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Corporate tax differentials in a multi-country world with imperfectly integrated economies

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Abstract

This paper investigates the determinants of corporate tax differentials in a tax competition model with three imperfectly integrated countries of different population sizes. Introducing a third country in a quasi-linear model of new economic geography, we show that the tax differential between any two countries is increasing with their population differential, but this effect is weakened by trade liberalization.

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1. Introduction

Among OECD countries, business tax rates lie in a range from 12,5 % in Ireland to 39,5 % in Japan in 2012[1]. According to the empirical analysis of Egger *et al.* (2009), countries' characteristics account for the lions' share of the variance in bilateral tax differentials. There exists a wide literature on asymmetric tax competition that contributes to explain this fact by showing that the larger country will set a higher tax rate (Wilson, 1991; Bucovetsky, 1991)[2]. Nevertheless, these theoretical contributions very often rely on a two-country model (for a survey of the literature, see Wilson, 1999; or Wilson and Wildasin, 2004). To our knowledge, the model of Peralta and Van Ypersele (2005) is the only one that investigates asymmetric tax competition in a multi-country framework where all countries compete to attract competitive firms[3]. They show that, in an environment with constant returns to scale and perfectly integrated markets, countries enjoying a higher capital-to-labor ratio will export (resp. import) and tax (resp. subsidize) capital. In this paper, we complement the analysis of the determinants of tax choices made by asymmetric countries by asking the following question. What are the determinants of business tax differentials in multi-country world with imperfectly integrated economies?

To answer this question, we build a model that accounts for important features of the real world. Specifically, we rely on a quasi-linear new economic geography model *à la* Ottaviano and Van Ypersele (2005). This framework combines increasing returns to scale and trade costs in order to incorporate structural determinants driving firms' location decision at the international scale. It allows us to analyze how trade liberalization endogenously affects the relative attractiveness of each country and the resulting tax choice of their government. As trade cost fall, firms are more and more incited to exploit increasing returns to scale by locating in the most populated country and exporting (at a decreasing cost) to the smaller country. This lowers the tax base elasticity in the larger country and, in return, allows its government to set a higher tax without inducing large capital outflows[4]. Said differently, high-tax countries keep being attractive as soon as they enjoy important agglomeration economies. This result is well-known in the tax competition literature based on New Economic Geography frameworks (see Ludema and Wooton, 2000; Andersson and Forslid, 2003; Baldwin and Krugman, 2004 among others). However, this literature suffers a noteworthy limitation. It always considers an economy with two countries, whereas in reality each country is often surrounded by more than two neighboring countries that also compete in taxes to attract firms. Thus, firms enjoy a larger set of location opportunities and tax competition is fiercer. This note contributes to this literature by proposing a three-country extension of Ottaviano and Van Ypersele (2005) in order to analyze the determinants of tax disparities in a framework closer to this real world situation.[5]

The remaining of this note is organized as follows. Section 2 sets out the model and its main results in the absence and presence of fiscal policy. The last section concludes.

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[1] We used the combined corporate tax rates from the OECD Tax Database that combines central and sub-central (statutory) corporate income tax rate, given by the adjusted central government rate plus the sub-central rate.

[2] An exception is the article by Pieretti et Zanaj (2011) in which the authors show that a small country can attract foreign capital without practicing tax undercutting by supplying higher levels of public goods than larger jurisdictions, provided that mobility costs are low.

[3] Another strand of the literature develops three country models to investigate competition for FDI (see, for example, Haulfer and Wooton, 1999). Nevertheless, the third country only hosts capital owners; it is not engaged in tax competition. Moreover, profits are repatriated to capital owners so that any third-country effects are ruled-out.

[4] This prediction has been empirically corroborated (see Brülhart *et al.,* 2012).

[5] A *n*-country version of this model with market size asymmetries, trade costs and imperfect competition becomes analytically intractable.

2. The model

Our model is a 3-country extension of Ottaviano and Van Ypersele (2005) simplified, without loss of generality, by assuming oligopolistic rather than monopolistic competition.[6] The economy consists of three imperfectly integrated countries $i \in \{1,2,3\}$, which compete to attract firms. These firms produce a homogeneous good, labelled *x*, under increasing returns to scale and Cournot competition. 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 fixed and equally distributed across individuals in either country. However, we assume that a share $\sigma_i \in (0,1)$ of the total population (*L*) is living in country *i*. 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.[7]

2.1. Consumption

Consumers in each country share the same quasi-linear utility function:

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

with $a > 0$ and $i \in \{1,2,3\}$. Every resident in the economy supplies one unit of labour. The wage rate in each country is determined in the numéraire industry, which uses labour as its only input and requires one unit of labour to produce one unit of the good. Free trade in the numéraire thus equalizes the wage (*w*) across countries to unity. Moreover, each resident receives income from capital at the world net return to capital, denoted by *r* and endogenously determined in the long-run. Thus, the budget constraint for a representative consumer in country *i* is:

$$w + r\frac{K}{L} + \frac{T_i}{\sigma_i L} = z_i + p_i x_i \tag{2}$$

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

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

$$X_i = \sigma_i L \frac{a - p_i}{\beta} \tag{3}$$

Intuitively, aggregate demand is increasing in the market size advantage (i.e., $\sigma_i L$), which makes the largest market more profitable for firms.

2.2. Firms' output decision

There are increasing returns to scale in the oligopolistic industry. Indeed, producing any amount of good *x* requires a fixed amount of capital, which is normalized to one so that there

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[6] Our model is also very close to Haufler and Wooton (2010). As they do, we assume oligopolistic competition but contrary to them, we assume that capital owners live in the country engaged in tax competition. These different assumptions do not affect, however, our results. They can be replicated in a model *à la* Haufler and Wooton (2010).

[7] This framework is close to the standard model of asymmetric tax competition (Bucovetsky, 1991; Wilson, 1991), so that any differences in the model's predictions are imputable to the assumptions of imperfect competition and positive trade costs.

is a perfect correspondence between the number of firms and the capital stock (K).[8] This good is traded at a cost of τ units of the numéraire per unit shipped between every two countries[9]. This raises the marginal cost of serving the foreign market from 0 to τ.[10]

Firms are able to segment their markets by choosing the quantities to sell on the domestic and the foreign market independently. In the following, we present output levels for a firm located in country 1, and symmetric expressions hold for firms located in the other countries. The level of operating profit for a firm located in country 1 is:

$$\Pi_1 = p_1 x_{11} + (p_2 - \tau)x_{12} + (p_3 - \tau)x_{13} \tag{4}$$

where x_{ij} denotes sales in country j from firms located in country i. Maximizing profits taking into account demand (equation 3) yields the following output levels for a firm located in a country 1:

$$x_{11} = \frac{\sigma_1 L}{\beta}\frac{a + \tau K(1-\lambda_1)}{K+1}, \quad x_{12} = \frac{\sigma_2 L}{\beta}\frac{a - \tau(K\lambda_2 + 1)}{K+1}, \quad x_{13} = \frac{\sigma_3 L}{\beta}\frac{a - \tau(K\lambda_3 + 1)}{K+1}$$

where λ_i stands for the share of firms located in country i (with $\lambda_1 + \lambda_2 + \lambda_3 = 1$). Intuitively, all else equal, an exporter sells less in any given market than an indigenous rival ($x_{ij} < x_{ii}$) due to trade costs. We therefore obtain a similar result as in a two-country model: i.e., supply for a given market is decreasing with the share of firms located in this country, and this competition effect is strengthened by the level of trade costs.

The resulting equilibrium price in country 1 is:

$$p_1 = \frac{a + \tau(1-\lambda_1)K}{K+1}.$$

and symmetric expressions hold for the remaining countries. Three elements regarding this equilibrium price are worth noting explicitly. Firstly, the consumer price level in any country increases with trade barriers, because local firms are more protected against foreign competition. Secondly, it is decreasing in the number of firms located in this country, but this competition effect vanishes as trade costs 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. We assume, as is common in the literature, that the level of trade cost is not prohibitive so that it is always profitable for a firm to export $(\tau < \tau_{trade} = a/(K+1))$.

2.3. The equilibrium distribution of capital across countries

In the long run, net profits equal zero due to free entry and exit.[11] Thus, the equilibrium rate of return is determined by a bidding process for capital, which ends when no firm can earn a strictly positive net profit at the equilibrium market price; that is,

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

with

$$\Pi_1^* = \frac{\sigma_1 L}{\beta}\left(\frac{a + \tau\lambda_2 K + \tau\lambda_3 K}{K+1}\right)^2 + \frac{\sigma_2 L}{\beta}\left(\frac{a - \tau - \tau\lambda_2 K}{K+1}\right)^2 + \frac{\sigma_3 L}{\beta}\left(\frac{a - \tau - \tau\lambda_3 K}{K+1}\right)^2$$

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[8] The marginal cost is normalised to zero as in Ottaviano and Van Ypersele (2005), without loss of generality.

[9] Clearly, in reality, levels of trade integration are likely to vary across country-pairs. We rely on this simplification as an extension of the 3-country model allowing for different population sizes *and* different levels of trade costs across country-pairs becomes intractable.

[10] Trade costs must be understood in a general sense, as including non-tariff barriers and transportation costs.

[11] 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 gap between countries (which is our prime concern).

the equilibrium operating profits of firms established in country 1. The distribution of capital across countries can then be found by solving the arbitrage condition according to which no unit of capital can earn a higher net return by being invested in another country; that is, when $\Pi_1^* - t_1 = \Pi_2^* - t_2 = \Pi_3^* - t_3 = r$.

Before describing the impact of taxes on firm location, let us first present the free-market equilibrium (that is, the outcome in the absence of fiscal policy). The share of firms located in country *i* in the absence of taxes can be expressed as follows:

$$\lambda_i^M = \frac{K\tau\sigma_i(1-\sigma_i) + (2a-\tau)\left[\frac{1}{2}\sum_{i=1}^{3}\sigma_i(1-\sigma_i) - 3\prod_{j\neq i}\sigma_j\right]}{K\tau\left[\sum_{i=1}^{3}\sigma_i(1-\sigma_i)\right]}$$

where $2a-\tau$ is positive under the trade condition. Note that the main incentives to locate in the largest market are still at work in this three-country model. As soon as trade is costly, the share of capital invested in a country is increasing with its share of total population because firms save on trade costs by locating in this country ($d\lambda_i^M / d\sigma_i > 0$). Moreover, we check that this effect strengthens as trade costs fall ($d^2\lambda_i^M / d\sigma_i d\tau < 0$).

Assuming that governments implement a redistributive fiscal policy, the share of capital invested in country 1 becomes:

$$\lambda_1 = \lambda_1^M - \frac{\beta(K+1)}{KL\tau^2}\frac{\sigma_2(t_1-t_3)+\sigma_3(t_1-t_2)}{\sum_{i=1}^{3}\sigma_i(1-\sigma_i)}$$

and symmetric expressions hold for the share of capital invested in countries 2 and 3. Thus, intuitively, the share of capital invested in a country *i* decreases with the tax differential with respect to each one of the other countries. Importantly, we can check that this tax-base erosion effect is weakened by the share of population living in country *i*, while it is strengthened by the decline in trade costs. These results are summarized in the following proposition.

Proposition 1: *Consider three imperfectly integrated countries with different population levels. When trade costs are positive:*
i) the amount of capital invested in a country decreases with the tax differential with respect to each one of the other countries,
ii) this tax-base erosion effect is strengthened by the fall in trade costs and weakened by the share of population living in the country.

Said differently, trade liberalization makes firms' location more and more responsive to the business tax differentials as compared to market forces. We show in a last subsection how trade liberalization will thereby influence fiscal competition and the resulting tax disparities.

2.4. The equilibrium tax differentials across countries

Recall that governments are assumed to be benevolent. Inserting the budget constraint in the national welfare, we get the following objective function for government of country i:

$$W_i = \sigma_i L S_i + \sigma_i L + T_i + (\sigma_i - \lambda_i)(r - t_i)K$$

where $S_i = (a-p_i)^2/2\beta$ denotes the consumer's surplus. Thus, we can break down the national welfare into four components: the aggregate consumer surplus, the total gross labor income, the tax revenues from (or total subsidies to) capital, and the net income from capital invested abroad (when $\sigma_i > \lambda_i$ so that the country is a net exporter of capital).

Let us consider the most realistic case of interior location equilibrium where each one of the three country hosts at least one firm.[12] In order to assess the importance of third-country effects on tax differentials, we describe the tax gap between countries 1 and 2 and consider country 3 as the rest of the world[13]. Let us denote by $\Omega_{12} = (\sigma_1 - \sigma_2)L$ the population differential between countries 1 and 2. Their bilateral tax gap at the Nash tax equilibrium ($\Delta_{12}^* = t_1^* - t_2^*$) is given by:

$$\Delta_{12}^* = \Omega_{12} \frac{\tau}{\beta} \frac{2a\Phi - \tau\Sigma}{2K(2K\Xi - \Lambda) + \Gamma} \tag{7}$$

where $\Phi, \Sigma, \Xi, \Lambda$ and Γ are bundles of parameters that depend exclusively on the distribution of capital ownership (see appendix). We check that Φ, Ξ and Γ are positive for all $\sigma_i \in (0,1)$, whereas the sign of Σ and Λ is ambiguous.

Before describing the properties of the above expression, let us recall the main findings of the two-country model by Ottaviano and Van Ypersele (2005). They show (see eq. 22 in OvY) that both countries subsidize capital income but the subsidy is higher in the most populated country[14]. Nevertheless, trade liberalization reduces the resulting tax differential across countries because the site of production then becomes less relevant for investors. The bilateral tax gap in our three-country model (7) closely mirrors these properties. Indeed, observe that the tax gap between two countries is: i) proportional to their population differential and ii) equal to zero if and only if countries are equal-sized or trade integration is perfect (that is, τ=0).[15] In order to determine more precisely the properties of the tax gap (7), we need to determine the sign of the two following derivatives:

$$\frac{d\Delta_{12}^*}{d\Omega_{12}} = \frac{\tau}{\beta} \frac{2a\Phi - \tau\Sigma}{2K(2K\Xi - \Lambda) + \Gamma} \quad \text{and} \quad \frac{d^2\Delta_{12}^*}{d\Omega_{12} d\tau} = \frac{2}{\beta} \frac{a\Phi - \tau\Sigma}{2K(2K\Xi - \Lambda) + \Gamma}$$

After tedious calculations, we show that these derivatives are both positive (see appendix). The intuition for the positive sign of the first derivative is that a population advantage lowers the tax base erosion effect and thus allows the government of the most populated country to set a higher tax. As regards to the second derivative, the decline in trade costs reduces profit differential across countries, therefore leading to a tax convergence for a given market size asymmetry. We summarize these results by the following proposition.

Proposition 2: *Assume tax competition between three benevolent governments of differently populated countries. When that trade costs are non-prohibitive but high enough to yield an interior location equilibrium:*
(i) The tax gap between any two countries is increasing in their difference in population.
(ii) This relationship is vanishing as trade costs fall.

Interestingly, Exbrayat and Geys (2013) provide supportive evidence for this result. Using a dataset of 26 OECD countries over the period 1982-2004, they show that market size

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[12] When trade costs reach low values, all capital is invested in the most populated country and the tax competition game is equivalent to the core-periphery case, except that there are now two peripheral countries.

[13] The first-order conditions yield linear reaction functions, with a slope positive and lower than unity, as in the two country model. For a more detailed description of the terms-of-trade and capital-movement effects of capital taxation, we refer the reader to Ottaviano and Van Ypersele (2005).

[14] The authors also found out that the larger country is still a net-importer of capital (what the NEG literature calls a home-market effect) despite its lower subsidy level.

[15] Interestingly, the total capital stock had second-order effects on the tax gap in a two-country model (see OvY, 2005) whereas these second-order effects depend on the spatial distribution of capital ownership in the three-country model.

differences are strongly positively correlated with corporate income tax differences across countries but, crucially, trade integration weakens this link.

3. Conclusion

This paper has investigated the tax competition outcome in a model with three imperfectly integrated countries of different population sizes. We show that the tax differential between any two countries is increasing with their population differential, but this effect is weakened by trade liberalization. Therefore, the results of Ottaviano and Van Ypersele (2005, JIE) regarding business tax differentials keep being robust once third country effects are introduced in the analysis.

Although we chose a simple – quasi-linear – economic geography model to investigate the impact of third country effects on asymmetric tax competition in imperfectly integrated economies, the equilibrium location equilibrium is too complicated to address another important question. Indeed, recall that the home-market effect according to which a more populated country hosts a more than proportionate share of firms was questioned in a multi-country world (see Behrens *et al*., 2009). This might call into question a well-known result, in new economic geography models of tax competition, according to which the high tax – or low subsidy – country keeps being a net-importer of capital. This question is left for further research.

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Appendix

Bundles of parameters

The bilateral tax gap between country 2 and country 1 ($\Delta_{12}^{*}=t_1^{*}-t_2^{*}$) is given by:

$$\Delta_{12}^{*}=\Omega_{12}\frac{\tau}{\beta}\frac{2(a-w)\Phi-\tau\Sigma}{2K(2K\Xi-\Lambda)+\Gamma} \tag{7}$$

where $\Phi, \Sigma, \Xi, \Lambda$ and Γ are bundles of parameter that depend on the distribution of capital ownership. After simplifications, those expressions can be written as follows:

$$\Phi=\sigma_3^2(1-\sigma_3)[8K(2-\sigma_3)+13]+\sigma_3\left[(\sigma_1^2+\sigma_2^2)(6K+5)+2\sigma_1\sigma_2(K(10-7(\sigma_1+\sigma_2))+9)\right]$$
$$+\sigma_1\sigma_2[(6K+5)(\sigma_1+\sigma_2)+8K\sigma_1\sigma_2]$$

$$\Sigma=4K^2(\sigma_1^2+\sigma_2^2+\sigma_1\sigma_2-1)\sum_{i=1}^{3}(1-\sigma_i)+(1-\sigma_3)[2K+13+3\sigma_1\sigma_2(7-30K)]+8K(\sigma_1^4+\sigma_2^4)$$
$$+(\sigma_1^2+\sigma_2^2)[10K(1+6\sigma_1\sigma_2)-21]+(\sigma_1^3+\sigma_2^3)(8-20K)+2\sigma_1\sigma_2[14K(4\sigma_1\sigma_2+1)-17]$$

$$\Xi=3\left[\sigma_1+\sigma_2-(\sigma_1^2+\sigma_2^2)+1-\sigma_1\sigma_2\right]\sum_{i=1}^{3}(1-\sigma_i)$$

$$\Lambda=2(1-\sigma_3)(3\sigma_1\sigma_2-7)+(\sigma_1^2+\sigma_2^2)(10-8\sigma_1\sigma_2)+4\left[\sigma_1^3(2-\sigma_1)+\sigma_2^3(2-\sigma_2)\right]+\sigma_1\sigma_2(16-12\sigma_1\sigma_2)$$

$$\Gamma=15\sum_{i=1}^{3}\sigma_i^2(1-\sigma_i)+38\prod_{i=1}^{3}\sigma_i$$

Observe that Φ, Ξ and Γ are positive for all $\sigma_i\in(0,1)$, whereas the sign of Σ and Λ is ambiguous.

Proof of Proposition 2 i):

We first show that:

$$2K(2K\Xi-\Lambda)+\Gamma>0 \tag{8}$$

Recall that Ξ is positive. Moreover, tedious but straightforward calculations show that $\Gamma-2K\Lambda$ is positive for all admissible values of σ_i, so that inequality (8) always holds.

Then, we show that:

$$2a\Phi-\tau\Sigma>0 \tag{9}$$

Observe that this expression is a monotonic function of τ, and is positive when trade costs equal zero. Moreover, since we assumed that trade costs take only non-prohibitive values $(\tau<\tau_{trade})$, a sufficient condition for inequality (9) to hold is that $2a\Phi-\tau_{trade}\Sigma>0$. We can show that $2a\Phi-\tau_{trade}\Sigma=\tau_{trade}\mathrm{Z}$, with Z a bundle of parameters which is positive for all admissible values of σ_i (available upon request to the author). Thus, inequality (9) holds for non-prohibitive trade costs and we can conclude that $d\Delta_{12}^{*}/d\Omega_{12}>0$. ■

Proof of Proposition 2 ii):

Given the inequality (8), we get $d^2\Delta_{12}^{*}/d\Omega_{12}d\tau>0$ provided that

$$a\Phi-\tau\Sigma>0 \tag{10}$$

Similar to before, this expression is a monotonic function of τ, and is positive when trade costs equal zero. Thus, a sufficient condition for inequality (10) to hold is that $a\Phi - \tau_{trade}\Sigma > 0$. After manipulations, we get: $a\Phi - \tau_{trade}\Sigma = K\tau_{trade}(2K\Psi + \Theta)$, with Ψ and Θ bundle of parameters that depend exclusively on σ_i. For all admissible values of σ_i, Ψ is positive. This implies that $K\tau_{trade}(2K\Psi + \Theta)$ is positive for all $K > -\Theta/2\Psi$. Using the fact that parameters σ_i lie in the interval (0,1), simulations show that $-\Theta/2\Psi \in (-2, 1/2)$. Finally, recall that we assume oligopolistic competition, with a perfect correspondence between the number of firms and capital units so that K is higher than unity. Hence, the inequalities $K > -\Theta/2\Psi$ and (10) hold for all admissible values of K, τ and σ_i and we can conclude that $d^2\Delta_{12}^* / d\Omega_{12} d\tau > 0$. ■