Firstly, the consumer price level increases with trade barriers, because local firms are more protected against foreign competition. Secondly, the consumer price in a country is decreasing in the number of firms located in this country, but this competition effect is vanishing as trade cost fall. Finally, the export price net of transport cost (that is, $p_i - \tau$) is a decreasing function of trade costs and this relationship is strengthened by the toughness of competition in the foreign market.

Inserting these equilibrium prices in (4) yields the following operating profits in the short-run:

$$\Pi_i^* = \frac{\sigma_i L}{\beta} \left(\frac{a - \gamma w + \tau k_j}{K + 1} \right)^2 + \frac{\sigma_j L}{\beta} \left(\frac{a - \gamma w - \tau(k_j + 1)}{K + 1} \right)^2$$

In the long-run, net profits are equal to zero in equilibrium due to free entry and exit.⁵ Thus, the equilibrium rate of return is determined by a bidding process for capital, which ends when no firm can earn a strictly positive profit at the equilibrium market price, that is:

$$r_i = \Pi_i^* - t_i.$$

The location equilibrium of capital can now be found by solving the arbitrage condition according to which no unit of capital can induce a higher net return by being invested in another country, that is, when $\Pi_H^* - t_H = \Pi_F^* - t_F = r$. The resulting equilibrium number of firms in each country is given by:

$$k_H = \frac{K}{2} + \frac{2\sigma_H - 1}{2\tau} (2a - 2\gamma w - \tau) - \frac{K + 1}{2\tau^2 L} \beta \Delta, \quad k_F = K - k_H$$

where $(2a - 2\gamma w - \tau)$ is positive under the trade condition (see footnote 6) and $\Delta = t_H - t_F$ stands for the tax gap between country H and F . Let us first comment on the location of firms without

⁴ This requires that $\tau < \tau_{trade} \equiv \frac{a - \gamma w}{K + 1}$.

taxation so that $\Delta=0$. As soon as trade is costly, the country with a larger demand for the increasing returns industry attracts an even larger share of the production because firms save on trade cost by locating in this country. This is the so-called ‘home-market effect’. Now, assuming that governments set different capital taxes with a higher tax in country H ($\Delta > 0$), the share of firms in country H will be relatively smaller than it would be at the free-market equilibrium (i.e. in the absence of governments and taxation). Finally, there is a threshold of trade cost $\tau^{CP} = \beta\Delta \frac{K+1}{2L(2\sigma-1)(a-\gamma w)}$ under which the home-market effect is so strong that a core-periphery structure emerges characterized by the complete concentration of the industrial sector in the biggest country.

2.3. Tax competition

We assume that each government is benevolent. Inserting the budget constraint in the national welfare, we get the following objective function for government of country i :

$$W_i = \sigma_i L S_i + T_i + \sigma_i L \gamma w + \sigma_i K r$$

where $S_i = (a - p_i)^2 / 2\beta$ denotes the consumers’ surplus. Thus, we can break down the national welfare into four components: aggregate consumers’ surplus, tax revenues redistributed to residents if $T_i > 0$ (or total taxes paid by them if $T_i < 0$), total labour income and total return to capital.

Before proceeding further with the analysis, we isolate how each component of aggregate welfare reacts to a change in taxation. By introducing equilibrium prices in the consumers’ surplus, we can easily show that in order to favour the decline in price prevailing in its domestic market, and increase the domestic consumers’ surplus, each government has an incentive to set a low tax burden on capital ($dS_i/dt_i < 0$). Nevertheless, raising the capital tax has a positive effect on tax revenues redistributed to workers provided that the tax base elasticity is less than one in absolute value. Intuitively, those two effects are stronger for the most populated country. Finally, the effect of taxation on the return to capital is *a priori* ambiguous. By inducing more competition among firms, a tax cut reduces operating profits but a lower tax burden also has a direct positive effect on the net return to capital. We can show that the latter effect dominates at

⁵ By contrast, Haufler and Wooton (2010) assume that there is no free entry so that firms retain positive profits also in the long run. While this assumption affects the equilibrium tax level, it is innocuous for the properties of the tax

the equilibrium, and the negative effect of taxation on the return to capital is stronger in absolute terms for the smaller country.

We now solve the tax game by distinguishing between interior equilibria (when each country has some industrial firms) and the core-periphery equilibrium (when all industrial firms end up in the biggest country). The game takes place in two stages. In the first, governments simultaneously choose their tax rates while in the second, firms and consumers make their choices taking tax rates as given. The game is solved by backward induction.

2.3.1 Nash tax gap under interior equilibrium configuration

We first consider the behaviour of governments when $\tau > \tau^{CP}$; that is, trade liberalization is low enough for interior equilibria to be sustainable. In such a case, the tax base elasticity in both countries is positive and the Nash tax gap between country H and F resulting from the above trade-off is the following:

$$\Delta^* = (2\sigma_H - 1)L \frac{\tau}{\beta} \frac{6(a - \gamma w) - \tau(2K + 3)}{4K + 5} \quad (5a)$$

This makes clear that the main property of the tax gap is that it is increasing with the difference in population between both countries provided that trade costs are positive ($d\Delta^*/d\sigma_H > 0$), and that this relationship is vanishing as trade costs fall ($d^2\Delta^*/d\sigma_H d\tau > 0$). Intuitively, firms generate higher profits by locating in the largest market because they save trade costs. Hence, the tax base elasticity is lower in this country, which allows its government to set a higher capital tax. The government of the less populated country on the other hand tries to compensate firms for its location disadvantage via a lower capital tax. Nevertheless, this relationship vanishes as trade costs fall. Consequently, trade integration limits the ability of the largest country to set a higher tax than the small one. This is clear when imagining the extreme case of a perfectly integrated economy (that is, $\tau = 0$). Here, firms are indifferent between locating in country H or F , both governments set zero taxes and no tax differences remain between countries.

gap between countries.

2.3.2. Nash tax gap under core-periphery equilibrium configuration

Let us now consider the specific case where trade costs are so low ($\tau < \tau^{CP}$) that all capital ends up invested in the largest country (i.e. $k_H = K$). Under such a configuration, the world net return to capital is equal to the net return to capital in country H. Hence, the tax base elasticity in country H is equal to zero, while the welfare in country F is unaffected by a marginal rise in t_F . Thus, the government in H will set its tax rate at the highest level compatible with the government in F being unable to affect the location of firms. Formally, this implies that the tax differential is equal to the difference in gross return to capital evaluated at $k_H = K$, which yields:

$$\Delta^{CP} = L\tau \frac{(2a - 2w\gamma - \tau)(2\sigma_H - 1) - K\tau}{\beta(K + 1)} \quad (5b)$$

Clearly, the main property of the tax gap described in section 2.3.1 above still holds under this configuration: the tax gap is increasing with the difference in population between both countries ($d\Delta^{CP} / d\sigma_H > 0$), and this relationship is vanishing as trade costs fall ($d^2\Delta^{CP} / d\sigma_H d\tau > 0$).

We summarize these results in the following proposition:

Proposition 1: *Assume tax competition between two benevolent governments of differently populated countries:*

- (i) *The tax gap is increasing with the difference in population between both countries.*
- (ii) *This relationship is vanishing as trade costs fall.*

Before testing these properties, it is of interest to point out that they are robust to various extensions. Indeed, Ottaviano and Van Ypersele (2005) as well as Gaigné and Riou (2007) found qualitatively similar results as in Proposition 1 in a model where mobile firms produce horizontally differentiated goods and consumers have quasi-linear preferences with a love for variety. Moreover, the above properties are robust to (1) the introduction of public good provision, (2) changes in the timing of events (i.e. allowing the big country to act as Stackelberg leader in the tax game) and (3) alternative assumptions on government behaviour (i.e. allowing for Leviathan behaviour). Details of the results using these alternative modelling approaches can be obtained from the authors upon request.

3. Empirical Analysis

3.1. Model specification

To evaluate Proposition 1, we exploit data from an unbalanced panel of 26 OECD countries over the period 1982-2004 (thus having maximally 325 country-pairs per period).⁶ Our baseline regression is:

$$TaxGap_{ijt} = \beta_1 \varphi_{ijt} + \beta_2 PopGap_{ijt} + \beta_3 (PopGap_{ijt} \times \varphi_{ijt}) + \beta_4 Y_{ijt} + O_i + D_j + \eta_t + \varepsilon_{ijt}$$

where ij refers to a country-pair with $i \neq j$ and t indexes time.

The dependent variable – i.e. the tax gap between a pair of countries ($TaxGap_{ijt}$) – is defined as the difference between the Effective Average Tax Rate (EATR) on firms in countries i and j at time t . We thereby employ a weighted average of the EATR levied on machinery and buildings (see Loretz, 2008, for details of the weighting scheme applied), although using the EATR on buildings *or* machinery does not affect our main findings (details available upon request). Clearly, as the tax gap between countries i and j is the same as that between countries j and i , we only include each country-pair once per year to avoid an unwarranted multiplication of observations. Note also that we employ EATR rather than the Effective Marginal Tax Rate (EMTR) or the statutory tax rate for two reasons. First, the statutory tax rate does not include tax base effects (see Devereux *et al.*, 2002). Clearly, however, such tax base effects are likely to be important since tax rate reductions in recent years have tended to be accompanied by tax base expansions. Moreover, firms are likely to decide their investment decisions based on what the entire tax schedule (i.e. tax base and tax rate) implies for them. Second, our theoretical analysis is inspired by competition over ‘greenfield’, rather than additional investments. As such, EATR is more likely to be the relevant measure for firms’ decision-making than EMTR. Nevertheless, for reasons of comparison and robustness, we run our estimations also with EMTR and the statutory tax rate (see below).

There are two central explanatory variables. Firstly, $PopGap_{ijt}$ stands for the difference in population size between countries i and j at time t (in million people) and allows analyzing how the tax gap responds to population size differences between countries (part *i*) of Proposition 1).

⁶ The set of countries includes Australia, Austria, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, Great-Britain, Greece, Hungary, Ireland, Italy, Iceland, Japan, Korea, Mexico, the Netherlands, Norway, New-Zealand, Poland, Portugal, Sweden, Turkey and US. The starting point follows from the availability of corporate tax rate data (source: Loretz, 2008), while the endpoint is due to the lack of trade data after 2004 (source: CEPII).

Although one could think of a more general measure of market potential, we use the difference in population size as this is most closely related to the theoretical model specified above (for robustness checks with a more general measure, see section 3.3). Secondly, to address part *ii*) of Proposition 1, we introduce the level of trade liberalisation (ϕ_{ijt}) – which approximates the effect of trade costs deriving from various impediments to trade and corresponds to the general interpretation of trade costs in the theoretical model (see note 5) – and interact it with PopGap_{ijt} . ϕ_{ijt} is obtained by estimating a gravity equation controlling for remoteness by the use of country fixed effects (Rose and Van Wincoop, 2001; Feenstra, 2003; Redding and Venables, 2004; for details, see appendix A.1). Larger values of ϕ_{ijt} indicate closer trade integration (and thus lower trade costs), implying that, based on Proposition 1, we expect a positive sign for β_2 and a negative one for β_3 .⁷ This variable has several advantages compared to standard measures of trade openness (i.e. imports and exports as a share of GDP) or trade costs. First, it has a clear theoretical underpinning that is closely linked to the model developed in this paper. Second, it limits the endogeneity bias plaguing the use of such standard measures (by running the first-stage regressions described in Appendix A.1). Clearly, however, by extracting ϕ_{ijt} from this first-stage regression, it becomes a ‘generated regressor’. Still, OLS leads to consistent coefficient estimates in the presence of generated regressors. Moreover, and crucial, while the estimated covariance matrix of the tax gap estimation needs to be adjusted to account for the variability in the trade integration variable when evaluating specific hypothesis tests, it still allows correct inference on whether the coefficient estimate of the generated regressor significantly differs from 0. Hence, it allows consistent significance tests, which is our prime interest here (for details, see Pagan, 1984; for a similar approach, see Head and Mayer, 2006).

The vector Y represents a number of control variables that can be expected to affect tax rates in both countries, and therefore the tax gap between these countries. Specifically, building on a large political economics literature, we include the difference in country-pairs’ real GDP (in ten millions dollars), public consumption (i.e. public sector size as a share of GDP), urbanness (share of population in urban areas), share of young and old in the population (under 14 and over 65 respectively), unemployment rates, openness (imports plus exports as a share of GDP), political

⁷ We also include ϕ_{ijt} independently in the empirical model. Although important to avoid biased inferences on its interaction with PopGap_{ijt} , these coefficient estimates have no substantive meaning since they refer to the effect of trade integration when there is no difference in population size – a situation that does not occur in the dataset.

leaning of the government (1 if right-wing, 0 if centre and -1 if left-wing), a simple linear time trend and two dummy variables equal to 1 when one or both countries are part of the European Union or its precursors.⁸ Data definitions, summary statistics and sources are in appendix A.2.

Finally, O_i and D_i represent a vector of country of ‘origin’ and ‘destination’ indicator variables and η_t is a set of year dummies, which pick up country-specific and time-specific effects. The former are thereby specified as fixed, rather than random, effects (as supported by a standard Hausman specification test). Importantly, inclusion of these fixed effects goes some way towards mitigating bias induced by not explicitly introducing third-country effects in the empirical model (as mentioned, however, we return to potential third-country effects in section 3.3).⁹ Note that we also experimented with country-pair fixed effects. As this alternative specification does not affect our main findings (details available upon request), but more strongly reduces our degrees of freedom compared to employing separate origin and destination fixed effects, we retain the latter approach in the main analysis.

3.2. Empirical results

Our main results are summarized in Table 1. Column (1) presents baseline results when using the OLS estimator. However, since the tax gap between countries – just like the tax rates of individual countries – is likely to show significant persistence over time, we also estimate the model including a lagged dependent variable. These results are given in Column (2). Although the Nickell-bias is likely to be small given the length of our time series (over 20 years), we nonetheless check whether instrumenting the lagged dependent variable with two further lags affects our findings. These results are given in Column (3).¹⁰ In the remainder, we refer to the results in Column (1) as a ‘static’ model, while the results in Columns (2) and (3) are designated as ‘dynamic’. Throughout the analysis, we rely on Newey-West heteroscedasticity-consistent standard errors to address potential heteroscedasticity. Yet, as we have a large number of clusters (over 250 in our case) with relatively few observations (less than 25) in each cluster, one could

⁸ The trade openness variable is used to control for the impact of multilateral – rather than bilateral – trade integration on tax differentials. As such, we evaluate the effect of bilateral trade integration, *given* the extent of multilateral trade integration. We return to such potential third-country effects in section 3.3.

⁹ We thank José De Sousa for fruitful comments and discussions on this point.

¹⁰ A similar approach to instrumenting the lagged dependent variable is taken in Devereux *et al.* (2008). The validity of these instruments is confirmed by a standard Hansen test in all regressions (except when using the statutory tax

also consider clustering standard-errors by country-pair (see Wooldridge, 2003). Doing so provides very similar results (details available upon request).

--- Table 1 about here ---

We find that the difference in population size has a positive and highly statistically significant impact on the difference in effective average tax rates between countries when trade integration is absent (i.e. $\phi_{ijt} = 0$). This result is robust in terms of sign and statistical significance both in the absence and presence of the lagged dependent variable. Hence, in line with part *i*) of Proposition 1 (as well as predictions from standard asymmetric tax competition models without trade; e.g., Wilson, 1991; Bucovetsky, 1991), a bigger country sets a higher corporate income tax rate.

Including the impact of trade integration on the relation between population differences and the tax gap, we see in Column (1) that trade liberalization has no direct impact on the tax gap but, as expected, it significantly reduces the impact of the population differential on the tax gap. This significant mediation effect persists when controlling for the strong persistence in the tax gap over time (see Columns (2) and (3)). This finding confirms part *ii*) of Proposition 1, and illustrates the empirical relevance of the models of tax competition based on New Economic Geography frameworks. It suggests that tax disparities across countries can indeed be partly explained by the fact that some countries are exposed to tax competition to a different degree than others - as argued in the NEG literature.

Turning briefly to our control variables, we find that EU membership of both countries positively affects the corporate tax gap between them. This might be surprising at a first sight since the absence of competitive barriers within the European Union could be argued to increase the potential for strategic interactions and thereby exacerbate tax competition (e.g., Besley *et al.*, 2001; Redoano, 2007; Davies and Voget, 2008). It can be explained, however, by the fact that there are important disparities between former and new member-states (for a similar discussion, see Besley *et al.*, 2001; Redoano, 2007; Crabbé and Vandebussche, 2008; Davies and Voget, 2008). The corporate tax rate difference between two countries is also significantly larger when

as dependent variable, see section 3.3). In any case, the similarity with and without instrumentation of the lagged dependent variable indicates that the Nickell bias is indeed limited in our sample.

only one of them is member of the EU. This might reflect the reduced openness of ones economy compared to the rest of the world – and thus lower competitive pressures from abroad – when entering a protected environment within the globalised world (e.g., Redoano, 2007).

The sign of unemployment differences is at odds with the idea that higher unemployment is costly in terms of unemployment benefits (leading to higher tax rates). Rather, it suggests that governments use corporate tax cuts as a device to reduce unemployment by attracting new firms (e.g., Exbrayat *et al.*, 2008; Haufler and Mittermaier, 2010). The difference in the share of youngsters across countries is associated with a significantly reduced corporate tax gap between these countries, while the difference in share of elderly has no consistent effect across estimations. The GDP-gap, differences in urbanness and governments' political leaning have no consistent effect (in terms of either sign or statistical significance – or both) across our different specifications.

3.3 Robustness analyses

3.3.1 Non-linear trade cost effects?

As a corollary to the analysis of the Nash tax gap (see section 2.3), it is interesting to point out that trade costs could well have a non-linear effect on the tax gap between countries, provided that there is a positive population gap. Specifically, tax disparities can be shown to exhibit a concave relation with trade costs ($d\Delta^* / d\tau > 0$ and $d^2\Delta^* / d\tau^2 < 0$). This holds both for the interior equilibrium (in section 2.3.1) and the core-periphery equilibrium (in section 2.3.2) – with the single difference that the relationship between the tax gap and trade costs is not strictly increasing (but rather hump-shaped with a maximum value at $\tau = \tau^{CP} / 2$) in the latter case. To illustrate this more formally, note that equations (5a) and (5b) can also be rewritten as, respectively:

$$\Delta^* = \frac{6L(a - w\gamma)}{\beta(4K + 5)}(2\sigma_H - 1)\tau - \frac{L(2K + 3)}{\beta(4K + 5)}(2\sigma_H - 1)\tau^2 \quad (5a')$$

$$\Delta^{CP} = \frac{2L(a - w\gamma)}{\beta(K + 1)}(2\sigma_H - 1)\tau - \frac{L(2\sigma_H - 1 + K)}{\beta(K + 1)}\tau^2 \quad (5b')$$

This non-linear impact of trade costs can be evaluated by estimating a slightly extended version of the empirical model employed up to now:

$$TaxGap_{ijt} = \delta_1 \varphi_{ijt} + \delta_2 \varphi_{ijt}^2 + \delta_3 PopGap_{ijt} + \delta_4 (PopGap_{ijt} \times \varphi_{ijt}) \\ + \delta_5 (PopGap_{ijt} \times \varphi_{ijt}^2) + \delta_6 Y_{ijt} + O_i + D_j + \eta_t + \varepsilon_{ijt}$$

The results are given in Table 2. Clearly, given the presence of the interaction terms between trade integration and the population differential, the results on φ and φ^2 cannot be directly interpreted as marginal effects. Nonetheless, it can be easily observed that in both the static and dynamic model our results reject the prediction that tax disparities are a concave function of trade costs. Specifically, to the limited extent that such non-linearity exists in the data, it points in the opposite direction (note that this finding persists when dropping the interactions between φ and $PopGap$; available upon request). One potential explanation is that the large majority of our sample concerns highly developed countries with relatively high levels of trade integration. Consequently, variation in integration in our sample might well be too limited to pick up these finer distinctions. Unfortunately, however, data from a wider sample of countries is unavailable.

--- Table 2 about here ---

3.3.2. *Alternative corporate tax measures*

Although the theoretical model is predicated on greenfield investments (see above), it may be of interest to assess whether our results likewise hold for statutory tax rates and Effective Marginal Tax Rates (EMTR). A priori, one would expect weaker effects when using EMTR-differences between country-pairs as the dependent variable. The reason is that this measure of taxation is relevant for marginal investment decisions rather than discrete ones. For differences in statutory tax rates between countries (Stattax), however, one could expect similar if not stronger results than those for EATR. Statutory tax rates are the most directly observable measure of corporate taxation, and can thus more easily be compared from one country to another.

--- Table 3 about here ---

The results in Table 3 confirm the above intuition. While the results are qualitatively similar to those in Table 1, the model performs better when using effective average rather than effective

marginal tax rates as dependent variable. Indeed, the model's R^2 reaches its lowest level when we use effective marginal tax rates. This is the case both for the static and dynamic model (see Columns (4) through (6)). When turning to statutory tax rate differences (i.e. Columns (7) through (9)), we find largely similar results than those when using EATR in section 3.2 above (except that the dynamic regression does not pass the Hansen test).

Note also, as indicated above, that our results are robust to using the tax rate levied on investments in machinery, buildings or a weighted average of both. This holds for EATR as well as EMTR (details upon request).

3.3.3 Separating the population gap

One might argue that the rigorous bilateral approach taken in our analysis thus far imposes that the effects of both countries' population sizes have the same effect on the tax differential between them. This may conceal potential asymmetries in the observed effects.¹¹ Table 4 therefore presents results where we include the population size of the origin and destination country separately – each interacted with the bilateral measure for trade integration. Although the relative strength of the population variables cannot directly be interpreted in such a setting (as this obviously depends upon which country is selected as origin or destination), it is clear that the tax gap is significantly positively affected by the size of the origin country and significantly negatively by that of the destination country. This is in line with our theoretical model, as well as with the results derived in Table 1 above. Yet, the difference in coefficient estimates for origin- and destination-countries suggests that there indeed appears to be an asymmetry across countries. Coefficient estimates for the origin countries are higher (in absolute values), and the mediation effect of trade integration through the population of destination countries is not significant in the dynamic model whereas it is always significant for origin countries. Still, as the exact nature of such asymmetries (and their implications) reasonably goes beyond the scope of the present analysis, we leave further analysis of this for future research.

--- Table 4 about here ---

3.3.4. Third country effects

In the real world, country i is not only engaged in tax competition with country j , but should also take its fiscal attractiveness relative to all other countries into account when deciding upon its tax policy. A 3-country extension of our theoretical model (where the third country k is interpreted as the rest of the world) illustrates that the tax gap between country i and j then not only depends on their bilateral difference in population and trade costs, but also on the relative population size of both other countries as well as the level of trade costs between countries i and j and the rest of the world. While the analytical expression becomes quite complex, this suggests that the main mechanisms at work in the 2-country model still prevail in this extended setting. We evaluate this proposition by extending the empirical model in the following way:

$$\begin{aligned} TaxGap_{ijt} = & \beta_1 \varphi_{ijt} + \beta_2 \varphi_{ikt} + \beta_3 \varphi_{jkt} + \beta_4 PopGap_{ijt} + \beta_5 PopGap_{ikt} + \beta_6 PopGap_{jkt} \\ & + \beta_7 (PopGap_{ijt} \times \varphi_{ijt}) + \beta_8 (PopGap_{ikt} \times \varphi_{ikt}) + \beta_9 (PopGap_{jkt} \times \varphi_{jkt}) + \beta_{10} Y_{ijt} + O_i + D_j + \eta_t + \varepsilon_{ijt} \end{aligned}$$

where we expect positive signs for β_5 and β_9 , negative ones for β_6 and β_8 and signs as before for β_4 and β_7 . The intuition is the following: i) $PopGap_{ikt}$ exerts a positive influence of the absolute level of taxation in country i (and, ceteris paribus, also on $TaxGap_{ijt}$) while $PopGap_{jkt}$ exerts a positive influence of the absolute level of taxation in country j (and, ceteris paribus, a negative influence on $TaxGap_{ijt}$) and ii) both relationships are attenuated by trade integration.

Unfortunately, we cannot estimate this regression directly because of a severe collinearity problem. Indeed, when the difference in population between countries i and j increases, it mechanically increases (decreases) the population gap between country i (j) and the rest of the world. To overcome this problem, we redefine the third-country part of the model in terms of the population of country i relative to the total population in the 26 OECD countries in our sample. The resulting variable – $RelPop_{ikt}$ – is independent of $PopGap_{ijt}$, and the difference in population between country j and k is (weakly) negatively correlated with $PopGap_{ijt}$ so that a change in $PopGap_{jkt}$ is incorporated in our empirical model through $PopGap_{ijt}$ and $RelPop_{ikt}$ variables. Hence, we estimate the following regression, where $Open_{ikt}$ denotes the overall trade openness of country i :

¹¹ We are grateful to Simon Loretz for pointing this possibility out to us.

$$TaxGap_{ijt} = \beta_1 \varphi_{ijt} + \beta_2 PopGap_{ijt} + \beta_3 (PopGap_{ijt} \times \varphi_{ijt}) + \beta_4 Open_{ikt} + \beta_5 RelPop_{ikt} \\ + \beta_6 (RelPop_{ikt} \times Open_{ikt}) + \beta_7 Y_{ijt} + O_i + D_j + \eta_t + \varepsilon_{ijt}$$

Results are reported in Table 5. First, we can observe that controlling for third country effects does not affect our main results: that is, the tax differential between i and j remains increasing with their population gap and this relationship is weakened by bilateral trade integration. The coefficient estimates are also very similar, suggesting that subsuming third-country effects into our fixed effects did not bias our inferences. Second, the results provide evidence for the existence of significant third-country effects. As expected, the relative size of a country with respect to the rest of the world has a positive impact on its tax difference with country j , and this relationship is weakened by its trade openness to the world.

--- Table 5 about here ---

3.3.5. Income effects

Another simplification of the theoretical model is that it abstracts from income effects by approximating demand in country i by its population size and assuming quasi-linear preferences. To overcome this, we can introduce a more general measure for countries' market potential. Specifically, we thereby rely on the *real* market potential variable provided by the CEPII, which has several advantages.¹² First, it is estimated from a theory-grounded gravity equation, which implies that trade liberalisation is estimated rather than approximated by, say, the inverse of distance (see Appendix A). Secondly, it takes into account that the market potential in a country is not only increasing with demand coming from other countries but also decreasing with the average price in those countries. Finally, it is estimated using a dataset covering more than 150 countries, thus allowing us to indirectly take into account third-country effects.

Using this *real* market potential variable, we estimate the following regression:

$$TaxGap_{ijt} = \beta_1 \varphi_{ijt} + \beta_2 RmpGap_{ijt} + \beta_3 Y_{ijt} + O_i + D_j + \eta_t + \varepsilon_{ijt}$$

where $RmpGap_{ijt}$ denotes the difference in the *real* market potential of countries i and j .¹³ We expect β_2 to be positive, since, everything else equal, an increase in the real market potential in country i means this country becomes more profitable for firms and thus can attract more capital,

¹² <http://www.cepii.fr/anglaisgraph/bdd/marketpotentials.htm>

allowing its government to raise taxation. Note that this market potential measure inherently accounts for trade integration effects (see Appendix A), such that no interaction with trade integration is required here.

--- Table 6 about here ---

Results are reported in Table 6 and Columns (1) and (2) confirm that the difference in market potential has a significant positive impact on the tax gap. This complements the results provided in Davies and Voget (2008) and Exbrayat (2009), which show that a countries' market potential has a positive impact of absolute *levels* of corporate taxation. Nonetheless, to take this analysis one step further, Columns (3) and (4) present results when the market potential differential is decomposed into the difference in *domestic* and *foreign* market potential. This allows evaluating whether the difference in domestic market potential rather than the difference in foreign market potential matters most for governments.¹⁴ The results illustrate that both elements have a significant positive impact on the tax difference. Clearly, however, given the scale of both variables, the difference in *domestic* market potential thereby exerts a stronger impact than the difference in *foreign* market potential. This is not surprising, as a firm's mark-up is higher for domestic sales than for foreign ones because of trade costs.

3.3.6 Alternative constellations of control variables

Two of our control variables may generate some concern. First, one could argue that including variables for the EMU leads to overspecification of the model, in that such variables will by definition be highly correlated with a shift in trade integration between the countries involved.¹⁵ Second, our data on governments' political leaning are highly incomplete and inclusion of this variable leads to a significant reduction of our sample, especially for less affluent countries (e.g., South Korea, Mexico and Turkey). To evaluate potential biases induced by these problems, we also estimated our baseline estimations excluding these variables. As shown in Table 7, this does not affect our main findings.

¹³ We exclude $PopGap_{ijt}$ from this model as it would be highly correlated with $RmpGap_{ijt}$.

¹⁴ We approximate domestic market potential by the difference between (predicted) total market potential and (predicted) foreign market potential.

¹⁵ We are grateful to José De Sousa for pointing this out to us.

--- Table 7 about here ---

4. Concluding discussion

This paper contributes to the literature on international corporate income tax competition by analysing the determinants of international tax disparities. Using a standard footloose quasi-linear capital model, we show that the difference in capital taxation between two imperfectly integrated countries is increasing with the difference in population. Moreover, and crucially, this relationship vanishes as trade costs fall. Then, we provide the, to the best of our knowledge, first empirical test of these theoretical predictions employing a panel of 26 OECD countries over the period 1982-2004. As such, the analysis addresses two central research questions: *a)* can tax differentials be in part explained by the coexistence of imperfect trade integration and asymmetric market sizes? and *b)* does increased trade integration reduce the ability of largest countries to set higher taxes?

Our results provide significant evidence to answer both questions positively. That is, the difference in population between two countries increases the tax gap between them, *ceteris paribus*, and this relationship is weakened by trade liberalization. This supports the view presented in the NEG literature that countries with larger markets can impose higher levels of corporate taxation compared to countries with smaller markets, provided that exportation is sufficiently costly. These empirical results are robust to different measures of corporate taxation and the inclusion of third-country and income effects.

While our analysis provides a first attempt at explaining international tax disparities from a New Economic Geography perspective, various questions remain. One concerns disentangling the main effects underlying tax convergence in our model: i.e. the influences of changes in consumer surplus, capital returns and tax revenues effect (see the discussion in section 2.3). Another question relates to the so-called ‘home market effect’; i.e. the fact that the country with a larger demand for the increasing returns industry attracts an even larger share of production. While earlier work gives somewhat mixed evidence on the existence of a home market effect in general (e.g., Davis and Weinstein, 2003; Crozet and Trionfetti, 2008; Behrens *et al.*, 2009), another way to empirically address NEG model’s predictions would be to separate between low-tax and high-tax countries in such studies. Technically, the prediction is that high-tax countries remain net importers of capital, as their attractiveness should overcompensate their higher tax-

setting in equilibrium. Finally, it remains unclear to what extent higher taxes set by some countries truly results from their attractiveness with respect to mobile firms or from the fact that they host an industrial cluster (which induces firms' immobility and allows governments to tax them more severely). In the latter case, the higher corporate tax rate would not result from asymmetric tax competition with an interior location equilibrium, but from rent-seeking behaviour towards immobile firms. One possibility to address this in future work might be to move the analysis from the country to the sectoral level, thereby exploiting the variation that exists in the extent of industrial clustering across sectors.

Appendix A1: Measuring trade liberalization and market potential

Assuming a Dixit–Stiglitz–Krugman model of monopolistic competition and trade in a multi-region setting, one can estimate bilateral trade relations from a gravity equation which takes the following simple multiplicative form (see Head and Mayer, 2010):¹⁶

$$X_{ij} = FX_i \times \varphi_{ij} \times FM_j$$

with X_{ij} the bilateral exports from country i to country j , φ_{ij} denotes the freeness of trade¹⁷, while FX_i and FM_j stand for exporter and importer fixed effects.¹⁸ As standard in the literature, we consider that trade freeness depends on several variables that either enhance or deter trade: bilateral distance ($Dist_{ij}$), a dummy for contiguity (C_{ij}), a dummy for common language (L_{ij}) and a dummy for colonial links (Col_{ij}).¹⁹ Taking logs, our gravity regression is specified as follows:

$$\ln X_{ijt} = FX_{it} + FM_{jt} + \delta \ln Dist_{ij} + \lambda_1 C_{ij} + \lambda_2 L_{ij} + \lambda_3 Col_{ij} + u_{ijt}$$

(6)

To estimate this regression, we merge bilateral trade data over the period 1980-2004 with data for trade liberalisation – both provided by the CEPII – and estimate (6) for each year separately. We thus get the following predicted value for bilateral trade integration:

$$\hat{\varphi}_{ijt} = Dist_{ij}^{\delta} \exp(\hat{\lambda}_1 C_{ij} + \hat{\lambda}_2 L_{ij} + \hat{\lambda}_3 Col_{ij})$$

To get the market potential measure, Head and Mayer (2010) estimate the same gravity equation as (6), but use a larger sample of 150 countries and incorporate additional impediments to trade being relevant on such a larger sample (a dummy for common membership in a regional trade agreement, WTO/GATT membership, and currency union). The real market potential is found by calculating:

$$\hat{Rmp}_{it} = \sum_j \exp(\hat{FM}_{jt}) \hat{\varphi}_{ijt}$$

¹⁶ A wide range of different micro-foundations yield the crucial requirement of this equation. Those include Dixit–Stiglitz’ (1977) model of monopolistic competition, Anderson and van Wincoop’s (2003) model based on national product differentiation, but also comparative advantage models such as Eaton and Kortum (2002) and, more recently, models incorporating firm heterogeneity (e.g., Chaney, 2008).

¹⁷ Formally, $\varphi_{ij} = \tau_{ij}^{1-\sigma}$, with τ_{ij} the bilateral iceberg costs and σ the elasticity of substitution between varieties.

¹⁸ The exporter fixed effects typically capture the export capabilities of country i while the importer fixed effects capture demand from country j .

¹⁹ In an earlier version, we also included time-varying trade policy variables such as a variable measuring common membership of regional trade agreements. However, as there is not enough heterogeneity in our sample with respect to these variables to provide reliable results, we do not retain them in final model.

A.2. Data sources and summary statistics

$EATR_{it}$: Effective Average Tax Rate (source: Devereux *et al.*, 2002).

$EMTR_{it}$: Effective Marginal Tax Rate (source: Devereux *et al.*, 2002).

$EATR_{it}$: Statutory Tax Rate (source: Devereux *et al.*, 2002).

ϕ_{ijt} : Trade integration index (own calculations using Trade and Production database of CEPII).

Rmp_{it} : Real market potential (source: CEPII)

$FRmp_{it}$: Foreign real market potential

$DRmp_{it}$: Domestic real market potential

$PCONS_{it}$: public consumption in percentage of GDP per capita (source: Penn World Tables).

$UNEMP_{it}$: standardized unemployment rate (source: OECD Social Expenditures database).

$RealGDP_{it}$: real GDP (in million) (source: Penn World Tables).

POP_{it} : population (in million) (source: Penn World Tables).

$OPEN_{it}$: trade openness (source: Penn World Tables).

$LEFT_{it}$: Coded 1 if executive right-wing, 0 if centre and -1 if left-wing (source: World Bank: Database of Political Institutions).

URB_{it} : proportion of population living in urban areas (source: World Bank Development Indicators).

OLD_{it} : proportion of population over age 65 (source: World Bank Development Indicators).

YOU_{it} : proportion of population under age 14 (source: World Bank Development Indicators).

$EMU_{single_{it}}$: dummy = 1 if only one country in a country-pair ij is member of EMU (or its predecessors).

$EMU_{both_{it}}$: dummy = 1 if both countries in a country-pair ij are member of EMU (or its predecessors).

Summary statistics for variables in differences (1982-2004)

Variable	Mean	Std. Dev.	Min.	Max.
EATRGap	-0.006	0.119	-0.460	0.469
EMTRGap	-0.007	0.128	-0.511	0.524
StattaxGap	-0.004	0.139	-0.55	0.517
ϕ	0.003	0.007	0.000	0.100
RmpGap	-0.00034	0.00237	-104.00	0.00743
FRmpGap	1.34 E-06	6.36 E-06	-32.6 E-06	32.5 E-06
DRmpGap	-0.00034	0.00237	-104.00	0.00743
PopGap	-0.01997	0.08092	-0.29251	0.12347
OldGap	0.095	2.929	-8.450	7.450
YouGap	-0.727	3.899	-13.66	12.14
UrbGap	1.934	15.613	-38.8	44.8
RealGDPGap	0.00091	0.0069	-0.0279	0.0282
PconsGap	-1.151	5.931	-26.02	22.93
UnempGap	0.696	5.764	-20.5	21.2
LeftGap	-0.076	1.284	-2	2
OpenGap	0.561	38.963	-142.011	163.823

Note: PopGap and RealGDPGap in million; RmpGap, FRmpGap and DrmpGap in trillion (to make coefficient estimates more readable in Tables 1 through 7).

Appendix B: Results

Table 1: Estimation results for the baseline regression (1982-2004)

Variable	(1) EATR	(2) EATR	(3) EATR
Intercept	0.161*** (8.35)	-0.024 (-0.54)	0.201*** (8.07)
Lagged dependent variable	-	0.740 *** (57.42)	0.679*** (37.76)
φ	-0.035 (-0.30)	0.080 (1.21)	0.119* (1.78)
PopGap	0.257*** (17.74)	0.057*** (6.90)	0.073*** (7.07)
PopGap * φ	-0.451*** (-3.22)	-0.173** (-2.05)	-0.244** (-2.35)
RealGDPGap	0.326*** (5.27)	0.094*** (2.61)	0.034 (0.86)
PconsGap	-0.001 (-1.18)	-0.001 (-1.53)	-0.003*** (-6.88)
UnempGap	-0.006*** (-19.74)	-0.002*** (-9.59)	-0.002*** (-9.67)
OldGap	0.001 (0.60)	-0.001 ** (-2.04)	0.000 (0.02)
YouGap	-0.011*** (-14.07)	-0.002*** (-5.08)	-0.002*** (-3.91)
UrbGap	-0.004*** (-6.95)	-0.001** (-2.35)	-0.001 (-1.34)
LeftGap	-0.001 (-1.53)	0.001*** (3.30)	0.002*** (4.29)
OpenGap	-0.001*** (-9.90)	-0.0002*** (-4.54)	-0.0001 (-1.14)
EMUsingl	0.007** (2.05)	0.006** (2.85)	0.006** (2.33)
EMUboth	0.003 (0.98)	0.006** (0.98)	0.005** (2.38)
Country dummies (O & D)	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Trend	Yes	Yes	Yes
N	4730	4573	4103
R ² (overall)	0.811	0.929	0.935
Anderson Canonical			3385.5***
Hansen			1.628

Note: Dependent variable: EATRGap; t-statistics based on heteroscedasticity-consistent standard errors in parenthesis: *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions.

Table 2: Estimation results for the extended regression (1982-2004)

Variable	EATR (1)	EATR (2)	EATR (3)
Intercept	0.657*** (17.92)	-0.028 (-0.64)	0.005 (0.86)
Lagged dependent variable	-	0.740*** (57.37)	0.680*** (37.76)
φ	-0.004 (-0.02)	0.291** (2.01)	0.484*** (3.31)
φ^2	2.026 (0.51)	-3.416* (-1.84)	-6.101*** (-3.20)
PopGap	0.239*** (16.10)	0.054*** (6.42)	0.070*** (6.60)
PopGap * φ	11.000** (3.05)	-0.119 (-0.56)	-0.314 (-1.47)
PopGap * φ^2	-315.600*** (-4.41)	-0.434 (-0.11)	26.000 (0.67)
N	4730	4573	4103
R ² (overall)	0.812	0.9287	0.935
Anderson Canonical			3372.0***
Hansen			1.786

Note: Dependent variable: EATRGap; t-statistics based on heteroscedasticity-consistent standard errors in parenthesis: *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions, while Hansen is the test for over-identifying restrictions. Control variables as in Table 1 included in every regression.

Table 3: Robustness checks: using alternative tax measure (1982-2004)

Variable	(4) EMTR	(5) EMTR	(6) EMTR	(7) Stattax	(8) Stattax	(9) Stattax
Intercept	0.223*** (8.84)	-0.007 (-0.15)	0.240*** (7.99)	0.708*** (17.29)	-0.032 (-0.64)	0.257*** (8.05)
Lagged dependent variable	-	0.737*** (52.78)	0.647*** (34.14)	-	0.744*** (57.95)	0.685*** (40.45)
φ	0.006 (0.05)	0.098 (1.29)	0.142* (1.83)	-0.148 (-1.14)	0.053 (0.76)	0.042 (0.58)
PopGap	0.272*** (14.71)	0.063*** (6.04)	0.089*** (7.05)	0.284*** (17.07)	0.064*** (6.30)	0.092*** (7.28)
PopGap * φ	-0.466** (-2.97)	-0.183* (1.93)	-0.286** (-2.44)	-0.684*** (-3.44)	-0.301** (-2.75)	-0.369** (-2.93)
N	4730	4573	4103	4993	4867	4439
R ² (overall)	0.759	0.9153	0.922	0.818	0.931	0.930
Anderson			3496.1***			3787.1***
Hansen			0.033			9.124**

Note: t-statistics based on heteroscedasticity-consistent standard errors in parenthesis: *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions, while Hansen is the test for over-identifying restrictions. Control variables as in Table 1 included in every regression.

Table 4: Separating the population gap (1982-2004)

Variable	(1) EATR	(2) EATR	(3) EMTR	(4) EMTR	(5) Stattax	(6) Stattax
Intercept	0.265** (2.37)	-0.034 (-0.67)	0.278** (2.18)	-0.054 (-1.00)	0.275** (2.18)	-0.26 (-0.43)
Lagged dependent variable	-	0.674*** (36.78)	-	0.769*** (36.98)	-	0.679*** (39.55)
ϕ	0.886*** (4.78)	0.457*** (4.34)	1.096*** (4.91)	0.506*** (4.28)	1.024*** (5.15)	0.529*** (4.60)
Pop-origin	10.80*** (11.58)	0.234*** (4.90)	12.60*** (10.90)	0.245*** (4.43)	10.30*** (11.33)	0.314*** (5.84)
Pop- origin * ϕ	-21.50*** (-7.42)	-0.915*** (-4.28)	-24.70*** (-7.19)	-0.953*** (-3.82)	-29.50*** (-9.23)	-13.50*** (-5.95)
Pop-destination	-0.217*** (-14.75)	-0.065*** (-6.14)	-0.224*** (-11.85)	-0.055*** (-4.67)	-0.243*** (-14.37)	-0.083*** (-6.19)
Pop-destination * ϕ	-0.188* (-1.65)	0.005 (0.08)	-0.290** (-2.03)	0.006 (0.08)	-0.149 (-1.23)	0.022 (0.28)
N	4730	4103	4730	4103	4730	4103
R ² (overall)	0.816	0.935	0.764	0.925	0.821	0.931
Anderson		3330.2***		3330.2***		3741.5***
Hansen		1.614		0.377		8.945***

Note: t-statistics based on heteroscedasticity-consistent standard errors in parenthesis: *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions, while Hansen is the test for over-identifying restrictions. Control variables as in Table 1 included in every regression.

Table 5: Controlling for third-country effects (1982-2004)

Variable	(1) EATR	(2) EATR	(3) EMTR	(4) EMTR	(5) Stattax	(6) Stattax
Intercept	12.038*** (12.23)	3.307*** (6.52)	14.783*** (12.11)	4.210*** (6.96)	10.018*** (10.70)	3.404*** (5.98)
Lagged dependent variable	-	0.667*** (36.01)	-	0.634*** (32.53)	-	0.679*** (39.46)
ϕ	-0.100 (-0.86)	0.066 (1.01)	-0.077 (-0.56)	0.080 (1.05)	-0.199 (-1.52)	0.0002 (0.00)
PopGap	0.261*** (17.42)	0.082*** (7.34)	0.279*** (14.67)	0.099*** (7.44)	0.285*** (16.43)	0.101*** (7.17)
PopGap * ϕ	-0.383** (-2.56)	-0.218** (-2.16)	-0.380** (-2.28)	-0.253** (-2.21)	-0.634*** (-2.97)	-0.346*** (-2.74)
Openness	-0.011*** (-11.1)	-0.005*** (-6.55)	-0.015*** (-11.85)	-0.006*** (-7.10)	-0.009*** (-7.73)	-0.004*** (-5.11)
RelPop	12.2*** (11.44)	3.31*** (6.06)	15.1*** (11.36)	0.424*** (6.50)	10.1*** (9.88)	0.373*** (5.47)
RelPop * Openness	-0.010*** (-11.32)	-0.004*** (-6.98)	-0.001*** (12.02)	-0.001*** (-7.47)	-0.0001*** (-7.87)	-0.0004*** (-5.41)
N	4730	4103	4730	4103	4993	4439
R ² (overall)	0.819	0.936	0.770	0.924	0.822	0.931
Anderson		3304.8***		3414.0***		374534***
Hansen		2.04		0.12		8.607***

Note: t-statistics based on heteroscedasticity-consistent standard errors in parenthesis: *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions, while Hansen is the test for over-identifying restrictions. Control variables as in Table 1 included in every regression.

Table 6: Robustness checks: using the market potential (1982-2003)

Variable	(1) EATR	(2) EATR	(3) EATR	(4) EATR
Intercept	0.223*** (2.2)	0.042** (3.06)	0.196** (2.08)	
Lagged dependent variable	-	0.649*** (34.80)	-	0.631*** (32.10)
ϕ	-0.070 (-0.51)	0.129 (1.58)	-0.056 (-0.43)	0.129 (1.62)
RmpGap	1.66*** (21.38)	0.651*** (11.76)	-	-
DRmpGap	-	-	1.520*** (19.59)	0.653*** (11.76)
FRmpGap	-	-	0.0004*** (14.69)	0.0001*** (5.35)
N	4477	3850	4477	3850
R ² (overall)	0.823	0.937	0.830	0.937
Anderson		3020.2***		2826.1***
Hansen		1.189		0.673

Note: t-statistics based on heteroscedasticity-consistent standard errors in parenthesis: *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions, while Hansen is the test for over-identifying restrictions. Control variables as in Table 1 included in every regression.

Table 7: Alternative configuration of control variables (1982-2004)**Baseline regression without ‘Leftdiff’ (columns (1)-(2)) or EMU-variables (columns (3)-(4))**

Variable	(1) EATR	(2) EATR	(3) EATR	(4) EATR
Intercept	0.075*** (3.61)	0.189*** (7.93)	0.502*** (4.57)	0.019 (0.38)
Lagged dependent variable	-	0.688*** (38.77)	-	0.678*** (37.52)
ϕ	-0.056 (-0.52)	0.087 (1.36)	-0.030 (-0.25)	0.136** (2.01)
PopGap	0.285*** (20.83)	0.070*** (7.22)	0.258*** (17.91)	0.076*** (7.24)
PopGap * ϕ	-0.332*** (-2.85)	-0.196** (-2.09)	-0.461*** (-3.19)	-0.254** (-2.35)
N	5514	4672	4730	4103
R ² (overall)	0.824	0.938	0.811	0.935
Anderson		3590.6***		3383.4***
Hansen		0.678		1.240

Note: t-statistics based on heteroscedasticity-consistent standard errors in parenthesis:
 *** significant at 1%, ** at 5% and * at 10%. Anderson Canonical correlation statistic tests for weak identifying restrictions, while Hansen is the test for over-identifying restrictions. Control variables as in Table 1 included in every regression, **except** leftdiff in Columns (1)-(2) and EMUsingle and EMUboth in Columns (3)-(4).

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