Tax Competition with and without Tax Discrimination against Domestic Firms

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1The usual disclaimer applies.
1 Introduction

A controversial issue in the study of tax competition is whether it is desirable for countries or regions to agree not to provide preferential treatment to different forms of capital. The common view is that without such restrictions, countries will aggressively compete for capital that is relatively mobile across different locations, resulting in taxes that are far below their efficient level. By eliminating such preferential treatment, no capital will be taxed at very low rates, because doing so would sacrifice too much tax revenue from the relatively immobile capital. But this solution is not without cost: in an attempt to attract mobile capital, governments can be expected to reduce the common tax rate below the tax at which relatively immobile would be taxed in the preferential case.

In an important paper, Keen (2001) analyzes this tradeoff using a model with two tax bases that exhibit different degrees of mobility and finds that governments raise more revenue when the more mobile tax base gets preferential treatment. But Janeba and Peters (1999) show that the elimination of preferential treatment leads to higher total levels of tax revenue. Other papers have generalized and extended these results, including Janeba and Smart (2003), Wilson (2005), Konrad (2007), and Marceau, Mongrain and Wilson (2009). They all consider a model with two tax bases that differ in their degrees of mobility. A general insight appears to be that if one of the two tax bases becomes perfectly mobile, so that the region with the lowest tax rate always attracts it, then the non-preferential regime raises more revenue. Keen’s argument in favor of preferential treatment is based on a model where the two tax bases exhibit finite, but different, elasticities with respect to the difference in the regions’ tax rates. He cannot analyze the case where one of the tax base elasticities approaches infinity, because then a pure-strategy equilibrium does not exist. Wilson (2005) and Marceau, Mongrain and Wilson (2010) consider mixed-strategy equilibria and obtain results supporting Janeba and Peters.

In the current paper, we present a case for the non-preferential regime that does not require either tax base elasticity to be large. Moreover, whereas the previous literature is silent about the magnitude of the difference in tax revenue between the two regimes, our results suggest that the difference can be quite large. Indeed, replacing preferential treatment with non-preferential treatment nearly doubles tax revenue in our basic model with symmetric regions.
These new results are based a different view of the meaning of preferential tax treatment. The standard view in this literature is that governments distinguish between different types of capital or firms according to their mobility characteristics. But other literature on optimal taxation in an open economy emphasizes the difficulties involved in making such distinctions. Preferential treatment must be based on observable characteristics of firms that may be only loosely associated with mobility differences.\(^1\) Thus, preferential tax regimes often consist of the foreign-owned portion of a tax base being taxed at a lower rate that the domestic-owned portion, a behavior that is also labeled “discrimination.” Some countries – e.g. Canada and the US – have signed mutually advantageous tax treaties which would be jeopardized if one or the other actor were to start discriminating. And the prohibition of the asymmetric treatment of foreign and domestic firms has been included in treaties in the EU and the OECD. Both the OECD and the EU are active in trying to reduce the extent of discrimination among their members.\(^2\)

We model this distinction between foreign and domestic firms by considering a two-region world in which each region initially possesses a stock of “domestic firms” which must incur a cost to relocate to the other region, whereas the “foreign firm” that it seeks to attract are the other region’s domestic firms. Although both foreign and domestic firms in the basic model face the same distribution of moving costs in this model, this does not mean that the tax elasticities of the foreign and domestic tax bases are the same in equilibrium, because these elasticities depend on how many firms of each type are located in the region. In fact, the foreign elasticity goes to infinity as the excess of the domestic tax rate over the foreign tax rate goes to zero. In particular, there is a large incentive to lower the tax on foreign firms enough to attract at least a small number of foreign firms, since before the tax is lowered, there are no current foreign firms in the region that will be taxed less. We thus generate a preferential tax system where foreign firms are taxed more lightly than domestic firms. But this tax system is shown to raise substantially less revenue than a non-preferential regime, where foreign and domestic firms face the same tax rate. We also consider asymmetries between different regions, measured by their numbers of

\(^1\)Hong and Smart (2010) assume that all firms must face the same statutory tax rates, and they analyze the use of tax havens to achieve desirable differences in effective marginal tax rates. Hagen, Osmundsen, and Schjelderup (1998) work with a model where a firm’s mobility is related to the size of its investment, in which case it is optimal to impose a nonlinear tax on investment.

\(^2\)On this, see OECD (1998).
domestic firms, and we find that both small and large regions raise more revenue under the non-preferential regime. However, when the small region become significantly smaller than the large region, the difference in tax revenue between non-preferential and preferential regimes goes to zero.

Two important extensions are investigated. First, we add some perfectly-mobile firms to the model. Intuition might suggest that their existence leads to lower taxes, as regions compete more aggressively to attract them. But we find that taxes are actually higher in both the preferential and non-preferential cases, with the latter again raising more revenue. The smaller region attracts these mobile firms, and the resulting increase in its tax base implies a lower tax base elasticity for its foreign firms, providing it with an incentive to tax these firms at a higher rate.

Our second extension is to undertake a dynamic analysis, where each region recognizes that the new firms that it attracts this period will generate tax revenue in future periods. Under the preferential regime, this means that setting taxes on new foreign firms at low enough rates to attract them this period will enable the region to tax them at higher rates in future periods. Using the assumptions from our static model about the distribution of moving costs, we again find that the non-preferential regime yields substantially more revenue than the preferential regime.

The plan of this paper is as follows. First, we consider a simple example where all firms face a single moving cost. This example quickly produces a huge difference between the revenue raised under the non-preferential and preferential regimes. Next, we develop the basic model, in which moving costs are uniformly distributed. Then we add the zero-moving-cost firms to the analysis. Finally, we consider the dynamic model.

2 Example

A simple example illustrates the potentially large negative impact on total tax revenue from allowing some firms to receive preferential tax treatment. Assume two identical regions, each containing the same number of “domestic firms” Throughout this paper, we follow the common practice in this literature of assuming that each region chooses its tax policy to maximize tax revenue. Each firm earns the same exogenous before-
tax profits, normalized to equal one, which can be taxed at rates up to 100 percent (assuming rates above 100 percent would cause firms to cease operations). But each firm can move to the other region after incurring a moving cost $c$.

Consider the non-preferential regime, under which all firms are taxed at the same rate, $t$. In this case, 100 percent taxation of profits is an equilibrium if $c$ is sufficiently high. In particular, $c$ must exceed $1/2$. Then each region realizes that it can almost double its tax base by reducing its tax rate to a level slightly below $1 - c$, but the lower tax rate leaves the region with less tax revenue than before.

In contrast, consider a preferential regime, where the existing domestic firms can be taxed at a rate that differs from the tax rate on the "foreign firms" that the region seeks to attract (which are the other region’s domestic firms). Then each region will compete for these foreign firms by reducing its tax rate on foreign firms until the tax reduction that these firms receive by switching regions is less than moving cost $c$, assuming the required foreign tax rate remains greater than zero. In this way, the tax offered to foreign firms gets bid down to zero, whereas the tax on domestic firms is increased to $c$, so that these firms have no incentive to move (assuming indifference about moving is resolved in favour of staying). Any higher tax would create this move.

No firms switch locations under either regime. Thus, all firms face a 100 percent tax under the non-preferential regime, whereas each firm’s tax payments equal the moving cost $c$ under the preferential regime. For moving cost slightly greater than one-half of profits, we then find that switching from the preferential regime to the non-preferential regime by raises tax payments by almost 100 percent.

Whereas the tax competition literature commonly focuses on the under-taxation of mobile capital or firms, our finding that profits are taxed at 100 percent suggests inefficient over-taxation. There are a few responses to this reaction. First, the assumption that profits are exogenously fixed implies that they essentially represent returns to a fixed factor from the combined viewpoint of the system of regions, and well-known efficiency arguments dictate that this factor be taxed at rates up to 100 percent before factors in variable supply are taxed. Second, examples with less than 100 percent taxation could be constructed by introducing an upward sloping supply curve for a firm’s investment, conditional on its location, a route taken by Marceau et al. (2010). We do not follow that route here because our focus is instead on “partially
mobile firms”, that is, firms that can move after incurring a moving cost. Finally, smaller moving costs would eliminate the equilibrium where all firms are taxed at 100 percent under the non-preferential regime. Instead, regions would play a mixed strategy, where some tax rates below 100 percent are played with positive probabilities. Marceau et al. (2010) consider mixed strategies, but the focus of the current paper is on what can be said in cases where pure-strategy equilibria exist.

Finally, introducing heterogeneous moving costs will clearly result in equilibria with less than 100 percent taxation, since governments will face upward-sloping supply curves for foreign firms, with lower taxes attracting foreign firms with higher moving costs. We can then examine how the equilibrium tax rates depend on the implied tax-base elasticities. We next develop such a model and show that the non-preferential regime continues to raise substantially more revenue than the preferential regime.

3 Basic Model

The economy again contains two regions, which are indexed by \( j \in \{1, 2\} \). In each region, there are \( N_j \) identical domestic firms, with \( N_1 > N_2 \). Denote by \( n \in [0, 1] \) the size heterogeneity between the regions, where \( n = N_2/N_1 \). If both regions have the same size, then \( n = 1 \); as the difference grows, \( n \) goes down. All firms have the possibility of moving, but face different moving costs. Moving costs are uniformly distributed between zero and one. Each firm generates \( \gamma \geq 1 \) before-tax profits for its owners, regardless of where it locates, and profits are taxed where they are earned. Thus, any movement of firms from one region to another will be based on tax considerations and will therefore result in the expenditure of socially-wasteful moving costs.

The general timing of events is as follows. First, regions choose their tax rates, with the goal of maximizing tax revenue, and all firms draw a moving cost. Then firms choose whether to move or remain in their initial location. Finally, taxes are collected.
3.1 Non-Preferential Regime

Under a non-preferential regime, each region chooses a unique tax rate on all firms, $t_j$ for region $j \in \{1, 2\}$, regardless of whether the firm is already in the region ("domestic firms"), or just moved to the region ("foreign firms"). For any given $t_1 > t_2$, a firm in region 1 stays in region 1 as long as $(1-t_1)\gamma \geq (1-t_2)\gamma - c$. Thus, all firms with $c > (t_1 - t_2)\gamma$ stay in region 1, and so the tax revenue from all domestic firms is $N_1[1-\gamma(t_1 - t_2)]\gamma t_1$. Since no firms move from region 2 to region 1 when $t_1 > t_2$, this quantity represents the total tax revenue for region 1. If $t_1 \leq t_2$, tax revenue from domestic firms is given by $N_1 \gamma t_1$. Firms in region 2 will move to region 1 whenever $c < (t_2 - t_1)\gamma$, generating tax revenue of $N_2[t_2-t_1]\gamma^2 t_1$ for region 1. Total tax revenue in region 1, denoted $R^1(t_1,t_2)$, is given by

$$R^1(t_1,t_2) = \begin{cases} 
N_1[1-\gamma(t_1 - t_2)]\gamma t_1 & \text{if } t_1 > t_2 \\
N_1 \gamma t_1 + N_2[t_2-t_1]\gamma^2 t_1 & \text{if } t_1 \leq t_2 
\end{cases} \quad (1)$$

The best-response function is given by:

$$t_1(t_2) = \begin{cases} 
\frac{1+\gamma t_2}{2\gamma} & \text{if } t_1 > t_2 \\
\frac{1/n+\gamma t_2}{2\gamma} & \text{if } t_1 \leq t_2 
\end{cases} \quad (2)$$

Similarly, tax revenue from region 2 is given by:

$$R^2(t_1,t_2) = \begin{cases} 
N_2[1-\gamma(t_2-t_1)]\gamma t_2 & \text{if } t_2 > t_1 \\
N_2 t_2\gamma + N_1[t_1-t_2]\gamma^2 t_2 & \text{if } t_2 \leq t_1 
\end{cases} \quad (3)$$

The best-response function is given by:

$$t_2(t_1) = \begin{cases} 
\frac{1+\gamma t_1}{2\gamma} & \text{if } t_2 > t_1 \\
\frac{n+\gamma t_1}{2\gamma} & \text{if } t_2 \leq t_1 
\end{cases} \quad (4)$$
Whenever $N_1 = N_2$, inserting $t_1 = t_2$ into the best-response functions and solving yields the following Proposition.

**Proposition 1:** Under a non-preferential regime, if $N_1 = N_2$, then there exists a unique symmetric Nash equilibrium where $t_1 = t_2 = 1/\gamma$.

![Figure 1: Symmetric equilibrium when $N_1 = N_2$](image)

As $\gamma$ increases, firms effectively become more mobile, since the moving cost, which is bounded between zero and one, becomes small relative to the benefit of moving. Note also that the elasticity of the tax base with respect to the tax rate is the same regardless of whether it is created by attracting more new firms or retaining more existing firms. See Figure 1.

Whenever $N_1 > N_2$, we must look at the reaction functions over the different segments $t_1 > t_2$ and $t_2 > t_1$. First, note that for some value of $t_2$, the reaction functions for region 1 may yield two best responses: one with $t_1 > t_2$ and one with $t_1 < t_2$. Only one of the two can be a global maxima. Substituting the reaction functions into $R^1(t_1, t_2)$ reveals that $t_1 = \frac{1+\gamma t_2}{2\gamma} \geq t_2$ is the global maxima, as long as $(1 + \gamma t_2)^2 \geq n(1/n + \gamma t_2)^2$, which is satisfied for any value of $n \in [0, 1]$. Similarly, for some value of $t_2$, the reaction functions for region 2 may yield two best responses: one with $t_1 > t_2$ and one with $t_1 < t_2$. Again, only one of the two can be a global maxima. Substituting the reaction functions into $R^2(t_1, t_2)$ reveals that $t_2 = \frac{n + \gamma t_2}{2\gamma} \leq t_1$ is the
global maxima, as long as \((n + \gamma t_1)^2 \geq n (1 + \gamma t_2)^2\), which is satisfied for any value of \(n \in [0, 1]\). Finally, it is impossible for the reaction functions for region 1 and region 2 to cross over the range \(t_1 < t_2\), so it must be the case that \(t_1 \geq t_2\). The next proposition relates the equilibrium tax rates to differences in regional size.

**Proposition 2:** Under a non-preferential regime, whenever \(N_1 > N_2\), there exist an asymmetric Nash equilibrium where \(t_1 = \frac{2 + n}{3\gamma}\) and \(t_2 = \frac{1 + 2n}{3\gamma}\).

Note that in the asymmetric equilibrium, the large region in term of the number of domestic firms sets a higher tax rate, but also asymmetry leads to lower tax rates by both region. See Figure 2.

Propositions 1 and 2 can be better understood by looking at the tax-base elasticity for each region. Denote by \(\epsilon_i = -\frac{t_i}{B_i} \frac{\partial B_i}{\partial t_i}\) the elasticity of the tax base \(B_i\) with respect to tax \(t_i\). When \(N_1 = N_2\) this elasticity is continuous and given by \(\epsilon_1 = \frac{\gamma t_1}{1 - \gamma (t_1 - t_2)}\) and \(\epsilon_2 = \frac{\gamma t_2}{1 - \gamma (t_2 - t_1)}\) for regions 1 and 2, respectively. With these symmetric elasticities, we obtain a symmetric equilibrium with \(t_1 = t_2\). When \(N_1 > N_2\), then the elasticities become discontinuous at \(t_1 = t_2\). For example, the elasticity for region 1 is given by \(\epsilon_1 = \frac{\gamma t_1}{1 - \gamma (t_1 - t_2)}\) when \(t_1 \geq t_2\), but becomes \(\epsilon_1 = \frac{\gamma t_1}{1 - n - \gamma (t_1 - t_2)}\) when \(t_1 < t_2\). Similarly, the elasticity for region 2 is given by \(\epsilon_2 = \frac{\gamma t_2}{1 - \gamma (t_2 - t_1)}\) when \(t_2 \geq t_1\), and becomes \(\epsilon_2 = \frac{\gamma t_2}{n - \gamma (t_2 - t_1)}\) when \(t_2 < t_1\). When the symmetric equilibrium occurs, \(t_1 = t_2\) for
the same tax base elasticity as in the case where \( N_1 = N_2 \). However, the asymmetric equilibrium involves different elasticities for both regions. The larger region 1 faces a lower elasticity because \( 1/n > 1 \), and so sets a higher tax rate. For the small region, attracting new firms has a bigger impact on tax revenue than defending its own firms because there is more firms to attract than to defend.

We now look at tax revenue. Under a symmetric equilibrium, total tax revenue for the two regions is given by \( R^1 = N_1 \) and \( R^2 = N_2 \). Thus, both regions get the same tax revenue when \( N_1 = N_2 \), and the larger region 1 gets more revenue when \( N_1 > N_2 \). In the latter case tax revenue is given by \( R^1 = N_1(2 + n)^2/9 \) and \( R^2 = N_1(1 + 2n)^2/9 \). Note that the larger region always raises more revenue than the smaller region, although it loses firms.

To better understand the negative impact of tax competition, we will construct a series of measures that relates actual tax revenue to the potential tax revenue. Denote by \( r^i = R^i/N_i\gamma \), the ratio of tax revenue to potential tax revenue in region \( i \). Consequently, we get that \( r^1 = (2 + n)^2/9\gamma \) and \( r^2 = (1 + 2n)^2/9n\gamma \) (note that if \( n = 1 \), then \( r^1 = r^2 = 1/\gamma \)). More heterogeneity in size (smaller \( n \)) definitively leads to lower tax revenue relative to potential tax revenue in region 1. Two reasons contribute for this loss in tax revenue. The first one is the tax rate effect: with more heterogeneity in size, both regions set lower tax rates. As the small region get smaller, it faces higher tax elasticity and become more aggressive. The large region has no other choice than to also lower its own tax rate. The second reason is due to the fact that firms seek lower tax rates by moving. In particular, firms with low moving cost move from region 1 to region 2. We will refer to this as the mobility effect. On the other hand, more heterogeneity in size (smaller \( n \)) leads to lower tax revenue relative to potential tax revenue in region 2 if \( n > 1/2 \), but leads to higher relative tax revenue when \( n < 1/2 \). The mobility effect has a negative impact for region 1, but a positive impact for region 2. If region 2 is very small relative to region 1, the positive mobility effect dominates the tax rate effect, leading to higher relative tax revenue in the small region.

It is also useful to look at the sum of revenue for both region relative to total potential tax revenue in the economy; this measure is denoted by \( r = (R^1 + R^2)/(N_1 + N_2)\gamma \). In a non-preferential tax regime, \( r = (2+n)^2+(1+2n)^2/9(1+n)\gamma \). Again, an increase in heterogeneity (smaller \( n \)) leads to lower tax revenue. The tax rate effect operates in the same way as both regions set lower tax rate. We need to be a bit more careful
when looking at the mobility effect since a loss for region 1 is a gain region 2. However, because region 2’s tax rate is lower than region 1’s tax rate, the overall mobility effect is negative.

The last measure we will look at is total moving costs relative to potential tax revenue. In a non-preferential regime, firms only move in one direction. The difference in tax payments given by Proposition 2 determines the share of region 1’s domestic firms that choose to move to region 2. A total of \( N_1(1 - n)/3 \) firms choose to move, which are the ones with the lowest moving cost. These firms incur additional wasteful moving costs without any gains in productivity. The sum of moving cost generated is given by:

\[
N_1 \int_0^{1-n} cdc = N_1 \frac{(1 - n)^2}{18}.
\]

Total moving costs relative to potential tax revenue is then given by \( \rho = (1 - n)^2/18(1 + n)\gamma \). With more heterogeneity (lower \( n \)), the smaller region competes more aggressively for firms because it faces a relatively more elastic tax base, and this greater competition leads to more firms moving and more cost generated.

### 3.2 Preferential Regime

Under the preferential regime, each region \( i \) taxes its existing domestic firms and newly-arrived foreign firms at different rates, \( t_i \) for domestic firms and \( \tau_i \) for foreign firms. When \( t_1 > \tau_2 \), a firm in region 1 will stay in region 1 if \( (1 - \tau_1)\gamma \geq (1 - t_2)\gamma - c \), or \( c > (\tau_1 - t_2)\gamma \). As a result, the tax revenue obtained from all domestic firms is given by \( N_1[1 - \gamma(t_1 - \tau_2)]\gamma t_1 \). On the other hand, if \( t_1 \leq \tau_2 \), all domestic firms stay, yielding tax revenue equal to \( N_1\gamma t_1 \). In addition, firms in region 2 will move to region 1 whenever \( c < (t_2 - \tau_1)\gamma \), generating additional tax revenue of \( N_2[t_2 - \tau_1]\gamma^2\tau_1 \) for region 1. Total tax revenue in region 1, \( R^1(t_1, \tau_1, t_2, \tau_2) \), is given by:

\[
R^1(\cdot) =
\begin{align*}
N_1[1 - \gamma(t_1 - \tau_2)]\gamma t_1 & \quad \text{if } t_1 > \tau_2 \text{ and } \tau_1 \geq t_2 \\
N_1[1 - \gamma(t_1 - \tau_2)]\gamma t_1 + N_2[t_2 - \tau_1]\gamma^2\tau_1 & \quad \text{if } t_1 > \tau_2 \text{ and } \tau_1 < t_2 \\
N_1\gamma t_1 & \quad \text{if } t_1 \leq \tau_2 \text{ and } \tau_1 \geq t_2 \\
N_1\gamma t_1 + N_2[t_2 - \tau_1]\gamma^2\tau_1 & \quad \text{if } t_1 \leq \tau_2 \text{ and } \tau_1 < t_2
\end{align*}
\]
The best-response functions for $t_1$ and $\tau_1$ are given by:

$$
t_1(\tau_2) = \begin{cases} 
\frac{1+\gamma \tau_2}{2\gamma} & \text{if } t_1 > \tau_2 \\
\tau_2 & \text{if } t_1 \leq \tau_2 \leq 1 \\
1 & \text{if } t_1 \leq \tau_2 > 1 
\end{cases}
$$  \quad (6)

$$
\tau_1(t_2) = \frac{t_2}{2} \quad \text{if } \tau_1 < t_2
$$  \quad (7)

To better understand those reaction functions, we will look at the first-order conditions on the relevant ranges for both $t_1$ and $\tau_1$. For any given $t_1 > \tau_2$, region 1 loses some domestic firms to region 2. Consequently, region 1 faces an elastic tax bases, and so the reaction function – first line of equation (6) – directly comes from the first-order condition on $t_1$. Now, imagine a $t_1 \leq \tau_2$, then the tax base would be perfectly inelastic for region 1, since region 1 would retain all its firms. Then, region 1 would like to set 100% tax rate on domestic firms. However, this cannot be done unless region’s 2 tax rate was itself equal to 100%, because $t_1$ would not be lower than $\tau_2$. Consequently $t_1$ must equal $\tau_2$ in all those cases. Similarly, if $\tau_1 < t_2$, some firms move from region 2 to region 1, and so region 1 again faces an elastic tax base. This leads to the reaction function given by equation (7). Now, imagine a $\tau_1 \geq t_2$, then no firms would move to region 1, so any $\tau_1$ on that range yields zero tax revenue. Moreover, given that $\tau_1(t_2) = \frac{t_2}{2}$, it has to be the case that $\tau_1 < t_2$. We will now look at region 2’s problem. Tax revenue from region 2 is given by:

$$
R^2(\cdot) = \begin{cases} 
N_2[1 - \gamma(t_2 - \tau_1)]\gamma t_2 & \text{if } t_2 > \tau_1 \text{ and } \tau_2 \geq t_1 \\
N_2[1 - \gamma(t_2 - \tau_1)]\gamma t_2 + N_1[t_1 - \tau_2]\gamma^2 \tau_2 & \text{if } t_2 > \tau_1 \text{ and } \tau_2 < t_1 \\
N_2\gamma t_2 & \text{if } t_2 \leq \tau_1 \text{ and } \tau_2 \geq t_1 \\
N_2\gamma t_2 + N_1[t_1 - \tau_2]\gamma^2 \tau_2 & \text{if } t_2 \leq \tau_1 \text{ and } \tau_2 < t_1 
\end{cases}
$$  \quad (8)

The best-response function for $t_2$ and $\tau_2$ are given by:

$$
t_2(\tau_1) = \begin{cases} 
\frac{1+\gamma \tau_1}{2\gamma} & \text{if } t_2 > \tau_1 \\
\tau_1 & \text{if } t_2 \leq \tau_1 \leq 1 
\end{cases}
$$
\[ t_2(t_2) = \frac{t_2}{2} \quad \text{if} \quad t_2 < t_1 \]  

As we can see from these reaction functions, there exists an equilibrium set of taxes \( \{t_1, \tau_2\} \) resulting from the competition for firms already located in region 1. Similarly, there exists an equilibrium set of taxes \( \{\tau_1, t_2\} \) resulting from the competition for firms already located in region 2. The next proposition identifies these taxes.

**Proposition 3:** Under a preferential regime, there exists a unique Nash equilibrium where \( t_1 = \frac{2}{3\gamma} \) and \( \tau_2 = \frac{1}{3\gamma} \), and where \( t_2 = \frac{2}{3\gamma} \) and \( \tau_1 = \frac{1}{3\gamma} \).

As we see in Figure 3, a region always sets lower taxes on foreign firms compared to domestic firms, independently of \( N_1 \) and \( N_2 \), so the tax preference is always used to attract foreign firms in the preferential regime. To better understand this result, we can examine the tax-base elasticities, which are always discontinuous at \( t_1 = \tau_2 \), no matter how \( N_1 \) differs from \( N_2 \). For region \( i \), define \( \epsilon_i^d = -\frac{L_i}{B^d_i} \frac{\partial B^d_i}{\partial t_i} \) as the elasticity of the domestic tax base \( B^d_i \) (keeping firms) with respect to tax \( t_i \), and \( \epsilon_i^f = -\frac{\tau_i}{B^f_i} \frac{\partial B^f_i}{\partial \tau_i} \) as the elasticity of the foreigner tax base \( B^f_i \) (stealing firms) with respect to tax \( \tau_i \).
For region 1, the domestic tax base elasticity is 
\[ \epsilon_1^d = \frac{\gamma t_1}{1-\gamma(t_1-\tau_2)} \]
when \( t_1 \geq \tau_2 \), and become zero when \( t_1 < \tau_2 \). The intuition is that when the domestic tax rate in region 1 falls below the foreign tax rate in region 2, no firms move from region 1 to region 2. Similarly, the foreign tax base elasticity for region 2 is given by 
\[ \epsilon_2^f = \frac{\tau_2 t_1}{\tau_1-\tau_2} \]
when \( \tau_2 \leq t_1 \), and become zero when \( \tau_2 > t_1 \). The equilibrium occurs at non-zero elasticities for both regions, and so \( \tau_2 \leq t_1 \). Moreover, the elasticity of the foreign tax base for region 2 is larger than the elasticity of the domestic tax base for region 1. If \( \tau_2 < t_1 \) by just a small amount, then region 2 gets almost no firms moving from region 1. Reducing \( \tau_2 \) changes the tax base by a large proportion, since the denominator of \( \epsilon_2^f \) is small. On the contrary, region 1 loses relatively little domestic tax base by increasing the tax \( t_1 \) on its domestic firms, since the denominator of \( \epsilon_1^d \) is sizeable when \( \tau_2 \) is only slightly less than \( t_1 \), indicating a relatively large number of domestic firms in region 1. In light of these different tax-setting incentives for the two regions, it is understandable that \( \tau_2 < t_1 \) in equilibrium.

It interesting to note that firms are moving in both directions, which is undesirable in our framework, because these movements generate wasteful moving costs.

Simple calculations yield tax revenue of \( R^1 = N_1(4+n)/9 \) for region 1 and \( R^2 = N_1(4n+1)/9 \) for region 2. Thus, if the two regions have the same size \( (n = 1) \), each collected four-ninths of the revenue obtained under the non-preferential regime, representing a substantial revenue loss. In the asymmetric case, the larger region 1 again obtains more tax revenue than the smaller region 2. More important is the difference in tax revenue between the preferential and non-preferential regimes. For the large region 1, the preferential regime always leads to lower tax revenue. For the small region 2, non-preferential tax regime also lead to higher tax revenue as long as \( [1+2n]^2 > 4n + 1 \). For any \( n > 0 \) this condition is always satisfied, but if region 2 is sufficiently smaller than region 1 (very small \( n \)), then region 2 would collect almost the same tax revenue under a preferential regime compared to a non-preferential regime.

We now look at our different revenue measures defined in the last section. First, the ratios of tax revenue to potential tax revenue are given by 
\[ r^1 = (4+n)/9\gamma \]
and 
\[ r^2 = (4n+1)9n\gamma. \]
More heterogeneity (lower \( n \)) reduces the ratio for region 1, but increases the ratio for region 2. To better understand, we will look at the tax rate effect and the mobility effect separately. Since all tax rates are independent of \( n \), changes in heterogeneity generate no tax rate effect. All the action is driven by the mobility effect. With more heterogeneity, region 1 loses more firms and region 2
gains more firm meaning that $r^1$ is increasing in $n$ and $r^2$ is decreasing in $n$. Not surprisingly, the total tax revenue to total potential tax revenue ratio is independent of $n$ and given by $r = 5/9\gamma$. Also, for any $n > 0$, the preferential regime yields a smaller $r$ compare to the non-preferential regime, meaning that overall the preferential regime lowers the ability to generate tax revenue. Finally, we look at the total moving cost relative potential tax revenue. In a preferential, some firms move from region 1 to region 2, and some firms move from region 2 to region 1. A total of $N_i/3$ firms move from each region $i$, creating a sum of moving costs equal to:

$$\left(N_1 + N_2\right) \int_0^{1/3} cdc = \frac{N_1 + N_2}{18}.$$

Total moving cost relative potential tax revenue is given by $\rho = 1/18\gamma$. It is independent of $n$, as the same overall number of firms move. With the bi-directional movement of firms, the preferential regime always generates more wasteful moving cost than the non-preferential regime.

4 Some Perfectly Mobile Firms

We now extend our model to include a mass of firms with zero moving cost in each region. Moving costs are now distributed between zero and one in the following way: in each region, a proportion $\lambda$ of firms face a zero moving cost and a proportion $1 - \lambda$ have a moving cost uniformly distributed between zero and one. We will look at both regimes the same way we did in the last section.

4.1 Non-Preferential Regime

Under a non-preferential regime, each region chooses a unique tax rate on all firms, regardless of whether the firm is already in the region or just moved to the region. For any given $t_1 > t_2$, a firm in region 1 will stay in region 1 as long as $(1 - t_1)\gamma \geq (1 - t_2)\gamma - c$; this implies that all firms with zero moving cost would move to region 2. All firms with $c > (t_1 - t_2)\gamma$ will stay in region 1. The tax revenue from all domestic firms is $(1 - \lambda)N_1[1 - \gamma(t_1 - t_2)]\gamma t_1$. Since no firms move from region 2 to region 1 when $t_1 > t_2$, this represents the total tax revenue for region 1. If $t_1 \leq t_2$, tax
revenue from domestic firms is simply \( N_1 \gamma t_1 \). Firms in region 2 will move to region 1 whenever \( c < (t_2 - t_1) \gamma \), including all firms with a zero moving cost. This generates a tax revenue of \( \lambda N_2 \gamma t_1 + (1 - \lambda)N_2[t_2 - t_1] \gamma^2 t_1 \) for region 1. Total tax revenue in region 1, \( R^1(t_1, t_2) \), is given by

\[
R^1(t_1, t_2) = \begin{cases} 
(1 - \lambda)N_1[1 - \gamma(t_1 - t_2)] \gamma t_1 & \text{if } t_1 > t_2 \\
N_1 \gamma t_1 + \lambda N_2 \gamma t_1 + (1 - \lambda)N_2[t_2 - t_1] \gamma^2 t_1 & \text{if } t_1 \leq t_2 
\end{cases}
\] (11)

The best-response function is given by:

\[
t_1(t_2) = \begin{cases} 
\frac{1 + \gamma t_2}{2 \gamma} & \text{if } t_1 > t_2 \\
\frac{(1/n + \lambda)/(1 - \lambda) + \gamma t_2}{2 \gamma} & \text{if } t_1 < t_2 \\
t_1 = t_2 - \iota & \text{if } t_1 = t_2
\end{cases}
\] (12)

where \( \iota > 0 \) is as small as possible. Similarly, tax revenue from region 2 is given by:

\[
R^2(t_1, t_2) = \begin{cases} 
(1 - \lambda)N_2[1 - \gamma(t_2 - t_1)] \gamma t_2 & \text{if } t_2 > t_1 \\
N_2 \gamma t_2 + \lambda N_1 \gamma t_2 + (1 - \lambda)N_1[t_1 - t_2] \gamma^2 t_2 & \text{if } t_2 \leq t_1
\end{cases}
\] (13)

The best-response function is given by:

\[
t_2(t_1) = \begin{cases} 
\frac{1 + \gamma t_1}{2 \gamma} & \text{if } t_2 > t_1 \\
\frac{(1/n + \lambda)/(1 - \lambda) + \gamma t_1}{2 \gamma} & \text{if } t_2 < t_1 \\
t_2 = t_1 - \iota & \text{if } t_2 = t_1
\end{cases}
\] (14)

One important difference when some firms have a zero moving cost is that a symmetric Nash equilibrium no longer exists. When \( t_1 = t_2 \), each region would benefit from lowering its tax rate by a very small amount to attract the perfectly-mobile firms from the other region. If the tax are lowered by a small amount, the impact on the rest of the tax base is marginal, but the gain is discrete. However,
there exist an pure strategy asymmetric equilibrium when $N_1$ is sufficiently greater than $N_2$. The next proposition describes its properties.

**Proposition 4:** Under a non-preferential regime, there exist a pure strategy asymmetric Nash equilibrium where $t_1 = \frac{2-\lambda+n}{3(1-\lambda)}$ and $t_2 = \frac{1+\lambda+2n}{3(1-\lambda)}$ only if $n < 1 - 2\lambda$ and $\lambda < 2/5$.

The equilibrium representation is similar to Figure 2, but there are some added restrictions. First, for both reaction function to be satisfied, it must be the case that $t_1 > t_2$, which is possible only when $n < 1 - 2\lambda$. Second, a discrete deviation by region 1 must be not profitable. When region 1 sets higher taxes than region 2, it losses all perfectly-mobile firms. Region 1 could be tempted to set $t_1 = t_2 - \iota$, and not only retain all its firms from moving, but also steal all perfectly-mobile firms from region 2. This is a possible discontinuous deviation not capture by the first-order condition. Consequently, the tax revenue in region 1 evaluated at $t_1 = \frac{2-\lambda+n}{3(1-\lambda)}$ and $t_2 = \frac{1+\lambda+2n}{3(1-\lambda)}$ must be larger than the tax revenue evaluated at the same $t_2$, but at $t_1 = t_2 - \iota$. No deviation is profitable as long as:

$$(2 - \lambda + n)^2 \geq 3(1 - \lambda n).$$

This condition is satisfied at $n = 1 - 2\lambda$ only if $\lambda < 2/5$. Since $n < 1 - 2\lambda$, and the left hand side of the condition is increasing with $n$, while the right hand side is decreasing with $n$, both $\lambda < 2/5$ and $n < 1 - 2\lambda$ will guarantee that this condition is satisfied. Intuitively, we get a pure strategy asymmetric equilibrium only when there is enough difference in sizes and when there is not to many perfectly-mobile firms. Heterogeneity in size is needed to get sufficient differences in tax rate so that it is costly for region 1 to move down its tax rate just below region 2’s tax rate. Low density of perfectly-mobile firms is needed so that the gain for region 1 of lowering its tax rate is not to large. If either of these condition is not satisfied, no pure strategy equilibrium will exist, but a mixed strategy equilibrium similar to the ones found in Marceau, Mongrain and Wilson (2010) will exist.

Assuming the pure strategy equilibrium exist, the tax revenues for the two regions are given by $R^1 = N_1(2-\lambda+n)^2/9(1-\lambda)$ and $R^2 = N_1(1+\lambda+2n)^2/9(1-\lambda)$. Again, the large region still manages to collect more tax revenue despite losing firms. Tax revenue relative to potential tax revenue in each region is given by $r^1 = (2 - \lambda + n)^2/9(1 - \lambda)\gamma$ and $r^2 = (1 + \lambda + 2n)^2/9(1 - \lambda)n\gamma$, while economy wide tax revenue relative to potential tax revenue is given by $r = [(2 - \lambda + n)^2 + (1 + \lambda + 2n)^2]/9(1 - \lambda)(1 + n)\gamma$. 

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Finally, total moving costs relative to potential revenue is given by \( \rho = (1 - n)^2/18(1 - \lambda)(1 + n)\gamma \). Heterogeneity has similar effects on all ratios as in the previous section. More size heterogeneity (small \( n \)) lowers \( r^1 \). It also lowers \( r^2 \) if \( n > (1 - \lambda)/2 \), but increases \( r^2 \) if \( n < (1 - \lambda)/2 \). Overall, more heterogeneity lowers \( r \) and increases \( \rho \).

The effect of \( \lambda \) on tax revenue is very interesting. First, if we look at tax rates, we can see that \( t_1 \) is decreasing with \( \lambda \), but that \( t_2 \) is increasing with \( \lambda \). For the small region, the presence of a larger stock of firms easily “attractable” (zero moving cost) increases the cost of lowering its tax rate. In particular, the small region’s tax-base elasticity falls because its tax base rises, since it attracts more firms. For the large region, the opposite happens: by losing a larger stock of firms, the larger region faces a more elastic tax base. Consequently, the small region gains tax revenue when \( \lambda \) increases (\( r^2 \) is increasing in \( \lambda \)); tax rates are higher, and the region attracts more firms. For the larger region 1, an increase in \( \lambda \) forces the region to set lower taxes, and it losses more perfectly-mobile firms, but at the same time it keep more firms at the margin since \( t_2 \) increases and \( t_1 \) decreases. This last effect dominates, so \( r_1 \) is also increasing with \( \lambda \). Since both tax revenues increases with \( \lambda \), the total tax revenue ratio \( r \) is increasing with \( \lambda \); a result which seems surprising at first. It also interesting to see what happen with moving total cost. Adding firms with zero moving cost does not directly change total moving cost. Since it reduces the tax gap, it also reduces the number of firms with positive cost that moves. Consequently, \( \rho \) falls with \( \lambda \).

### 4.2 Preferential Regime

Under a preferential regime, we again define \( t_i \) and \( \tau_i \) as region \( i \)'s tax rate for domestic and foreign firms, respectively. When \( t_1 > \tau_2 \), a firm in region 1 will stay in region 1 if \((1 - \tau_1)\gamma \geq (1 - t_2)\gamma - c \). Thus, only the firms with \( c > (\tau_1 - t_2)\gamma \) stay in region 1, so the tax revenue from all domestic firms is given by \((1 - \lambda)N_1[1 - \gamma(t_1 - \tau_2)]\gamma t_1 \). On the other hand, if \( t_1 \leq \tau_2 \), all domestic firms stay, so the tax revenue from those firms is is given by \( N_1\gamma t_1 \). Moreover, firms in region 2 move to region 1 whenever \( c < (t_2 - \tau_1)\gamma \), generating tax revenue of \( \lambda N_2\gamma \tau_1 + (1 - \lambda)N_2[t_2 - \tau_1]\gamma^2\tau_1 \) for region 1. Total tax revenue in region 1, \( R^1(t_1, \tau_1, t_2, \tau_2) \), is given by:
\[ R^1 = \begin{cases} (1 - \lambda)N_1[1 - \gamma(t_1 - \tau_2)]\gamma t_1 & \text{if } t_1 > \tau_2 \text{ and } \tau_1 \geq t_2 \\ (1 - \lambda)N_1[1 - \gamma(t_1 - \tau_2)]\gamma t_1 + \lambda N_2 \gamma \tau_1 + (1 - \lambda)N_2[t_2 - \tau_1]\gamma^2 \tau_1 & \text{if } t_1 > \tau_2 \text{ and } \tau_1 < t_2 \\ N_1\gamma t_1 + \lambda N_2 \gamma \tau_1 + (1 - \lambda)N_2[t_2 - \tau_1]\gamma^2 \tau_1 & \text{if } t_1 \leq \tau_2 \text{ and } \tau_1 \geq t_2 \\ N_1\gamma t_1 + \lambda N_2 \gamma \tau_1 + (1 - \lambda)N_2[t_2 - \tau_1]\gamma^2 \tau_1 & \text{if } t_1 \leq \tau_2 \text{ and } \tau_1 < t_2 \end{cases} \]

The best-response function for \( t_1 \) and \( \tau_1 \) are given by:

\[ t_1(\tau_2) = \begin{cases} \frac{1 + \gamma \tau_2}{2\gamma} & \text{if } t_1 > \tau_2 \\ \tau_2 - \iota & \text{if } t_1 \leq \tau_2, \end{cases} \] (16)

\[ \tau_1(t_2) = \begin{cases} \frac{\lambda(1 - \lambda) + \gamma t_2}{3\gamma} & \text{if } \tau_1 < t_2 \\ t_2 - \iota & \text{if } t_1 = t_2. \end{cases} \] (17)

Similar best-response functions exist for region 2. As in the previous section, there exist an equilibrium set of taxes, \( \{t_1, \tau_2\} \), resulting from the competition for firms already located in region 1, and a set of taxes, \( \{\tau_1, t_2\} \), resulting from the competition for capital already located in region 2. Using the best-response functions, we obtain–

**Proposition 5**: Under a preferential regime, there exist a unique pure Nash equilibrium where \( t_1 = \frac{2 + \lambda/(1 - \lambda)}{3\gamma} \) and \( \tau_2 = \frac{1 + 2\lambda/(1 - \lambda)}{3\gamma} \), and where \( t_2 = \frac{2 + \lambda/(1 - \lambda)}{3\gamma} \) and \( \tau_1 = \frac{1 + \lambda/(1 - \lambda)}{3\gamma} \), if and only if \((2 - \lambda)^2 + n(1 - \lambda)^2 \geq 3 + 9\lambda\).

First, note that \( t_1 > \tau_2 \) and \( t_2 > \tau_1 \) for any values of \( \lambda \) and \( n \). The equilibrium representation looks very similar to figure 3. As in the last section, we still need to make sure that discrete deviations are not beneficial for either region. Region 1 for example, may want to set tax rate \( t_1 \) on domestic firms just bellow \( \tau_2 \), so to keep all domestic firms, including all perfectly-mobile firms. Such potential deviation is not captured by the first-order conditions because of the discontinuity in tax revenue. The equilibrium tax revenues are \( R^1 = N_1 \frac{(2 - \lambda)^2 + n(1 - \lambda)^2}{9(1 - \lambda)} \) and \( R^2 = N_1 \frac{n(2 - \lambda)^2 + (1 - \lambda)^2}{9(1 - \lambda)} \). The deviation in this context would be to set \( t_1 = \tau_2 - \iota \) for region 1, or \( t_2 = \tau_1 - \iota \) for region 2. Comparing the tax revenue reveals that such deviations are not beneficial as long as:

\[ (2 - \lambda)^2 + n(1 - \lambda)^2 \geq 3 + 9\lambda. \] (18)
The intuition is the same as in the previous section, lowering its tax rates to keep all domestic firms is beneficial only if there are a large number of perfectly-mobile firms (high $\lambda$). Moreover, a more symmetric distribution of firms (high $n$), tends to make such a deviation less favourable because tax competition in less intense.

Tax revenue relative to potential tax revenue in each region is given by $r^1 = \frac{[(2 - \lambda)^2 + n(1 - \lambda)^2]/9(1 - \lambda)\gamma}{\gamma}$ and $r^2 = \frac{[(n(2 - \lambda)^2 + (1 - \lambda)^2)/9(1 - \lambda)n\gamma}{\gamma}$, while economy wide tax revenue relative to potential tax revenue is given by $r = \frac{[(2 - \lambda)^2 + (1 - \lambda)^2]/9(1 - \lambda)\gamma}{\gamma}$. Finally, total moving costs relative to potential revenue is given by $\rho = \frac{(1 - 2\lambda)^2/18(1 - \lambda)\gamma}{\gamma}$. More size heterogeneity (small $n$) lowers $r^1$, but increases $r^2$, while leaving $r$ unchanged. More heterogeneity as also no impact on $\rho$, since tax rates are independent of $n$. The same results hold without perfectly-mobile firms.

Looking at the payoff reveals that the large region enjoys higher tax revenue. Both regions’ tax revenues are decreasing with size heterogeneity. Tax revenues are increasing with $\lambda$ (for the relevant range of $\lambda$), so perfectly-mobile firms discipline tax competition even in the preferential regime (as long as the pure-strategy equilibrium exist). As it was the case for $\lambda = 0$, tax revenue are always higher for the large region (region 1) under the non-preferential regime. The small region collect higher tax revenue under the non-preferential regime as long as $(1 + \lambda + 2n)^2 > n(2 - \lambda)^2 + (1 - \lambda)^2$. This condition is always strictly satisfied, even when $n \rightarrow 0$. The non-preferential regime generates strictly more tax revenue for any value $\lambda > 0$.

5 Dynamic Model

Let us now assume that the Nash game in taxes is repeated over time. At the start of each period, governments choose tax rates and existing firms draw a moving cost from the uniform distribution described above. Firms then decide where to locate. Finally, they generate taxable profits, and taxes are levied. The same sequence of events is repeated in each future period. To simplify matters, we limit our consideration to the symmetric case of identical regions, which impose identical tax policies in each period. With moving costs independently distributed across time, the probability that a firm stays in a country for $T$ additional periods is identical across all firms, regardless
of how long they have previously been located in the country. Thus, the future tax revenue streams from either retaining a domestic firm or attracting a foreign firm are the same. For a given discount factor of future taxes, we may therefore define $V$ as the common future revenue coming from any firm that is subject to taxes this period, regardless of whether it is a new or old firm. In the preferential regime, $V$ will be independent of how many foreign firms are attracted because equilibrium tax rates are independent of region size, a property that holds here. We assume that regions forecast that the economy will remain in the symmetric equilibrium in future periods, independently of regional size. In this case, they will have no incentive to deviate from the symmetric equilibrium in any given period, and therefore no differences in firm sizes will occur. In other words, $V$ will remain independent of current tax policy choices.

To calculate $V$, introduce $i$ as a discount rate, and note that no firms move in a symmetric equilibrium for the non-preferential regime, since there are no tax advantages from doing so. Given tax payments $t\tau$ each period, we then have

$$t\gamma + V = \frac{t\gamma}{i}$$

(19)

In the preferential case, the discount rate is lowered, reflecting the constant probability that a firm moves in any given period.

For the non-preferential regime, we may modify the revenue function for region 2 so that it now measures the discounted sum of revenue:

$$R^2(t_1, t_2) = \begin{cases} 
N_2[1 - \gamma(t_2 - t_1)][\gamma t_2 + V] & \text{if } t_2 > t_1 \\
N_2[\gamma t_2 + V] + N_1[t_1 - t_2]\gamma[\gamma t_2 + V] & \text{if } t_2 \leq t_1
\end{cases}$$

(20)

Region 1’s revenue function is similarly defined. It is then straightforward to modify the first-order conditions for each region’s optimal tax policy and derive the following expression for the common equilibrium tax rate.

$$t = \frac{1 - V}{\gamma}$$

(21)

We may then solve for the discounted sum of revenue, starting in the initial period:
\[ t \gamma + V = 1 \] \hspace{1cm} (22)

In other words, it is always the case that one unit of revenue is collected from each firm over its lifetime, regardless of the size of its tax base. This result can be understood by observing once again that a rise in each firm’s profits represents an increase in the tax base elasticity, given that moving costs are remaining uniformly distributed over the unit interval. Thus, the share of profits that are taxed declines as profits rise in this case.

Turning to the preferential tax regime, we again modify the revenue expressions to incorporate discounted values of future revenue. The discounted tax revenue for both region are respectively given by:

\[ R^1 = N_1[1 - \gamma(t_1 - \tau_2)][\gamma t_1 + V] + N_2[t_2 - \tau_1]\gamma[\gamma \tau_1 + V] \text{if } t_1 > \tau_2 \& \tau_1 < t_2 \] \hspace{1cm} (23)

\[ R^2 = N_2[1 - \gamma(t_2 - \tau_1)][\gamma t_2 + V] + N_1[t_1 - \tau_2]\gamma[\gamma \tau_2 + V] \text{if } t_2 > \tau_1 \& \tau_2 \geq t_1 \] \hspace{1cm} (24)

where the assumed difference between foreign and domestic taxes reflects our previous findings, which continue to hold here. From the first-order conditions for revenue-maximization, we obtain the equilibrium tax rates, where subscripts are again omitted for the symmetric equilibrium:

\[ t = \frac{2}{3\gamma} - \frac{V}{\gamma}; \] \hspace{1cm} (25)

\[ \tau = \frac{1}{3\gamma} - \frac{V}{\gamma}. \] \hspace{1cm} (26)

Note that the existence of future revenue lowers both tax rates by identical amounts. From the second equation, we obtain the present value of taxes obtained from a new firm, measured from the initial period:

\[ \tau \gamma + V = \frac{1}{3}. \] \hspace{1cm} (27)

An existing domestic firm faces the higher tax \( t \) in the initial period. Thus, we use the first equation to obtain its present value of taxes, measured from the initial period:
\[ t\gamma + V = \frac{2}{3}. \]  \hspace{1cm} (28)

To complete the analysis, we must compute the shares of new and old firms in equilibrium. With moving cost uniformly distributed over the unit interval, the share of firms that are new is simply the difference in tax payments: \( t\gamma - \tau\gamma = 1/3 \). Thus, average tax revenue per firm is

\[ \left(\frac{1}{3}\right)\left(\frac{1}{3}\right) + \left(\frac{2}{3}\right)\left(\frac{2}{3}\right) = \frac{5}{9}. \]

In other words, moving from the non-preferential regime to the preferential tax regime cuts tax payments by four-ninths.

While this percentage fall in tax payments is independent of the level of profits, dropping the assumption of a uniform cost distribution does open up other possibilities. Return to the example from the start of the paper, where all firms have a single moving cost, \( c \). For \( c \) sufficiently high, we saw that profits would be taxed at 100 percent under the non-preferential regime. This result continues to hold in the dynamic case. But under the preferential regime, a new consideration emerges. Recall that previously the tax levied on foreign firms was bid down to zero, whereas existing domestic firms were taxed at a rate equal to moving cost, thereby inducing them to remain. But now each region will have an incentive to lower its tax on foreign firms below zero (a positive subsidy), because the region realizes that it will obtain revenue from the foreign firms after the initial period (at which point they are subject to the positive domestic tax rate). Indeed, the only pure-strategy equilibrium is where the subsidy rises to the point where it exactly equals the present discounted value of taxes paid by the firm in future periods.\(^3\) The tax that generates these future tax payments equals moving cost \( c \) minus the subsidy obtained by each new firm. In this sense, no new firm entering a region will pay taxes in a present value sense.

There are no new firms in this example, because countries set their taxes on existing domestic firms at a level that induces them not to move. However, we can easily alter the example by allowing a random number of firms to become perfectly-mobile each period, as in the previous section. Then over time, each firm eventually

\(^3\)A similar result is obtained by Wilson (1996).
moves, at which time it faces no tax burden in an expected value sense. This contrast with the preferential regime, where all firms pay a 100 percent tax in our example.

These strong results hold because countries face an infinitely elastic supply of new firms when there is only single moving cost, a property we have avoided with our previous assumption of a uniform distribution of moving cost. In either case, however, we find that preferential tax treatment of new firms leads to a substantial loss in tax revenue.
6 References

Hong, Q. and M. Smart (2010), ”In Praise of Tax Havens: International Tax Planning and Foreign Direct Investment,” European Economic Review 54, 82-95.


Wilson, J.D. (1996), “The Tax Treatment of Imperfectly Mobile Firms: Rent-