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Abstract

Trade Integration and Business Tax Differentials: Evidence from OECD Countries

Nelly Exbrayat and Benny Geys*

Building on recent contributions to the New Economic Geography literature, this paper analyses the relation between asymmetric market size, trade integration and business income tax differentials across countries. First, relying on Ottaviano and Van Ypersele's (2005) foot-loose capital model of tax competition, we illustrate that trade integration reduces the importance of relative market size for differences in the extent of corporate taxation between countries. Then, using a dataset of 26 OECD countries over the period 1982-2004, we provide supportive evidence of these theoretical predictions: i.e., market size differences are strongly positively correlated with corporate income tax differences across countries but, crucially, trade integration weakens this link. These findings are obtained controlling for the potential endogeneity of trade integration and are robust to alternative specifications.

Keywords: Tax competition, trade integration, new economic geography, tax differentials

JEL classification: H2, H3, C23, F12

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> "You've had a broad substantial reduction in corporate tax rates outside the US. That occurs at a time when it's much easier (...) for companies to shift investment and income to take advantage of lower tax rates overseas. (...) To have a more competitive system, you want to try to bring down the rate closer to the range of our major trading partners."
>
> (Timothy Geithner, US Treasury Secretary, Wall Street Journal, 28-30 January 2011, 9)

1. Introduction

Looking at the evolution of corporate tax rates in developed countries over the last three decades, two observations stand out. The first is a decline in corporate tax rates (Figure 1, left-hand side). For example, between 1982 and 2011 OECD countries on average reduced their statutory and effective average corporate income tax rates by, respectively, 45 percent (from an average of 47% to an average of 26%) and 38 percent (from an average of 37% to an average of 23%).[1] The highest statutory corporate tax rate within the OECD stood at 65% (Israel) in 1982, and 41% (Japan) in 2011. The second is the presence of important corporate tax disparities across countries despite this downward trend. Indeed, while the standard deviation of the distribution of effective marginal, effective average, and statutory tax rates across OECD countries fell substantially between 1982 and 2000, this decline bottomed out since then, even though significant variation remains (Figure 1, right-hand side).

--- Figure 1 about here ---

Recent studies indicate the importance of such tax differences for firm location or FDI flows (Bénassy-Quéré *et al*., 2005; Kammas, 2011; Brülhart *et al*., 2012). Empirical analyses aimed at understanding what allows some countries to sustain higher tax rates than others have, however, not followed suit.[2] Yet, such insights can have important policy implications. US Treasury Secretary Geithner's statement quoted above indeed makes clear that a central reason behind the US' planned overhaul of the corporate tax system lies in fears that increasing economic integration is undermining the US' ability to sustain higher tax rates compared to its main trading partners.[3]

This article analyses the determinants of corporate tax differentials across countries, focusing on the role of trade integration. From a theoretical perspective, we exploit insights from the

1 This decline is also present when looking only at countries that were OECD members throughout the 1982-2011 period.

2 While numerous studies analyse the decline in corporate tax rates (Devereux *et al*., 2002, 2008; Davies and Voget, 2008), Gilbert *et al.* (2005) is the only study analysing the determinants of corporate tax rate differentials. Compared to that study, we provide a firmer theoretical rationale for the analysis, address potential endogeneity problems, control for the influence of various country-level variables, and employ a wider sample of countries (i.e., 26 OECD countries versus 15 European countries).

3 Although we focus on international tax competition, countries often use a variety of measures to increase their appeal for international firms. Pieretti and Zanaj (2011), for example, analyse the case where jurisdictions compete for foreign capital via both taxes and public inputs that enhance firms' productivity while Charlton (2003) looks at investment subsidies. Also, some countries give preferential treatment to highly mobile tax bases (e.g., Ireland taxes manufacturing and financial services less than other sectors). We abstract from such cross-sectoral discrimination (for recent treatments, see Wilson, 2005; Marceau *et al*., 2010).

tax competition literature based on New Economic Geography (NEG) frameworks. While it has long been known that larger countries can sustain higher corporate taxes (a finding that goes back, at least, to Wilson, 1991; Bucovetsky, 1991), recent contributions to the NEG literature predict that bigger countries lose this advantage with increasing trade integration (or falling trade costs) because the site of production then becomes less relevant (Ottaviano and van Ypersele, 2005; Gaigné and Riou, 2007; Haufler and Wooton, 2010). Consequently, the NEG literature predicts that tax disparities across countries reflect the fact that some countries are exposed to tax competition to a different degree than others, depending on the level of trade costs and their relative market size. This paper's central contribution lies in assessing such claim's empirical relevance.

Our analysis proceeds in two stages. First, we build on the foot-loose capital model of Ottaviano and Van Ypersele (2005) to derive two empirically testable predictions: *a)* tax differentials are a function of the coexistence of imperfect trade integration and asymmetric market sizes and *b)* increased trade integration reduces the ability of large countries to set higher taxes. Second, we evaluate these predictions employing data for 26 OECD countries (thus generating up to 325 country-pairs) over the period 1982-2004. Unlike existing empirical tax competition studies – which mostly estimate tax reaction functions, where the tax rate in one country is linked to a population- or distance-weighted average of competing countries' tax rates (Devereux *et al*., 2002, 2008; Davies and Voget, 2008) – we thereby explicitly model the tax rate difference between each country-pair. The reason is threefold. First, the focus of reaction function analyses lies on absolute levels of taxation. This can be misleading, since what matters for firms' location choices – and thus 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). Moreover, tax differentials more directly capture the idea that investors arbitrate not only among foreign locations, but also between each foreign location and domestic investment. Finally, 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, which is our central concern.

Our results support theoretical predictions from Ottaviano and Van Ypersele (2005) and Haufler and Wooton (2010). Specifically, we show that the tax gap responds positively to population size (and GDP) differences between countries and, crucially, that this relationship is significantly attenuated by trade integration. Our analysis thereby controls for the endogeneity of standard measures of trade integration by extracting the level of trade liberalisation between each country-pair from a gravity equation (Rose and Van Wincoop, 2001; Feenstra, 2003; Redding and Venables, 2004; Head and Mayer, 2011). This constitutes strong evidence since the relatively highly-integrated nature of OECD countries' economies provides an environment least likely to expose substantial effects.

In the following section, we formulate our main hypothesis on the determinants of international business tax differentials. The empirical verification thereof is described in section 3. The last section concludes and discusses some avenues for further research.

2. Related literature and testable hypothesis

The first theoretical explanation for cross-country business tax differentials goes back to Bucovetsky (1991) and Wilson (1991). They develop a tax competition model composed of two perfectly integrated and competitive economies that differ only in terms of their population size. Because capital demand mostly emanates from the larger country, a variation in its tax rate exerts a stronger impact on the return to capital so that the cost of capital is less responsive to tax policy. Consequently, the larger country sets a higher tax rate and the smaller country is a net-importer of capital. This path-breaking insight was recently revisited by analyses using a New Economic Geography (NEG) framework (Ludema and Wooton, 2000; Andersson and Forslid, 2003; Baldwin and Krugman, 2004). They deviate from the basic tax competition model by assuming increasing returns to scale and positive trade costs in order to provide structural determinants to the location of capital and the tax base elasticity (Baldwin *et al.*, 2003). To offer a detailed understanding regarding the role of asymmetric market size and trade integration for corporate tax differences across countries, we build on the latter literature – and most explicitly the foot-loose capital model of tax competition developed by Ottaviano and Van Ypersele (2005) (hereafter, OvY)[4] – to derive our key hypothesis. While we describe the key assumptions and results below, technical details are provided in AUTHORS (2012).

In the OvY model, the economy consists of two imperfectly integrated countries, which compete to attract monopolistic firms. These firms produce horizontally differentiated varieties of a good (say, x) under increasing returns to scale. Producing any variety requires a fixed amount of capital (normalised to one) and exporting any variety between countries involves a per-unit trade cost. Production also requires a variable amount of labor, which is normalized to zero without loss of generality. Another private good, the numéraire (z), is produced under perfect competition using only labour and is freely traded. Hence, there are two factors of production, physical capital and labour, whose total endowments are assumed to be fixed and equally distributed across individuals in either country. However, a higher share of the total population is assumed to live in one country. This is the only asymmetry introduced in the model as all consumers in both countries are also assumed to share the same quasi-linear utility function (which is quadratic in the horizontally differentiated varieties of good x and linear in the numéraire). All residents are immobile, but they can invest their capital in the country where industrial firms are most profitable.[5] Finally, the public sector in each country is represented by a benevolent government, which imposes a lump-sum tax on capital invested in its country. If this tax is positive, the resulting tax revenues are redistributed in a lump-sum way to the workers (and vice versa).

The spatial distribution of capital resulting from this simple set-up is characterized by the so-called 'home-market effect': i.e. the country with a larger demand for the increasing returns industry attracts more production relative to its population because firms save on trade costs by locating in this country. This result holds despite the fact that the larger country will set a higher capital tax in equilibrium, which marks a crucial difference with respect to the models of Bucovetsky (1991) and Wilson (1991). Moreover, this effect is strengthened by the level of trade liberalization. Particularly, there is a threshold level of trade costs under which it

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4 This choice is driven by three main reasons. Firstly, this model stays very close to the standard model of asymmetric tax competition (Bucovetsky, 1991; Wilson, 1991) so that any differences in the predictions are only imputable to the assumption of imperfect competition and positive trade costs. Second, by assuming mobile physical capital and immobile labour, the model is well-designed to explore business tax differentials between countries. Assuming human capital mobility (as in, for instance, Ludema and Wooton, 2000; Andersson and Forslid, 2003; Baldwin and Krugman, 2004) would indeed be more relevant for studies of tax competition on a smaller spatial scale, such as within a federal country. Thirdly, the main predictions of the OvY model are robust to various alternative assumptions (see below).

5 Industrial firms enter and exit freely. Thus, the rental rate to capital is determined by a bidding process among firms which ends when after-tax profits are equal to zero. The location equilibrium of capital is then obtained by equalizing the net-return to capital across countries.

becomes so cheap to serve the foreign market through exports that a core-periphery structure emerges, characterized by the complete concentration of firms in the larger country. Consequently, the tax base elasticity and the resulting tax equilibrium in the model will crucially depend on the level of trade liberalization.
Let us first consider the most realistic case of intermediate trade costs, which implies that there is only partial agglomeration in the larger country.[6] In such setting, the equilibrium tax gap between the large and small country (see eq. 22 in OvY) can be rewritten as follows:

$$\Delta^* = \Omega\tau \frac{(b+cK)(6a-\tau(3b+cK))}{2(2b+5cK)} \quad (1)$$

where τ stands for the per-unit level of trade cost, Ω is the difference in population between the big and the small country, K is the total stock of capital in the economy and the remaining terms are positive parameters from the demand function.[7] Equation (1) first of all indicates that the tax gap is increasing in the population difference, provided that trade costs are positive but not-prohibitive ($d\Delta^* / d\Omega = \tau(b+cK)(6a-\tau(3b+cK))/2(2b+5cK) > 0$).[8] The intuition is as follows. Firms generate higher profits by locating in the largest market (because they save trade costs), which lowers the tax base elasticity and allows the government in the larger country to set a higher capital tax. In contrast, the government of the less populated country must compensate its firms for their location disadvantage via a lower capital tax.[9] Equation (1) furthermore shows that for non prohibitive trade costs, trade liberalization reduces the positive impact of the market size difference on the tax gap between both countries ($d^2\Delta^* / d\Omega d\tau = (b+cK)(3a-\tau(3b+cK))/(12b+5cK) > 0$).[10] Indeed, the fall in trade costs reduces the difference in the net-return to capital between countries and thus limits the ability of the larger country to set higher taxes. It is also worth noting from equation (1) that the level of trade costs has no direct impact on the tax differential when countries are of equal size. Trade costs only matter through their influence on countries' relative market size (though trade integration clearly has a direct impact on the absolute *levels* of taxation).

Turning now to the case where trade costs are so low that complete agglomeration in the larger country occurs, and the tax base elasticity in that country equals zero. As there is no capital in the small country, the tax game will be such that the government of the larger country sets its tax rate at the highest level compatible with the government of the smaller country being unable to attract capital. The resulting tax differential is described in eq. 23 of OvY, and can be rewritten as follows:

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6 We do not consider the case of prohibitive trade costs given that we test the model's predictions on a sample of countries that de facto trade with each other (such that trade costs cannot be prohibitive in our dataset).

7 Specifically, $c \geq 0$ is an inverse measure of the substitutability between varieties. It captures the effect of the price of variety *j* on the demand for another variety *i* (cross-price effect). Nevertheless, as all prices of all varieties are equal to *p* in equilibrium, the demand for each variety boils down to $q=aK-bpK$, where parameter *b* captures the own-price effect.

8 In the OvY model, trade costs are non-prohibitive whenever $\tau<\tau_{trade}=2a/(2b+cK)$. We can easily check that $(6a-\tau(3b+cK))>0$ for all $\tau<\tau_{trade}$. Thus, Δ* and dΔ*/dΩ are positive for non-prohibitive values of trade costs.

9 Importantly, and contrary to standard tax competition models, this result is valid only for imperfectly integrated economies. Indeed, in the extreme case of a perfectly integrated economy (that is, τ=0), firms are indifferent between countries, so that both governments set equal tax rates.

10 Note that $(3a-\tau(3b+cK))>0$ for all $\tau<\tau_{trade}$, so that $d^2\Delta^*/d\Omega d\tau>0$ for non-prohibitive values of trade costs.

$$\Delta^{CP} = \tau(b + cK)\frac{(4a - 2b\tau)\Omega - KLc\tau}{4(2b + cK)} \quad (2)$$

We can easily verify that this expression is positive for all values of trade costs compatible with a core-periphery equilibrium and zero in the absence of trade costs.[11] More importantly, this tax gap shares the same two properties as the tax gap under the interior location equilibrium discussed above: i.e., it increases in the population difference between both countries for positive, but non-prohibitive, trade costs ($d\Delta^{CP} / d\Omega = \tau(2a - b\tau)(b + cK)/2(2b + cK) > 0$), and this relation is weakened as trade costs fall ($d^2\Delta^{CP} / d\Omega d\tau = (a - b\tau)(b + cK)/(2b + cK) > 0$).[12] Thus, in the extreme case of a perfectly integrated economy (that is, τ=0), firms are indifferent between locating in the large or small country (so that both governments set equal tax rates). These properties of the equilibrium tax differentials lead us to formulate the following testable prediction:

Hypothesis: *Assume tax competition between two benevolent governments of differently populated countries. For positive but non-prohibitive values of trade costs,*
a) the tax gap between both countries is increasing with the difference in their populations
b) this relationship is mitigated as trade costs fall.

Before empirically testing this hypothesis, we should note that it is robust to various extensions. One can indeed show the above prediction continues to hold in a three-country version of the model, and is robust to alternative assumptions regarding (1) the government's behaviour (e.g., the introduction of public good provision)[13], (2) changes in the timing of events under the interior equilibria configuration (i.e., allowing the big country to act as Stackelberg leader in the tax game) and (3) allowing for Leviathan behaviour (technical details to all these extensions are available upon request). Finally, Haufler and Wooton (2010) derive the same prediction assuming oligopolistic rather than monopolistic competition.

3. Empirical Analysis

3.1. Model specification

To test the above prediction, we exploit an unbalanced panel of 26 OECD countries over the period 1982-2004 (thus having maximally 325 country-pairs per period).[14] Our baseline regression is:

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[11] Indeed, $(4a-2b\tau)\Omega-KLc\tau$ is decreasing with the level of trade costs, and equal to zero at level of trade costs inducing a core-periphery structure (i.e. $\tau_{cp}=4a\Omega/(2b\Omega+cKL)$). Thus, $(4a-2b\tau)\Omega-KLc\tau$ is positive for all levels of trade costs compatible with a core-periphery structure.

[12] We can check that $(ab-\tau)>0$ for all $\tau<\tau_{trade}$. Thus, $d\Delta^{CP} / d\Omega$ and $d^2\Delta^{CP} / d\Omega d\tau$ are positive for non-prohibitive values of trade costs. Note also that the main difference under a core-periphery equilibrium is that trade costs exert a direct negative influence on the tax differential whereas they act only through the population differential at interior equilibria.

[13] In OvY model, governments are assumed to be engaged in a purely redistributive fiscal policy.

[14] 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 data allowing for the correction of the endogeneity of liberalisation after 2004 (source: CEPII-TradeProd and CEPII-Gravity databases; Head *et al.*, 2010; de Sousa *et al.*, 2012). Although using trade flow data provided

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

where ij refers to a country-pair with $i \neq j$ and t indexes time. Before discussing the operationalisation of the constituent parts of this model, two comments are required. First, one could argue that a natural alternative to this linear specification would start by taking the logarithm of eq. 1, and estimate a loglinear specification. Clearly, however, given the large number of negative values arising from the construction of both dependent and independent variables (i.e., as the difference between the values of countries *i* and *j*; see below), this is empirically unfeasible. Second, the explicit two-country set-up may be deemed problematic in a multi-country world. Still, we address the potential influence of 'third countries' in a number of ways throughout the analysis (see the end of this section, as well as section 3.4.3). This not only mitigates concerns about possible mis-specification bias, but also evaluates the robustness of our results to the exact operationalisation of such third-country effects.

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* (Loretz, 2008). We thereby employ the EATR levied on machinery, as this is a mobile and tradable good (unlike buildings). 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 (and select those country-pairs *ij* where country *i* was alphabetically prior to country *j*). 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 and 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, as the theoretical analysis is inspired by competition over 'greenfield' rather than additional investments,[15] EATR is the most appropriate measure. 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. First, $PopGap_{ijt}$ stands for the difference in population size between countries *i* and *j* at time *t* (in million people) and analyzes how the tax gap responds to population size differences between countries (part *a)* of OvY theoretical prediction). One could argue that this reliance on the population difference takes the theoretical model overly literal, and that the difference in GDP or market potential would be more appropriate (since Ω effectively measures the relative size of the market). We prefer the population measure as employing GDP creates an obvious endogeneity problem. This is not the case for the population-based measure since *corporate* taxation arguably leaves individuals' residence decisions – and thus the relative size of countries' populations – unaffected. Moreover, the population difference provides a credible measure of the relative market size since it is significantly positively related to the GDP-difference ($r=0.21$; $p<0.01$) as well as the market potential difference ($r=0.65$; $p<0.01$; this variable is defined in more detail in section 3.2). Still, we also report results using the GDP difference (correcting for the endogeneity of GDP) and the difference in market potential. Second, to address part *b)* of our central theoretical prediction, we introduce the level of bilateral trade liberalisation (φ_{ijt}) –

by, for instance, the IMF might have allowed us to slightly extend our time dimension, we prefer to rely on the CEPII-TradeProd dataset because it exploits mirror trade flows (i.e., it reports on both exporting and importing countries), which significantly improves both the coverage and accuracy of trade data (see Mayer *et al*., 2008).

15 What is taxed is the return to capital employed as a fixed cost in the modern industry, which is equal to firms' o*perating* profits.

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 – and interact it with $PopGap_{ijt}$. Given the endogeneity of traditional trade openness measures (i.e., imports and exports as a share of GDP), our identification strategy here rests on estimating φ_{ijt} from 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 section 3.3). Larger values of φ_{ijt} indicate closer trade integration (and thus lower trade costs), implying a positive sign for β_2 and a negative one for β_3.

We also include φ_{ijt} independently. This not only avoids biased inferences on its interaction with the population differential, but also allows testing whether trade integration fails to have a direct impact on the tax differential – as predicted by eq. 1.[16] Specifically, eq. 1 indicates that the level of trade costs only matters through its influence on countries' relative market size at interior equilibria, whereas it has a direct and negative influence on the tax gap at the core-periphery equilibrium. Consequently, a statistically insignificant coefficient β_1 would suggest that all governments consider the tax base elasticity to be positive, whereas a significant β_1 rather indicates that one government in each country-pair behaves as if all industrial firms were located in its country and tax base elasticity equals zero.

The vector Y_{ijt} represents a number of control variables that can be expected to affect tax rates, and therefore the tax gap between countries. Specifically, building on a large political economics literature, we include the difference in country-pairs' real GDP (in million 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 rate, openness (imports plus exports as a share of GDP), capital mobility (measured on a 10-point scale, where increasing numbers indicate higher capital mobility, and taken from the Economic Freedom of the World database), political leaning of the government (1 if right-wing, 0 if centre and -1 if left-wing), and two dummy variables equal to 1 when one or both countries are part of the European Union or its precursors.[17] Data definitions, summary statistics and sources are in appendix.

Finally, O_i and D_j represent a vector of country of 'origin' (i.e., first in our country-pair) and 'destination' (i.e., second in our country-pair) indicator variables and η_t is a set of year dummies, which pick up country-specific and time-specific effects. Importantly, inclusion of these fixed effects goes some way towards mitigating the potential bias of not explicitly introducing third-country effects in the empirical model (as mentioned, however, we return to such effects in section 3.4.3).[18] Note that we also experimented with country-pair fixed effects. As this alternative specification does not affect our main findings (details upon request), but more strongly reduces our degrees of freedom, we retain separate origin and destination fixed effects in the main analysis.

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[16] Still, excluding φ_{ijt} from the model does not affect our findings in any way.

[17] Trade openness 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. Note also that we chose to retain the difference in real GDP as a control variable, and will return to its likely endogenous nature below. Our results remain unchanged, however, when excluding either or both of these variables.

[18] We thank José de Sousa for fruitful comments and discussions on this point.

3.2. Measuring trade liberalization (and market potential)

Following Head and Mayer (2011), we estimate bilateral trade relations from a gravity equation which takes the following simple multiplicative form:[19]

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

with X_{ij} the exports from country i to country j, φ_{ij} the freeness of trade, and FX_i and FM_j as exporter and importer fixed effects. Formally, $\varphi_{ij} = \tau_{ij}^{1-\sigma}$, with τ_{ij} the bilateral iceberg costs and σ the elasticity of substitution between varieties. The exporter fixed effects typically capture the export capabilities of country i while the importer fixed effects capture demand from country j. Following the literature, we consider that trade freeness depends on several variables that either enhance or deter trade: bilateral distance ($Dist_{ij}$), contiguity (C_{ij}), common language (L_{ij}) and colonial links (Col_{ij}). Such historical elements provide a critical source of exogenous variation. Taking logs, our gravity regression is specified as follows:

$$\ln X_{ijt} = FX_{it} + FM_{jt} + \delta \ln Dist_{ij} + \lambda_1 C_{ij} + \lambda_2 L_{ij} + \lambda_3 Col_{ij} + u_{ijt} \quad (3)$$

Attempts to include time-varying trade policy variables – such as membership of regional trade agreements – proved unsuccessful (i.e., the model often fails to converge) as there is insufficient heterogeneity in our sample with respect to these variables.[20] To nonetheless account for temporal influences, we estimate eq. (3) separately for each year. This allows trade costs to change for each country-pair in each year, and does so without imposing a predefined functional form on such changes – unlike, for instance, introducing dummy variables for regional trade agreements or the fall of the Berlin Wall. This flexibility is important to pick up trade cost changes when they *de facto* occur (not when we would *de jure* expect them), and allows the strength of such effects to develop over time (rather than imposing a constant effect). The resulting model – estimated using bilateral trade data over the period 1980-2004 with data for trade liberalisation (both provided by CEPII) – provides a very good approximation of trade flows, with an average R^2 of 98% (88% when looking exclusively at variation within country-pairs over time), and variables used as trade cost proxies are statistically significant well beyond the 99% confidence level. From this set of estimations, we extract predicted values for bilateral trade integration as follows (Head and Mayer, 2011):[21]

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

Summary statistics are provided in Appendix. These illustrate that the estimated trade integration measure varies substantially both across space and time. Moreover, it picks up

[19] We choose this model because a wide range of different micro-foundations yield such an equation (e.g., Dixit and Stiglitz, 1977; Eaton and Kortum, 2002; Anderson and van Wincoop, 2003; Melitz and Ottaviano, 2008).

[20] Moreover, regional trade agreements may be endogeneous (Baier and Bergstrand, 2007).

[21] One can similarly extract a measure for a country's overall market potential: i.e., $\hat{Rmp}_{it} = \sum_j \exp\left(\hat{FM}_{jt}\right)\hat{\varphi}_{ijt}$ (see Head and Mayer, 2011). We use this measure in the robustness check in section 3.4.4 below).

important shifts in trade integration among OECD countries: e.g., our measure records substantial increases immediately following the fall of the Berlin Wall, around the Austrian-Finnish-Swedish EU-accession in 1995 and around the large-scale eastward EU enlargement in 2004, as well as a marked decline during the 1997-1998 global financial crises.

While this estimation of φ_{ijt} has a clear theoretical underpinning and addresses the endogeneity issue, extracting it from such first-stage regressions makes it a 'generated regressor'. Fortunately, OLS leads to consistent coefficient estimates in the presence of generated regressors (Pagan, 1984). 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).

3.3. Empirical results

Our key results are summarized in Table 1. Column (1) presents baseline results when using the OLS estimator. In Column (2), we relax the implicit assumption that both countries' population sizes have the same effect on the tax differential between them, and include the population size of the 'origin' and 'destination' country separately – each interacted with the bilateral measure for trade integration. We expect the tax gap to be positively affected by the size of the 'origin' country and negatively by that of the 'destination' country.[22] Column (3) presents the results from an IV estimation where we account for the potential endogeneity of GDP (using the difference in country-pairs' public consumption, share of elderly and political leaning of the government as instruments; their validity for this purpose is confirmed in the bottom row or Table 1). Finally, in Column (4), we operationalise the market size divergence between countries using the difference in their GDP (controlling for its endogeneity), rather than population size. Throughout the analysis, we rely on Newey-West heteroscedasticity-consistent standard errors and cluster standard errors by country-years to account for the non-independence of observations (i.e., the fact that a change in the corporate tax rate in country *i* in year *t* not only affects country-pair *ij*, but also all other country-pairs including *i*). Such clustering is feasible as we have a large number of clusters (450) with relatively few observations (25 or less) in each cluster (Wooldridge, 2003).[23]

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[22] We are grateful to Simon Loretz for pointing this possibility out to us. Note that all country-pairs *ij* have country *i* alphabetically prior to country *j* (see above), such that 'origin' and 'destination' here simply imply that a country *i* comes first in the alphabet. Although the relative strength of the population variables therefore cannot directly be interpreted (as this obviously depends upon which country is selected as 'origin' or 'destination'), it does allow evaluating whether any asymmetries exist in the country size effect. Evidently, any random rearrangement of 'origin' and 'destination' countries would affect the coefficient estimates, but not our ability to evaluate potential asymmetries in the country size effect.

[23] Note that each country-pair is simultaneously part of two clusters (i.e., one for the origin-country in year *t* and one for the destination-country in year *t*), creating a complicated correlation structure. As these two sets of clusters are by construction highly correlated and partially overlapping, clustering standard errors simultaneously in both dimensions is impossible. It also invalidates recently developed procedures accounting for multi-way clustering (e.g., Cameron *et al.*, 2011), as these are only valid for non-nested and non-overlapping clusters. To alleviate this problem, we ran all regressions using either origin-year or destination-year clustering and report the most conservative estimates obtained (i.e., origin-year clustering).

--- 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., $\varphi_{ijt} = 0$). Hence, in line with predictions from standard asymmetric tax competition models without trade (Wilson, 1991; Bucovetsky, 1991), a bigger country can – and does – set 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, as expected, increasing trade integration significantly reduces the impact of the population differential on the tax gap. The exact relation is depicted in Figure 2 (left panel). Even though the population differential retains a statistically significant effect at conventional levels throughout the range taken by the trade integration variable, the strength of this effect is decreasing in trade integration. This finding confirms part *b)* of OvY theoretical prediction, and illustrates the empirical relevance of the models of capital 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.

--- Figure 2 about here ---

Interestingly, Column (1) also indicates that trade liberalization has no direct impact on the tax gap when both countries are of equal size (i.e., when $\Omega = 0$), which is in line with theoretical predictions for interior equilibria (see eq. 1). However, calculating the effect of trade integration over the range of the population differential, we find that it significantly affects the tax differential whenever the population differential exceeds roughly 100 million inhabitants (which occurs in about 15% of our sample, with country-combinations including the US, Japan or Mexico). The exact relation is depicted in Figure 2 (middle panel). When the population differential is 'large enough', the effect of trade integration is to decrease the tax rate of the larger country relative to that of the smaller one. This provides support for the theoretical prediction that, for interior equilibria, the overall effect of trade integration on the bilateral tax differential is negative (from the perspective of the bigger country).

In Column (2), we find, in line with expectations (see above), that the tax gap is significantly positively affected by the size of the 'origin' country and significantly negatively by that of the 'destination' country. Moreover, the difference in coefficient estimates for origin- and destination-countries suggests an asymmetry across countries. Coefficient estimates for the origin countries are higher (in absolute values), and the mediating effect of trade integration through the population of destination countries is somewhat weaker (in a statistical sense). Nonetheless, in both cases, the results confirm the predictions from the theoretical model: i.e., trade integration weakens the link between market size differences and corporate income tax differences across countries.[24]

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[24] Note that the φ-coefficient is statistically significant in Column (2). This should, however, not be mis-interpreted as it derives from the difference in the specification. Indeed, in Column (1), the φ-coefficient gives the effect of trade liberalization when countries are equal-sized whereas in Column (2) it describes the effect of trade liberalization when the population is equal to zero in both the origin and destination countries (a more stringent condition that, obviously, does not occur in our data).

While Column (3) indicates that the results presented in Column (1) are not affected by the potential endogeneity of GDP, Column (4) shows that our results are robust to using the difference in GDP as a measure of market-size divergence. In particular, we find a significant positive baseline effect of the GDP-gap (i.e., when $\varphi_{ijt} = 0$), which declines for higher levels of trade integration. While this interaction effect is statistically fairly weak (p=0.175), it is sufficiently powerful to make the positive effect of the GDP-gap lose statistical significance at about $\varphi_{ijt} = 0.013$ (a value well above the mean, suggesting that the GDP-gap positively affects the corporate tax gap in the majority of our sample). The graphical representation in Figure 2 (right panel) is highly reminiscent of that generated when using population size to measure market size divergence (Figure 2, left panel).

Turning briefly to our control variables, we find that the sign of the unemployment difference 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 (Haufler and Mittermaier, 2011; Exbrayat *et al*., 2012). The difference in the share of young individuals across countries is associated with a significantly reduced corporate tax gap, while the difference in share of elderly has no effect. The same insignificance is observed for differences in governments' political leaning and consumption levels. EU membership of one or both countries is linked to a higher corporate tax gap, suggesting that corporate tax rates show higher variation within the EU than between other OECD countries.[25] Finally, capital mobility (captured by an inverse measure of the level of international capital controls) exerts the expected negative impact on corporate tax differentials.

3.4 Robustness analyses

3.4.1. Persistence and alternative corporate tax measures

Since the tax gap between countries – just like the tax rates of individual countries – shows significant persistence over time, we evaluate whether this persistence affects our core findings by including a lagged dependent variable (even though no clear argument in favour of such inclusion flows from the theoretical model). Although panel-data estimators are well-known to generate biased and inconsistent results in the presence of a lagged dependent variable, the length of our time series (over 20 years) implies that any such bias is likely to be small (Nickell, 1981). Nonetheless, we cautiously instrument the lagged dependent variable with two further lags.[26] The results are given in Columns (4), (6) and (8) of Table 2. They indicate that there is substantial persistence in tax differentials, but, crucially, this does not affect our core findings. Trade integration consistently mitigates the link between market size differences and corporate income tax differences.

In the remaining columns of Table (2), we furthermore illustrate that this same conclusion holds for alternative operationalisations of the tax measure. Although the theoretical model is predicated on greenfield investments (see above), Columns (5) through (8) evaluate the empirical model's robustness to statutory tax rates and Effective Marginal Tax Rates

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[25] 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. Still, excluding these variables does not affect our main findings (details upon request).

[26] This follows the approach taken in Devereux *et al*. (2008). The validity of these instruments is confirmed by a standard Hansen test in all regressions (except for the statutory tax as dependent variable, see Table 2).

(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 rather than discrete investment decisions. 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. The results in Table 2 confirm the above intuitions.

--- Table 2 about here ---

3.4.2 Non-linear trade cost effects?

As a corollary to the analysis of the Nash tax gap in OvY model, it is interesting to point out that trade costs have a non-linear effect on the tax gap between countries as soon as there is a positive population gap. Specifically, tax disparities can be shown to exhibit a concave relation with trade costs ($d^2\Delta^* / d\tau^2 < 0$). This holds both for the interior equilibrium and the core-periphery equilibrium – with the sole difference that the relationship between the tax gap and trade costs is not strictly increasing (but rather hump-shaped with a maximum value at $\tau = \tau_{CP}^M / 2$) in the latter case (Figure 3).

--- Figure 3 about here ---

To illustrate this more formally, note that equations (1) and (2) can also be rewritten as, respectively:

$$\Delta^* = 6a\frac{b+cK}{24b+10cK}\Omega\tau - \frac{(3b+cK)(b+cK)}{2(12b+5cK)}\Omega\tau^2 \tag{1'}$$

$$\Delta^{CP} = a\frac{b+cK}{2b+cK}\Omega\tau - \frac{(2b\Omega+KLc)(b+cK)}{4(2b+cK)}\tau^2 \tag{2'}$$

This corollary can be evaluated via a slightly extended version of our empirical model:

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

The results are given in Table 3. 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 observed that in both the static and dynamic model the prediction that tax disparities are a concave function of trade costs is rejected. To the limited extent that such non-linearity exists in the data, it points in the opposite direction (this finding persists when dropping the interaction terms; 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.

--- Table 3 about here ---

3.4.3 Third country effects with asymmetric trade costs

A three-country extension of OvY model (where the third country is interpreted as the rest of the world) illustrates that, when all country-pairs share the same level of trade integration, the theoretical prediction expressed in our main Hypothesis still holds regarding the most realistic case of interior equilibria (Technical details available upon request). While the analytical expressions become quite complex in a theoretical model allowing for variation in trade integration across country-pairs, it seems reasonable to lift this restriction in the empirical analysis. This, however, is not innocuous with respect to the empirical specification. Clearly, symmetric levels of trade integration between three countries (denoted 1, 2 and 3) imply that country 1 and 2 enjoy the same access to country 3. This makes that the relative attractiveness of country 1 with respect to country 2 – which drives their difference in tax base elasticity and the tax gap between them – is unaffected by both countries' relation to country 3. As serving the market in country 3 is just as easy from country 1 than 2, this plays no role in the tax-setting process. Allowing for asymmetric trade integration, this is no longer true and the attractiveness of country 1 relative to country 2 will now also depend on both countries' relative size and integration with country 3. The reason is that this reflects how profitable it is to serve the third country from country 1 as compared to country 2. Consequently, the bilateral tax gap (i.e., between country 1 and 2) will then also depend on the population differentials and bilateral levels of trade integration with respect to the third country. This implies extending the empirical model in the following way when accounting for third country effects with asymmetric trade costs:

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

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 on the absolute level of taxation in country *i* (and, ceteris paribus, also on $TaxGap_{ijt}$) while $PopGap_{jkt}$ exerts a positive influence on 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 $RelPop_{ikt}$. Hence, we estimate the following regression, where $Open_{it}$ denotes the overall trade openness of country *i*:

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

Results are reported in Table 4. First, we can observe that controlling for third country effects in this way does not affect our main results. The coefficient estimates are also very similar, suggesting that subsuming third-country effects into our fixed effects did not generate significant bias in 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 significantly weakened by its trade openness to the world.

--- Table 4 about here ---

3.4.4. Income effects

One central 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 rely on the real market potential variable provided by the CEPII, which has several advantages.[27] 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 section 3.3). Second, it takes into account that the market potential of 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*.[28] We expect β_2 to be positive, since, all 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, allowing its government to raise taxation. As this market potential measure inherently accounts for trade integration effects (see section 3.3), no interaction with trade integration is feasible here.

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27 The matching of production levels and trade flows by the CEPII allows construction of internal flows (i.e. production minus exports) and thus the estimation of border effects. In a robustness check, we used the real market potential predicted according to the Head and Mayer (2004) (rather than Redding and Venables, 2004) methodology that takes into account those border effects. The bilateral difference in this alternative measure of real market potential also exerts a positive and significant impact on tax differentials (available upon request). For more information on this dataset, see http://www.cepii.fr/anglaisgraph/bdd/marketpotentials.htm.

28 We exclude $PopGap_{ijt}$ from this model as it is highly correlated with $RmpGap_{ijt}$ (r=0.65; p<0.01).

--- Table 5 about here ---

The results reported in Table 5 – Columns (17) and (18) – 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), which show that a countries' market potential has a positive impact on absolute *levels* of corporate taxation. To take the analysis one step further, Columns (19) and (20) 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 foreign market potential matters most for governments.[29] 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 exerts a stronger impact. This is not surprising, as a firm's mark-up is higher for domestic sales than for foreign ones because of trade costs.

4. Concluding discussion

This paper contributes to the literature on international corporate income tax competition by analysing the determinants of international tax disparities – focusing on the potential role of trade integration. We thereby provide, to the best of our knowledge, the first empirical test of two key predictions of the New Economic Geography (NEG) approach to tax competition: *a)* tax differentials are a function of the coexistence of imperfect trade integration and asymmetric market sizes and *b)* increased trade integration reduces the ability of large countries to set higher taxes.

Our results – based on a panel dataset of 26 OECD countries over the period 1982-2004 – support both these theoretical predictions. That is, market size asymmetries between two countries increase the tax gap between them, *ceteris paribus*, and this relationship is weakened by trade liberalization. These findings are robust to different measures of market size (i.e. population or GDP) and corporate taxation (i.e. statutory tax rates, EATR and EMTR), and the inclusion of third-country and income effects. They provide one potential explanation for the considerably decline in tax disparities between OECD countries since the early 1980s (see Figure 1). Moreover, from a policy perspective, our evidence substantiates the US Treasury's fear that globalization is eroding the US' ability to sustain higher tax rates compared to other countries (see introduction). It also supports Ottaviano and van Ypersele's (2005, 45) contention that "the policy attitude towards tax competition should depend on the degree of trade integration". Analyzing distortions in the spatial distribution of firms induced by tax competition, they conclude that trade integration reduces the (positive) tax gap between the big and the small country that would be necessary to achieve the (second-best) optimum.[30] Therefore, from a welfare perspective, the effect of trade liberalization on tax convergence when governments behave non-cooperatively might not be strong enough to attenuate tax distortions with respect to the spatial distribution of firms.

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

[30] The second-best allocation is the spatial distribution of firms that the social planner would choose if he was able to assign any number of modern firms to a specific region, but unable to use lump-sum transfers from workers to firms to implement marginal cost pricing. Focusing on the most realistic case of interior location equilibria, the second-best optimum is characterized by a stronger home-market effect than when governments behave non-cooperatively.

Even so, various questions remain. One concerns 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 models’ 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 (see section 2.3.1). Another question is 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 in the extent of industrial clustering across sectors (cf. Brülhart *et al*., 2012). Finally, it would be interesting to extend the theoretical model by allowing not only for different market sizes but also different production costs to test whether or not trade integration reduces the comparative advantage of the low-cost country.

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

Variable	(1) EATR	(2) EATR	(3) EATR	(4) EATR
Intercept	0.404***	0.158***	0.413***	0.316***
	(9.82)	(3.03)	(10.24)	(5.67)
φ	-0.135	0.955***	-0164	0.179
	(-0.82)	(4.56)	(-0.99)	(0.51)
PopGap	1.279***	-	1.354***	0.894***
	(7.30)		(7.58)	(3.65)
PopGap * φ	-5.202**	-	-5.350**	-
	(-2.40)		(-2.51)	
Pop-origin	-	8.750***	-	-
		(5.15)		
Pop-origin * φ	-	-26.000***	-	-
		(-5.99)		
Pop-destination	-	-0.899***	-	-
		(5.67)		
Pop-destination * φ	-	2.560**	-	-
		(2.24)		
RealGDPGap	3.160***	2.800 ***	2.640*	5.753 ***
	(3.73)	(3.26)	(1.87)	(3.53)
RealGDPGap * φ	-	-	-	-186.736
				(-1.36)
PconsGap	-0.002	-0.002	-	-
	(-1.18)	(-1.36)		
UnempGap	-0.005***	-0.005***	-0.005***	-0.005***
	(-8.52)	(-8.88)	(-7.40)	(-7.07)
OldGap	-0.001	-0.002	-	-
	(-0.09)	(-0.94)		
YouGap	-0.011***	-0.011***	-0.011***	-0.010***
	(-10.13)	(-10.51)	(-12.43)	(-9.89)
UrbGap	-0.004***	-0.004***	-0.005***	-0.004***
	(-5.14)	(-4.81)	(-5.37)	(-5.01)
LeftGap	-0.0004	-0.0004	-	-
	(-0.34)	(-0.37)		
OpenGap	-0.001***	-0.001***	-0.001***	-0.001***
	(-3.84)	(-4.06)	(-3.03)	(-3.60)
CapMobGap	-0.006***	-0.006***	-0.006***	-0.006***
	(-6.50)	(-6.43)	(-6.47)	(-5.98)
EMUsingle	0.016***	0.018***	0.016***	0.018***
	(2.77)	(2.98)	(2.78)	(2.94)
EMUboth	0.013**	0.017***	0.013**	0.012**
	(2.18)	(2.91)	(2.14)	(2.03)
Country dummies (O & D)	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N	4730	4730	4730	4730
R^2 (overall)	0.792	0.797	0.791	0.777
Anderson Canonical	-	-	517.03***	96.683***
Hansen	-	-	2.356	3.312

Note: Dependent variable: EATRGap; t-statistics based on heteroscedasticity-consistent standard errors and clustered by origin-country-year 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

Table 2: Results alternative tax measures and lagged dependent variable (1982-2004)

Variable	(4) EATR	(5) EMTR	(6) EMTR	(7) Stattax	(8) Stattax
Intercept	0.184***	0.326***	0.194***	0.636***	0.254***
	(5.70)	(5.75)	(5.86)	(13.73)	(5.79)
Lagged dependent variable	0.669***	-	0.651***	-	0.682***
	(19.97)		(22.16)		(19.44)
φ	0.102	-0.149	0.133	-0.121	0.045
	(1.37)	(-0.67)	(1.40)	(-0.65)	(0.50)
PopGap	0.635***	0.772***	0.650***	2.467***	0.927***
	(4.74)	(3.10)	(4.77)	(12.87)	(4.98)
PopGap * φ	-2.211*	-6.421**	-2.324	-7.995**	-3.825**
	(-1.73)	(-2.37)	(-1.49)	(-2.47)	(-2.22)
N	4103	4730	4103	4993	4439
R^2 (overall)	0.932	0.693	0.912	0.825	0.931
Anderson Canonical	738.46***		582.49***		970.48***
Hansen	1.324		1.596		3.546*

Note: t-statistics based on heteroscedasticity-consistent standard errors and clustered by origin-country-year 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: Estimation results for the extended regression (1982-2004)

Variable	(9) EATR	(10) EATR
Intercept	0.375***	0.178***
	(8.01)	(5.17)
Lagged dependent variable	-	0.669***
		(19.96)
Φ	-0.138	0.401**
	(-0.39)	(2.18)
φ^2	1.802	-5.144***
	(0.45)	(-2.35)
PopGap	1.158***	0.614***
	(5.94)	(4.30)
PopGap $*$ φ	5.551	-3.649
	(1.02)	(-1.16)
PopGap $* \varphi^2$	-0.0002***	0.00004
	(-2.56)	(0.84)
N	4730	4103
R^2 (overall)	0.792	0.932
Anderson Canonical		738.49***
Hansen		1.409

Note: Dependent variable: EATRGap; t-statistics based on heteroscedasticity-consistent standard errors and clustered by origin-country-year 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: Controlling for third-country effects (1982-2004)

Variable	(11) EATR	(12) EATR	(13) EMTR	(14) EMTR	(15) Stattax	(16) Stattax
Intercept	13.008***	3.194***	19.385***	3.803**	9.825***	3.727***
	(6.24)	(3.24)	(6.01)	(2.51)	(4.93)	(2.64)
Lagged dependent variable	-	0.656***	-	0.638***	-	0.675***
		(19.15)		(21.57)		(18.77)
Φ	-0.229	0.049	-0.287	0.070	-0.231	-0.005
	(-1.58)	(0.66)	(-1.47)	(0.73)	(-1.35)	(-0.05)
PopGap	1.360***	0.698***	0.879***	0.715***	2.597***	0.986***
	(8.21)	(4.96)	(3.86)	(5.00)	(13.81)	(4.95)
PopGap * φ	-4.547**	-2.042*	-5.432**	-2.123	-7.532**	-3.623**
	(-2.18)	(-1.64)	(-2.10)	(-1.39)	(-2.41)	(-2.16)
Openness	-0.001***	-0.0002**	-0.0005***	-0.0001	-0.002***	-0.0002***
	(-5.11)	(-2.19)	(-2.96)	(-1.49)	(-11.71)	(-2.57)
RelPop	11.3***	2.57***	17.1***	3.23**	8.22***	0.310**
	(6.04)	(2.66)	(5.90)	(2.38)	(4.61)	(2.48)
RelPop * Openness	-0.010***	-0.004***	-0.002***	-0.001***	-0.001***	-0.0004**
	(-6.95)	(-3.03)	(-7.28)	(-3.20)	(-4.88)	(-2.40)
N	4730	4103	4730	4103	4993	4439
R^2 (overall)	0.801	0.933	0.708	0.912	0.829	0.931
Anderson		1195.79***		963.11***		1315.46***
Hansen		1.413		1.630		3.521*

Note: t-statistics based on heteroscedasticity-consistent standard errors and clustered by origin-country-year 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: Robustness checks: Introducing market potential (1982-2003)

Variable	**(17)** **EATR**	**(18)** **EATR**	**(19)** **EATR**	**(20)** **EATR**
Intercept	0.145***	0.043***	0.184***	-0.012
	(8.81)	(4.62)	(10.23)	(-1.04)
Lagged dependent variable	-	0.643***	-	0.624***
		(18.22)		(16.09)
Φ	-0.244	0.103	-0.226	0.101
	(-1.19)	(1.06)	(-1.19)	(1.07)
RmpGap	1.04***	0.528***	-	-
	(7.70)	(5.50)		
FRmpGap	-	-	0.043***	0.092**
			(8.80)	(2.25)
DRmpGap	-	-	0.0009***	0.0005***
			(6.03)	(5.30)
N	4477	3850	4477	3850
R^2 (overall)	0.805	0.934	0.816	0.934
Anderson		819.28***		806.09***
Hansen		1.389		1.062

Note: t-statistics based on heteroscedasticity-consistent standard errors and clustered by origin-country-year 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.

Figure 1: Corporate tax rate levels and convergence in OECD countries (1982-2011)

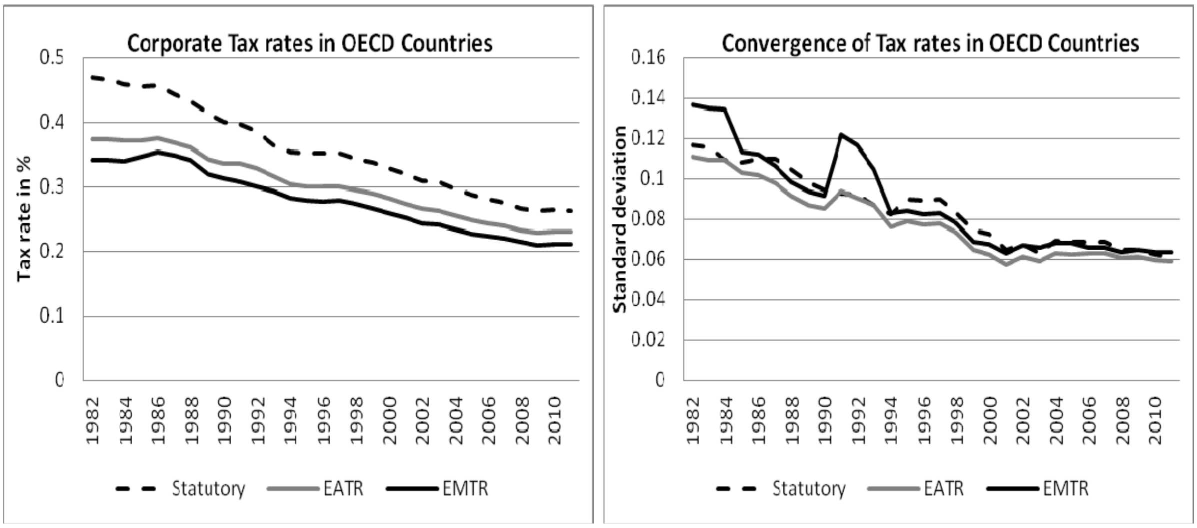


Figure 2: Graphical representation of interaction effects (baseline regressions)

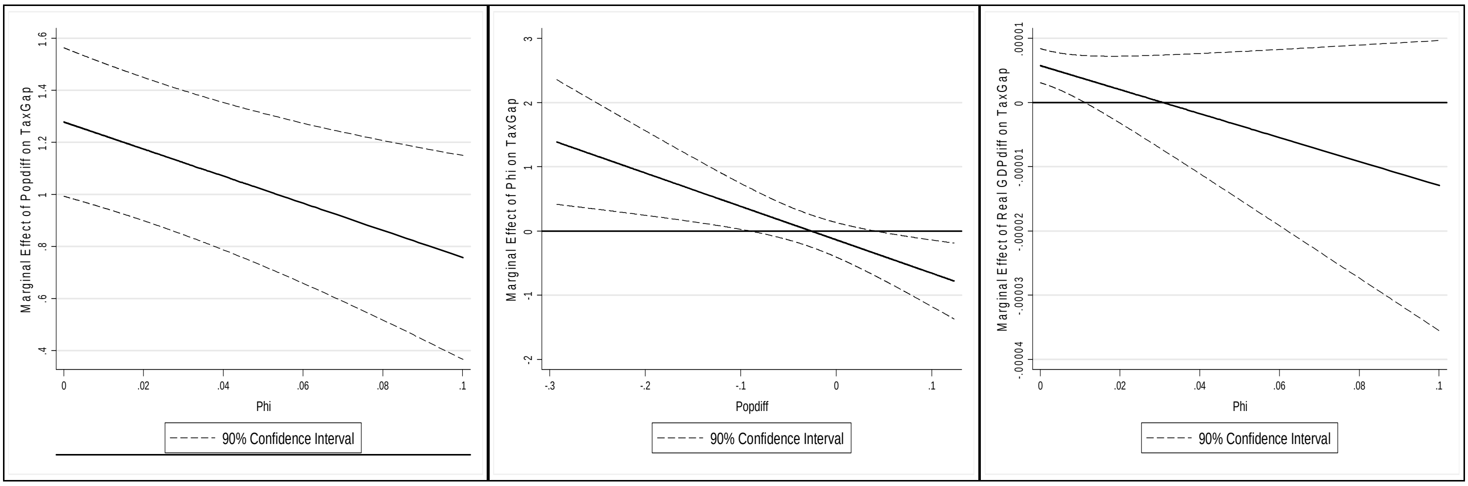
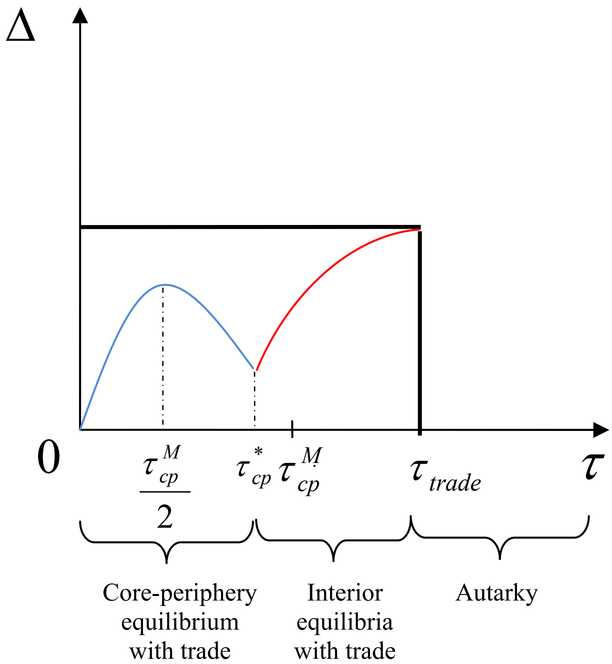


Figure 3: Trade costs and the tax gap in OvY (2005) model



Appendix: Data sources and summary statistics

$EATR_{it}$: Effective Average Tax Rate (source: Loretz, 2008).
$EMTR_{it}$: Effective Marginal Tax Rate (source: Loretz, 2008).
$EATR_{it}$: Statutory Tax Rate (source: Loretz, 2008).
φ_{ijt} : Trade integration (own calculations using Trade and Production and Gravity databases of CEPII).
Rmp_{it}: Real market potential (source: CEPII)
$FRmp_{it}$: Foreign real market potential (source: CEPII)
$DRmp_{it}$: Domestic real market potential (source: CEPII)
$PCONS_{it}$: 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 per capita (source: Penn World Tables).
$CapMob_{it}$: Index of Capital Mobility (source: Economic Freedom of the World database)
POP_{it}: population (in thousand) (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).
$EMUsingle_{it}$: dummy = 1 if only one country in a country-pair *ij* is member of EMU (or its predecessors).
$EMUboth_{it}$: 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	0.0018	0.1102	-0.4383	0.4218
EMTRGap	0.0105	0.1626	-1.0753	1.2290
StattaxGap	-0.0029	0.1349	-0.5500	0.5171
RmpGap	-0.1920	2.1459	-10.3755	7.4324
FRmpGap	0.0012	0.0055	0.0326	0.0325
DRmpGap	-0.1932	2.1451	-10.3759	7.4035
PopGap	-0.0204	0.0794	-0.2925	0.1235
OldGap	1.2489	4.7589	-13.9600	13.9800
YouGap	-2.3983	7.1670	-26.6500	25.1900
UrbGap	2.7153	15.2734	-40.3000	45.4000
RealGDPGap	0.0009	0.0069	-0.0279	0.0282
CapMobGap	0.6981	3.5192	-10	10
PconsGap	-0.8217	6.1094	-26.0200	23.6700
UnempGap	0.7896	5.6394	-20.500	21.6000
LeftGap	-0.1009	1.2760	-2	2
OpenGap	2.4466	36.1473	-142.0114	163.8226

Note: RealGDPGap in million; PopGap, RmpGap, FRmpGap and DrmpGap in billion (to make coefficient estimates more readable in Tables 1 through 6).

Summary statistics for estimated trade integration variable (1982-2004)

φ	Mean	Std. Dev.	Min	Max	Observations
Overall	0.00233	0.00632	1.39e-07	0.10009	N = 8125
Between country-pairs		0.00294	0.00018	0.02043	n = 325
Within country-pairs		0.00559	-0.01806	0.08199	T = 25

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