

# Inter-region Subsidy Competition for a New Production Plant: What is the Central Government Optimal Policy?

O.J. Parcero\*

CMPO and University of Bristol

December 23, 2003

## Abstract

This paper models inter-regional competition for FDI and optimal government policy intervention to protect the national interest. Two regional authorities bargain with a single multinational over where it will locate. This potentially leads to excessive competition between the regions, favouring the multinational. The federal government obviously wants to limit such competition but lacks information on comparative advantage. This paper examines its optimal policy. Among the main results we have the following two: First, the federal government would use tax policy to create asymmetries even when the underlying structure is symmetrical. Second, there are situations where, even though one MNC is more productive in one region, it is optimal for the country to make it go to the other one.

## 1. Introduction

It is well known that, in order to take advantage of positive externalities, local jurisdictions are willing to offer subsidies with the aim of attracting new production plants to their site. This results in multinational corporations (MNCs) holding simultaneous negotiations with different local jurisdictions' authorities within a

---

\*I would like to acknowledge the help of Carlos Ponce, David de Meza, Mariano Selvaggi, Michael Whinston, Tobias Regner for valuable comments.

given country to find out which one offers the most profitable conditions for the installation of a new production plant<sup>1</sup>.

There is substantial evidence of this kind of subsidy competition. For example, in 1993 the state of Indiana packaged a \$300 million deal to attract a United Airlines maintenance facility expected to create 6,300 jobs, while Kentucky issued \$140 million in potential tax credits to attract 400 steel jobs (Wall Street Journal, July 6, 1993). A survey of regional incentives programs implemented in other OECD countries can be found in Chandler and Trebilcock (1986). There is also evidence that this intergovernmental competition is quite common between municipalities, which enter 'bidding wars' using firm-specific agreements to attract plants (King, et al. (1993)).

There is also an existing literature that, using different set-ups, models this subsidy competition to attract MNCs to particular locations. For example, Bond and Samuelson (1986) and Doyle and van Wijnbergen (1984) model the fact that the tax competition between countries takes the form of a tax holiday. King and Welling (1992) examine a two-period model in which two regions compete simultaneously in each period. Closer to our approach, Barros and Cabral (2000) analyse "subsidy games" between countries in order to attract foreign direct investment (FDI) from a third country. They do welfare comparisons between the equilibria achieved by competitive subsidy, zero subsidy, and first-best subsidy.

In the present paper we are interested in the particular case where the central government of the country intervenes in this competition process in order to protect the national interest. To the best of my knowledge, Adams and Regibeau (1998) is the only paper that considers a central government intervention in a context of local subsidy competition for FDI. In a context of tariff-jumping argument for FDI and the possibility that the local authorities offer subsidies in order to attract MNCs, their paper try to determine what the optimal import tariff is.

However, there are two puzzling stylised facts that have not been addressed in Adams and Regibeaus' paper. First, the fact that central governments favour some regions and not others even when all of them are similar in terms of level of development and strategic location. The best example of this particular asymmetric treatment can be found in China. Specifically, at the beginning of the 1980's the Chinese government gave special economic privileges to three cities in Guangdong, one in Fujian, and none in Guangxi, even though there was no difference between the three regions in terms of development or strategic location. Another

---

<sup>1</sup>However, a similar situation could be found in the new economic blocs like the EU, NAFTA, or Mercosur, where the jurisdictions are the countries that form the blocs.

even better example involves the Shandong, Shanghai, and Zhejiang provinces. Again, in a similar situation at the beginning of the 1990s' all the privileges were given to Shanghai. Indeed, it is widely recognised that the application of these asymmetric policies was the main cause of the later development asymmetries between these regions. Thus, knowing that a symmetric treatment of similar regions would be desirable in terms of a more even regional development, why the asymmetric policy is chosen instead? Is it because it generates a higher aggregate country's welfare than the symmetric one?

The main purpose of the present paper is to show that, under certain circumstances, this is indeed the case. The principle underlying this result in our model is that an asymmetric tax treatment of similar regions is more effective than a symmetric one in reducing the adverse effect that the subsidy competition between the regions has on the country's welfare. For, in some circumstances, it reduces the bargaining power of the MNC.

Another worth mentioning result that emerges from our model is that, under some circumstances, the optimal central government policy generates a mismatch between a particular region and a MNC. By mismatch we mean a situation where, even though one MNC is more productive in one region, due to the central government's optimal policy it goes to the other one. The existence of mismatches contrasts with the solution when there is no central government intervention, in which case this never happens. This interesting result stems from the fact that in our model the central government has imperfect information about the type of MNC that is coming to the country. This implies that the taxes set ex-ante by the central government have to be conditional on the regions ultimately chosen by the MNC and not on their own type. Then, the central government faces a trade-off between reducing the inter-region subsidy competition and achieving the best match between region and MNC. In some situations the achievement of the former target gives rise to a mismatch. This result seems to support some critics' views that privileges given to particular regions are made at the cost of creating inefficiencies in the regional allocation of resources. However, in our model, this comes as a result of the central government applying a policy that maximises the country's welfare.

The structure of the paper is as follows. The basic model is presented in Section 2. In the first part of this section we begin by assuming one country with two identical regions; in the second part we allow the regions to differ. In Section 3 we discuss the main results of the model. Section 4 concludes and makes suggestions for further research.

## 2. The model

We assume a two-stage game involving the central government, two regions (i.e. 1 and 2), and an MNC. Thus, in the first stage, the central government determines the lump sum taxes to be imposed on the MNC<sup>2</sup> in each of the regions in order to maximise the country's welfare<sup>3</sup>, which is equal to the local welfare (externality minus regional subsidy) plus the central government tax. In the second stage, the MNC bargains with the two regional governments on the level of the lump sum subsidies to be paid by each of them<sup>4</sup>. Initially we assume that the MNC does not obtain any pre-subsidy profit and it only generates externalities to the winning region. Each regional government maximises its own utility, which we assume to be equal to the externality produced by the MNC minus the subsidy<sup>5</sup>. In addition, let's begin assuming that all players have perfect information. This means that the externality produced by the MNC in each region, the taxes imposed by the central government in the first stage of the game, and the payoff that the MNC obtains if it does not invest in the country under consideration (i.e. investing abroad) are common knowledge. For simplicity let's consider this last payoff to

---

<sup>2</sup>As we will see later whether the federal tax is on the MNC or on the region does not make any difference, except in terms of the amount of subsidy paid by the winning region.

<sup>3</sup>The in-advance setting of the taxes (a federal government take-it-or-leave-it offer to the MNC) acts as a commitment device for the federal government not to bargain with the MNC. Even though we do not prove it here, it seems obvious that because the federal government cannot prevent the regional subsidies, a take-it-or-leave-it offer would provide a higher country's welfare than a direct bargaining with the MNC.

<sup>4</sup>The bargaining seems a very appropriate framework to analyse this kind of problem because this is the most common way the MNCs induce different regions to compete for their production plants. This aspect has been particularly ignored by the literature, which seems to have a preference for the use of an auction framework. Furthermore, we assume here that the regional government cannot pre-commit to subsidies (or taxes) as it is done by the federal government. The main justification for this assumption is perhaps the fact that an MNC would more easily accept a pre-commitment if it is imposed by a third party (in this case the federal government) than if it is imposed to itself by the region. Thus, we could say that the federal government is a very good commitment tool for the regions.

<sup>5</sup>We are assuming that each region government does not consider the central government tax revenue in its own utility function. Obviously, this is not necessarily a realistic assumption if the way the central government expends this tax revenue result in higher benefits for the competing regions. However, one justification for assuming that can be the existence of a large number of regions in the country. In this case, each region will get negligible benefits from this central government tax revenue. Indeed, the federal government can expend this tax revenue in a way that only increases the utility of the regions that are not participating in the competition for the MNC.

be equal to zero.

To model the three-player bargaining game in which each regional government bids a lump-sum subsidy to attract a MNC, we use a version of the non-cooperative bargaining approach developed by Bolton and Whinston (1993). This is an alternating offer framework where the MNC alternates in making offers with the two regions. When it is the MNC's turn to make an offer, it can demand either a particular subsidy from one of the regions or it can make no demand. When it is the MNC's turn to receive offers, the two regions simultaneously make them by specifying the subsidy they are willing to pay. The result of this bargaining framework is that the MNC payoff is the maximum between: a) Half of the surplus it produces in the winning region; and b) the value of the outside option, given by the surplus it produces in the other region.

## 2.1. Two identical regions

The simplest case is when there is only one type of MNC and both regions are identical. In this case the externality produced by the MNC is the same in both regions. On the one hand, without central government intervention, the competition between the regions will induce them to offer a subsidy to the MNC equal to the full externality it produces. Thus, the MNC obtains a benefit equal to the total externality and the regions have no gain.

On the other hand, if the central government of the country decides to intervene, it is optimal for it to exempt one region from the competition (by setting a very high tax if the MNC chooses this region) and to charge the MNC a tax equal to the externality it produces in the other region. We will call this an asymmetric tax policy.<sup>6</sup> Then, the benefit of the externality is totally absorbed by the country.

In the previous case there is only one type of MNC. However, it is usually the case that a variety of MNCs are involved in negotiations with the different regions of a country. Then, industrial, technological, as well as, financial characteristics may produce differences in the externalities created by each particular MNC. To consider this we allow the existence of two types of MNCs (i.e.  $a$  or  $b$ ), which can produce different externalities, but the regions are still identical. Furthermore, it is usually the case that the central government has less information than the regions about the externalities produced by the MNCs. We capture this by assuming that

---

<sup>6</sup>Under the present case, this same result can be obtained by a symmetric tax policy which consist in charging the same tax in each region, which must be equal to the externality produced by the MNC.

it knows the externality each type of MNC can produce, but it does not know the realisation of the MNC type. In particular, it only knows that an MNC of type  $a$  shows up with probability  $p$  and an MNC of type  $b$  does it with probability  $1 - p$ . On the contrary, the regions know the type.

Again, in the decentralised solution (the one without central government intervention), the subsidy competition allows the MNC to obtain the full benefit of the produced externality, whatever its type is. Thus, there is no country's welfare derived from the new production plant. However, if the central government of the country intervenes, it is natural to think that, given that both regions are identical, it should apply the same tax policy to both regions (symmetric tax policy). It also seems reasonable to think that the optimal central government policy is to exempt one of the regions from the competition and to apply an appropriate tax on the other one (asymmetric tax policy). By the use of two numerical examples we now determine the optimal tax policies under different settings. In both examples we assume that an MNC of type  $a$  generates an externality of £40 and an MNC of type  $b$  one of £20.

**Example 1.** *In the first case we additionally assume that the probability of an MNC of type  $a$  showing up is high (say  $p = 0.8$ ). If this is the case, it pays to get the full externality from the MNC of type  $a$ , even though this is done at the cost of not attracting the MNC of type  $b$ . Thus, the optimal central government tax in each region in the case of the symmetric tax policy, or in the non-eliminated region in the case of the asymmetrical one, is equal to the externality produced by the MNC of type  $a$  (£40). Now, the MNC of type  $b$  does not come to the country under any of the tax policies, but the full externality is extracted from the MNC of type  $a$ . Then, both a symmetric and asymmetric tax policies are equally optimal for the country.*

However, a different result is obtained in the next example.

**Example 2.** *In this second example we assume a low enough  $p$  (say  $p = 0.2$ ) as to make it optimal for the central government to attract both types of MNCs. Let's first obtain the country's welfare under the asymmetric tax policy. In this case the central government eliminates one region from the competition (say region 1) and it charges a tax equal to the externality produced by the MNC of type  $b$  (£20) in the remaining one. As a result, the central government obtains the full externality produced by an MNC of type  $b$ . However, the MNC of type  $a$  bargains with the*

region 1 how to share the after-tax surplus of £20<sup>7</sup> (equal to the externality minus the central government tax in this region). As a result of this bargaining process, region 1 only obtains half of this after-tax surplus, for it has to give a subsidy of £10 to the MNC. This means that the country's welfare is £30 (externality minus subsidy) when an MNC of type *a* shows up and £20 when an MNC of type *b* does it.

Let's now obtain the country's welfare under the symmetric tax policy. In this case, the optimal central government tax in each region is equal to the externality produced by an MNC of type *b*. As before, the central government obtains all the externality produced by an MNC of type *b*. However, in the case that an MNC of type *a* shows up, the competition between the regions makes the MNC obtain the full after-tax surplus of £20. Thus, the country's welfare is equal to £20 whichever type of MNC shows up and the symmetric tax policy is dominated by the asymmetric one.

Thus, the following proposition applies.

**Proposition 3.** *When there are two identical regions, two types of MNCs that produce different externalities, and it is optimal for the country to attract both of them, a dissimilar treatment of similar regions is the only optimal tax policy. For it reduces the subsidy competition when the low type of the MNCs shows up.*

It is interesting to see that it is optimal to give different tax treatments to identical regions. Indeed, there is no way in which this last optimal result can be reached by the application of a symmetric tax policy. The reason for this is straightforward. It is true that setting the same tax in both regions, equal to the externality produced by an MNC of type *b*, reduces the competition when this type of MNC shows up. However, this policy is not very effective when an MNC of type *a* shows up, for the region that does not get the MNC becomes a binding outside option, which increases the subsidy that the winning region has to pay.

## 2.2. Two different regions

Until now we were assuming that the MNCs do not have any profit. However, given that the addition of MNCs profits makes the model a more general one without increasing its complexity, hereafter we will do so. Indeed, we will say

---

<sup>7</sup>In this paper, the expression after-tax will refer to the tax imposed by the federal government to the MNC.

that the surplus that an MNC of type  $i$  produces in region  $j$  ( $s_{ij}$ ) is equal to the addition of the profit and the externality ( $\pi_{ij}$  and  $e_{ij}$  respectively).

We begin solving the second stage of the game. Thus, when an MNC of type  $i$  ( $i=a, b$ ) shows up, region  $j$  would be the winner and get the new plant if the after-tax surplus in region  $j$  is higher or equal than in region  $k$ <sup>8</sup> (i.e.  $s_{ij} - g_j \geq s_{ik} - g_k$ )<sup>9</sup> and higher or equal than abroad ( $s_{ij} - g_j \geq 0$ ). Then, the equilibrium payoff for the MNC (i.e. the profit after paying the central government tax and receiving the regional subsidy) is,

$$\pi_{ij}^m = \max \left\{ \frac{s_{ij} - g_j}{2}; s_{ik} - g_k \right\} \quad (1)$$

which is equal to the maximum between half of the after-tax surplus an MNC of type  $i$  produces in the region  $j$  (i.e.  $\frac{s_{ij} - g_j}{2}$ ) and the value of the outside option given by the after-tax surplus it produces in region  $k$  (i.e.  $s_{ik} - g_k$ ). It is obvious that the subsidy that the winning region will pay is such that, the MNC will just get the payoff in expression 1. Thus, the equilibrium subsidy is:

$$d_{ij} = \max \left\{ \frac{s_{ij} - g_j}{2} - (\pi_{ij} - g_j); (s_{ik} - g_k) - (\pi_{ij} - g_j) \right\} \quad (2)$$

That is, it is like if the winning region takes the full after-tax profit ( $\pi_{ij} - g_j$ ) from the MNC, but then it compensates the MNC by giving back the payoff in expression 1. It is obvious that this subsidy can be a negative one and in a lot of cases this will be the case<sup>10</sup>.

Then, by subtracting the equilibrium subsidy from the externality in region  $j$  (i.e.  $e_{ij}$ ) we get the winning region's equilibrium payoff when an MNC of type  $i$  shows up.

$$\pi_{ij}^r = \min \left\{ \frac{s_{ij} - g_j}{2}; s_{ij} - g_j - (s_{ik} - g_k) \right\} \quad (3)$$

---

<sup>8</sup>For simplicity we will consider the subscripts  $j$  and  $k$  as indicating the winning and losing regions respectively.

<sup>9</sup>For simplicity we assume that if the previous weak inequality is satisfied with an equal sign, region  $j$  is the winner. In a similar way, there will be several situations throughout the paper where it will be assumed that one of the regions is the winner in the case of equality, though they will not be explicitly stated.

<sup>10</sup>As an example, think of the case where there is no outside option, no federal tax, and no externality (the surplus is just equal to the MNC's profit).



Finally, the country's welfare from each particular type of MNC that builds a plant in the country is equal to the central government tax plus the winning region equilibrium payoff. Thus, the expected country's welfare is given by the following expression:

$$w = \frac{1}{2} \left( \begin{aligned} & g_j + \min \left\{ \frac{s_{aj}-g_j}{2}; s_{aj} - g_j - (s_{ak} - g_k) \right\} p \text{ if } s_{aj} \geq g_j \\ & 0 \text{ otherwise} \end{aligned} \right)^{3/4} + \left( \begin{aligned} & g_j + \min \left\{ \frac{s_{bj}-g_j}{2}; s_{bj} - g_j - (s_{bk} - g_k) \right\} (1-p) \text{ if } s_{bj} \geq g_j \\ & 0 \text{ otherwise} \end{aligned} \right)^{3/4} \quad (4)$$

We already know the subsidies that the regions will set on each MNC's type. Now we pass to determine the optimal central government taxes and identify the winning region under different parameter values. Moreover, given the existence of four different pre-tax surplus levels (i.e.  $s_{a1}, s_{a2}, s_{b1}, s_{b2}$ ), which can have different values, there will be twelve different economic regimes. However, because of symmetry it is enough to only analyse the following six:

$$\textit{Economic regime I} : s_{a1} \geq s_{a2} \geq s_{b2} \geq s_{b1} \geq 0 \quad (5)$$

$$\textit{Economic regime II} : s_{a1} \geq s_{a2} \geq s_{b1} \geq s_{b2} \geq 0 \quad (6)$$

$$\textit{Economic regime III} : s_{a1} \geq s_{b2} \geq s_{a2} \geq s_{b1} \geq 0 \quad (7)$$

$$\textit{Economic regime IV} : s_{a1} \geq s_{b1} \geq s_{a2} \geq s_{b2} \geq 0 \quad (8)$$

$$\textit{Economic regime V} : s_{a1} \geq s_{b1} \geq s_{b2} \geq s_{a2} \geq 0 \quad (9)$$

$$\textit{Economic regime VI} : s_{a1} \geq s_{b2} \geq s_{b1} \geq s_{a2} \geq 0 \quad (10)$$

Hereafter, we will define a central government tax policy as the set of taxes that the central government imposes on the MNC, which as we already said are conditional on the region the MNC locates its new production plant. In addition, the following definitions are necessary.

**Definition 4.** We will define a tax policy as dominated if there are no parameter values for which this tax policy is the only one providing the highest country's welfare.

**Definition 5.** We will define a tax policy as regime dominated in a particular economic regime if there are no parameter values, compatible with this economic regime, for which this tax policy is the only one providing the highest country's welfare.

We pass now to analyse the optimal tax policies existing under different parameter values. To be sure that we consider all the possible cases, we will find the optimal policy for each particular match between regions and MNCs. This is done in the following six propositions:

### 2.2.1. Tax policy 1

**Proposition 6.** When the country only attracts one type of MNC, the optimal tax policy (hereafter tax policy 1) is one that extracts the entire surplus from an MNC of type  $a$  in region 1 and eliminates region 2 from the competition (i.e.  $g_1 = s_{a1}$  and  $g_2 = \infty$ ).

**Proof.** When the country only attracts one type of MNC, the MNC can be of type  $a$  or  $b$ . If, on the one hand, only an MNC of type  $a$  is attracted, it is optimal to eliminate region 2 and make it go to region 1 because it generates a higher surplus there. Then, the optimal tax on region 1 is one that extract the full surplus produced by this MNC (i.e.  $g_1 = s_{a1}$ ).

On the other hand, it is not optimal for the central government to only attract the MNC of type  $b$ . First, it is not possible to only attract the MNC of type  $b$  and make it go to region 1. For, in region 1, every tax that is accepted by an MNC of type  $b$  will also be accepted by an MNC of type  $a$ , what means that both MNC will come. Second, it is not possible to only attract the MNC of type  $b$  and make it go to region 2 in economic regimes I, II, and IV, because, again, every tax that is accepted by an MNC of type  $b$  will also be accepted by an MNC of type  $a$ , what will make both MNC come to the country. Indeed, given that we attract the MNC of type  $b$  to region 2 in economic regimes III, V, and VI, it would be possible and optimal to also attract an MNC of type  $a$  to region 1. Thus, we conclude that it is not optimal to only attract the MNC of type  $b$ . ■

The country's welfare under tax policy 1 is:

$$w_1 = s_{a1}p \quad (11)$$

### 2.2.2. Tax policy 2

**Proposition 7.** *When the country attracts both MNCs and they go to region 1, the optimal tax policy (hereafter tax policy 2) is to exempt region 2 from the competition and to set  $g_1 = s_{b1}$ .*

**Proof.** First, it is obvious that the two MNCs will not go to region 1 if the tax in this region is  $g_1 > s_{b1}$ . Second, given that region 2 is eliminated from the competition, a reduction of  $g_1$  below  $s_{b1}$  would reduce the country's welfare whichever type of MNC shows up. Finally, given that the central government sets  $g_1 = s_{b1}$ , it is not optimal not to eliminate region 2. For this region would become a binding outside option, for one or the other MNC depending on the parameter values, what would reduce the country's welfare. ■

The country's welfare under tax policy 2 is:

$$w_2 = s_{b1} + \frac{s_{a1} - s_{b1}}{2} p + s_{b1}(1 - p) \quad (12)$$

### 2.2.3. Tax policies 3a and 3b

**Proposition 8.** *When the country attracts both MNCs to region 2, the optimal tax policy is to exempt region 1 from the competition and to set  $g_2 = s_{b2}$  (hereafter tax policy 3a) if  $s_{a2} > s_{b2}$  (i.e. in economic regimes I, II, and IV) or  $g_2 = s_{a2}$  (hereafter tax policy 3b) if  $s_{a2} < s_{b2}$  (i.e. in economic regimes III, V, and VI).*

**Proof.** First, to exempt region 1 from the competition and charge  $g_2 > s_{b2}$  when  $s_{a2} > s_{b2}$  or  $g_2 > s_{a2}$  when  $s_{a2} < s_{b2}$ , will not attract both MNCs to region 2. Second, to charge a tax  $g_2 < s_{b2}$  or not to exempt region 1 from the competition when  $s_{a2} > s_{b2}$  will result in a lower country's welfare. Finally, to charge a tax  $g_2 < s_{a2}$  or not to exempt region 1 from the competition when  $s_{a2} < s_{b2}$  will also result in a lower country's welfare. ■

The country's welfare under tax policies 3a and 3b are respectively given by the following expressions:

$$w_{3a}^I = s_{b2} + \frac{s_{a2} - s_{b2}}{2} p + s_{b2}(1 - p) \quad (13)$$

$$w_{3b}^I = s_{a2} + \frac{s_{b2} - s_{a2}}{2} p + s_{a2}(1 - p) \quad (14)$$

#### 2.2.4. Tax policy 4

**Proposition 9.** *If  $s_{b2} \leq s_{a2}$  (i.e. in economic regimes I, II, and IV) and  $s_{a1} - s_{a2} - s_{b1} + s_{b2} \geq 0$ , the optimal tax policy (hereafter tax policy 4) that makes an MNC of type  $a$  go to region 1 and one of type  $b$  go to region 2 is one that sets  $g_1 = s_{a1} - s_{a2} + g_2$  and  $g_2 = s_{b2}$ .*

**Proof.** On the one hand, for an MNC of type  $a$  to go to region 1 the two following conditions are necessary.

$$s_{a2} - g_2 \leq s_{a1} - g_1 \quad (15)$$

$$g_1 \leq s_{a1} \quad (16)$$

The first of these conditions says that the after-tax surplus of an MNC of type  $a$  is higher in region 1 than in region 2. The second one is that the tax charged on the region 1 has to be low enough as to make the MNC of type  $a$  prefer region 1 to going abroad. On the other hand, the same kind of conditions are necessary for an MNC of type  $b$  to go to region 2. These conditions are given by the following expressions:

$$s_{b2} - g_2 \geq s_{b1} - g_1 \quad (17)$$

$$g_2 \leq s_{b2} \quad (18)$$

Then, by replacing 15 into 17 and rearranging we get the following necessary condition for a tax policy to induce an MNC of type  $a$  to go to region 1 and an MNC of type  $b$  to go to region 2:

$$s_{a1} - s_{a2} - s_{b1} + s_{b2} \geq 0 \quad (19)$$

On the one hand, it is clear that in economic regime I restriction 19 is always satisfied, but in economic regimes II and IV, this is not always the case. However, assuming that restriction 19 applies, the maximum tax on region 1 compatible with restrictions 15 and 16 is:

$$g_1 = \min(s_{a1} - s_{a2} + g_2, s_{a1}) \quad (20)$$

but because of restriction 18 and that we are assuming  $s_{b2} \leq s_{a2}$ , this is equivalent to

$$g_1 = s_{a1} - s_{a2} + g_2 \quad (21)$$

On the other hand, because of 18 and 21 and given that an MNC of type  $a$  has to go to region 1 and one of type  $b$  has to go to region 2, a reduction in  $g_2$  below  $s_{b2}$  will reduce the country's welfare whichever type of MNC shows up. First, when an MNC of type  $b$  shows up, it is obvious that a reduction in  $g_2$  will reduce the country's welfare because, under the present tax policy this type of MNC goes to region 2. Second, when an MNC of type  $a$  shows up, a reduction in  $g_2$  will produce a fall in  $g_1$  and thus it will reduce the country's welfare. Thus, we can conclude that, given that  $g_1 = s_{a1} - s_{a2} + g_2$ , it is optimal to set  $g_2 = s_{b2}$ .

Furthermore, given that  $g_2 = s_{b2}$ , a reduction in  $g_1$  below  $g_1 = s_{a1} - s_{a2} + g_2$  will not increase the country's welfare if an MNC of type  $b$  shows up, but it would reduce it if an MNC of type  $a$  shows up. This means that, if  $g_2 = s_{b2}$ ,  $g_1 = s_{a1} - s_{a2} + g_2$  is the optimal tax to be set on region 1. ■

Under tax policy 4 the country's welfare is<sup>11</sup>:

$$w_4 = [s_{a1} - (s_{a2} - s_{b2})]p + s_{b2}(1 - p) \quad (22)$$

### 2.2.5. tax policy 5

**Proposition 10.** *If  $s_{b2} \geq s_{a2}$  (i.e. in economic regimes III, V, and VI), the optimal tax policy (hereafter tax policy 5) that makes an MNC of type  $a$  go to region 1 and an MNC of type  $b$  go to region 2 is one that sets  $g_1 = s_{a1}$  and  $g_2 = s_{b2}$ .*

**Proof.** Because we are looking for the optimal tax policy that makes an MNC of type  $a$  go to region 1 and an MNC of type  $b$  go to region 2, restrictions 15, 16, 17, 18 and 19 have to be satisfied. However, because now we assume  $s_{b2} \geq s_{a2}$ , restriction 19 is always satisfied.

As before, the maximum tax on region 1 that makes the MNC of type  $a$  go to region 1 is given by expression 20. Indeed, it does not impose an upper limit on the tax on region 2. Then this is the optimal tax to be set on region 1. For, a higher tax would not be able to make an MNC of type  $a$  go to region 1, and a

---

<sup>11</sup>Expression 22 shows that the country's welfare in the case an MNC of type  $a$  shows up is only given by  $g_1$ . This is explained by the fact that the after tax surplus generated by an MNC of type  $a$  in region 1 is equal to the outside option and so the region 1 has to allow the MNC to appropriate all of this after tax surplus by charging no tax.

lower one would produce a lower country's welfare when an MNC of type  $a$  shows up and it will not produce a higher one when an MNC of type  $b$  shows up.

Furthermore, it is optimal for the central government to set  $g_2 = s_{b2}$  and extract the full surplus of an MNC of type  $b$  in region 2. For a higher tax would fail in making an MNC of type  $b$  go to region 2 and a lower one would reduce the country's welfare whichever MNC shows up. Then, given that this is the optimal tax on region 2, the expression 20 turns into  $g_1 = s_{a1}$ . ■

Under tax policy 5 the country's welfare is:

$$w_5 = s_{a1}p + s_{b2}(1 - p) \quad (23)$$

### 2.2.6. tax policy 6

**Proposition 11.** *It is not optimal for the central government, under any economic regime, to make an MNC of type  $a$  go to region 2 and an MNC of type  $b$  go to region 1.*

**Proof.** On the one hand, for an MNC of type  $b$  to go to region 1 the two following conditions are necessary.

$$s_{b2} - g_2 \leq s_{b1} - g_1 \quad (24)$$

$$g_1 \leq s_{b1} \quad (25)$$

The first of these conditions says that the after-tax surplus of an MNC of type  $b$  is higher in region 1 than in region 2. The second one is that the tax charged on the region 1 has to be low enough as to make the MNC of type  $b$  prefer region 1 to going abroad. On the other hand, the same kind of conditions are necessary for an MNC of type  $a$  to go to region 2. These conditions are given by the following expressions:

$$s_{a2} - g_2 \geq s_{a1} - g_1 \quad (26)$$

$$g_2 \leq s_{a2} \quad (27)$$

Then, by replacing 24 into 26 and rearranging we get the following inequality:

$$s_{a1} - s_{a2} - s_{b1} + s_{b2} \leq 0 \quad (28)$$

Thus, the present tax policy is feasible only if restriction 28 is satisfied. However, restriction 28 is never satisfied in economic regime I, III, V, and VI; so we can ignore these economic regimes and only look at economic regimes II and IV.

From restriction 25 we know that the maximum tax that can be imposed on region 1 is  $g_1 = s_{b1}$ . Furthermore, if  $s_{b2} \leq s_{a2}$  (which is the case in economic regimes II and IV), the maximum tax on region 2 that restriction 24 allows is  $g_2 = s_{b2}$ . Given that we are looking for a case where an MNC of type  $a$  goes to region 2 it is optimal to set a tax in region 1 not lower than  $s_{b1}$ . For, on the one hand, a lower tax would produce a fall in the welfare obtained from an MNC of type  $b$ . On the other hand, by increasing the value of the outside option for an MNC of type  $a$ , it would also make necessary to reduce the tax on region 2. In a similar way, it is not optimal to reduce the tax on region 2 below  $s_{b2}$ . Thus, the proof is done.

Then, to determine what the country's welfare is under this tax policy we need to know whether or not the outside options are binding. On the one hand, it is obvious that, given that  $g_1 = s_{b1}$  and  $g_2 = s_{b2}$ , region 2 does not constitute a binding outside option for an MNC of type  $b$ <sup>12</sup>. On the other hand, region 1 will not be a binding outside option for an MNC of type  $a$  if the following inequality applies:

$$\frac{s_{a2} - g_2}{2} \geq s_{a1} - g_1 \quad (29)$$

By replacing  $g_1 = s_{b1}$  and  $g_2 = s_{b2}$  into 29, and rearranging we get the following expression:

$$2s_{a1} - 2s_{b1} + s_{b2} - s_{a2} \leq 0 \quad (30)$$

Then, on the one hand, when inequality 30 is not satisfied in economic regime II and IV region 1 is a binding outside option for an MNC of type  $a$  and tax policy 6 is regime-dominated<sup>13</sup>. On the other hand, when inequality 30 is satisfied in economic regime II and IV the region 1 is not a binding outside option for an MNC of type  $a$ . In this case the country's welfare is given by the following expression:

$$w_6 = \frac{s_{a2} - s_{b2}}{2} p + s_{b1}(1 - p) \quad (31)$$

However, in economic regime II and IV this country's welfare is lower than the one in expression 12. Then, we can conclude that it is not optimal to make an

<sup>12</sup>Region 2 will not be a binding outside option for an MNC of type  $b$  if  $\frac{s_{b1} - g_1}{2} \geq s_{b2} - g_2$ .

<sup>13</sup>In this case the country's welfare is:

$$w = [s_{a2} - s_{b2} - (s_{a1} - s_{b1})]p + s_{b1}(1 - p)$$

which in economic regimes II and IV is lower than the one in expression eqw2b. Then, if region 1 is a binding outside option for an MNC of type  $a$ , tax policy 6 would be welfare dominated.

MNC of type  $a$  go to region 2 and an MNC of type  $b$  go to region 1. ■

### **2.2.7. Economic regimes under which particular tax policies are dominated**

We have just determined the complete set of non-dominated tax policies (i.e. tax policies 1, 2, 3a, 4, and 5). In addition, for tax policies 3a, 4, and 5 we have also found some economic regimes where they are regime dominated tax policies. In the following paragraph we go a step forward in this direction and determine the complete set of economic regimes where each of the five non-dominated tax policies is regime dominated. To do this we have to compare the country's welfare provided by every tax policy in every economic regime. The proof is very simple, but because it is space consuming we just give the following summary.

Thus, we find that tax policy 1 is regime dominated in economic regimes III, V, and VI (by tax policy 5). Tax policy 2 is regime dominated in economic regimes III and VI (by tax policy 5). Tax policy 3a is regime dominated in economic regimes II and IV (by tax policy 4); and in economic regimes III, V, and VI (by tax policy 5). Tax policy 3b is regime dominated in every economic regime (by tax policy 3a in economic regimes I, II, and IV and by tax policy 5 in economic regimes III, V, and VI). The application of tax policy 4 in economic regimes III, V, and VI will not attract the MNC of type  $a$  to the country and so it will be regime dominated (by tax policy 5). In economic regimes I, II, and IV, tax policy 5 is equivalent to tax policy 3a and so it is possible to ignore it in these economic regimes and just to refer to tax policy 3a.

Finally, in table 1 we summarise the results we have obtained until now. That is, for each tax policy (column 1), we specify the tax imposed in each region (columns 2 and 3), the distribution of the MNCs between the regions (columns 4 and 5), and the economic regimes for which each tax policy is not weakly dominated (column 6). In addition, in table 2 we determine under what parameter values each tax policy will be the optimal one in those economic regimes where it is not dominated. For example, it is obvious from table 1 that tax policies 4, 3a, 1, and 2 compete with each other in economic regime I. Then if all the expressions in row 1 of table 2 are higher than zero it means that tax policy 4 is the optimal one. In a similar way, when all the expressions in column 5 of table 2 are lower than zero, it means that tax policy 2 is the optimal one. The same interpretation applies for the reminding rows and columns.



**Table 1: Tax policies that are not regime dominated**

Tax Policy	Tax imposed on each state		MNC that each state gets		Economic Regime
	$g_c$	$g_d$	state c	state d	
1	$g_c = s_{ac}$	$g_d = \infty$	a		I <sup>b</sup> , II <sup>b</sup> , and IV <sup>b</sup>
2	$g_c = s_{bc}$	$g_d = \infty$	a, b		I, II, IV, and V
3a	$g_c = \infty$	$g_d = s_{bd}$		a, b	I <sup>a</sup>
4	$g_c = s_{ac} - (s_{ad} - g_d)$	$g_d = s_{bd}$	a	b	I, II <sup>b</sup> , and IV <sup>b</sup>
5	$g_c = s_{ac}$	$g_d = s_{bd}$	a	b	III, V <sup>b</sup> , and VI

Note: The superscripts a and b on the number identifying the economic regime specifies the type of MNC for which the particular tax policy does not reach the best match between state and MNC.

Figure 1:

**Table 2: Parameter values under which each tax policy is the optimal one**

	It provides a higher welfare than		
	1	2	3a
1		$\frac{s_{bc} + s_{ac}}{2} p - s_{bc} > 0$	$\frac{2s_{ac} - s_{ad} + s_{bd}}{2} p - s_{bd} > 0$
2	$s_{bc} - \frac{s_{bc} + s_{ac}}{2} p > 0$		
3a	$s_{bd} - \frac{2s_{ac} - s_{ad} + s_{bd}}{2} p > 0$	$s_{ad} - s_{ac} + s_{bd} - s_{bc} > 0$	
4	$s_{bd} - s_{ad} p > 0$	$s_{bd} - \left( s_{ad} - \frac{s_{ac} + s_{bc}}{2} \right) p - s_{bc} > 0$	$2s_{ac} - 3s_{ad} + s_{bd} > 0$
5		$(s_{ac} + s_{bc} - 2s_{bd}) p + 2(s_{bd} - s_{bc}) > 0$	

Figure 2:

### 3. Results

We have determined the tax policies that are non dominated and summarised all the relevant results in table 1. Then, the question is: What do we get from the model? The first thing to notice is that there are cases where the central government policy generates a mismatch between region and MNC. By mismatch we mean a situation where, even though one MNC is absolutely more productive in one region, it is optimal for the country to make it go to the other one or even not to get it at all. The existence of mismatches is an interesting result that contrasts with the solution when there is no central government intervention, where this never happens.

On the one hand, it is easy to see in table 1 that the case where the mismatch is produced because one MNC does not come to the country appears when tax policy 1 is the optimal one. On the other hand, by using a numerical example extracted from economic regime I, we can see a case of the second type of mismatch. That is, let's assume that  $s_{a1} = 40$ ,  $s_{a2} = 34$ ,  $s_{b2} = 20$ ,  $s_{b1} = 10$ , and  $p = 0.5$ . Then, in this case, the central government will find optimal to implement tax policy 3a with the consequence that both MNCs will go to region 2 and region 1 will be eliminated from the competition. It is clear that in this case there is a mismatch between the MNC of type  $a$  and the region 2, for that type of MNC produces a higher surplus in region 1. This is just an example of this type of mismatch, but as it is clear in table 1, it could also appear in economic regimes II, IV, and V.

The creation of mismatches would have been avoided had the central government had perfect information. In that case it would have charged taxes conditional on the MNCs' type and not on the region. That is, if the central government knows the type of MNC that shows up, its optimal policy would be to make it go to the region in which it produces the highest surplus and to set a tax equal to this surplus. As a result each type of MNC would go to its best matching region and the full surplus would be extracted by the central government. Then, it is clear that what causes the mismatch is the fact that the central government has imperfect information, which induces it to charge the taxes conditional on the regions and not on the MNCs.

Another interesting result of the present model is that, as can be seen in table, the after-tax surplus will be positive only when tax policies 2, 3a, or 4 are the optimal ones and always in the case an MNC of type  $a$  shows up. This also implies that there will be no after-tax surplus in economic regimes III and VI. That is, when the highest two surpluses are produced by the MNC of type  $a$  in region 1 and

the MNC of type  $b$  in region 2, in that order. In other words, when each region has absolute advantage only for the MNC from which it gets the highest surplus, which we can identify as a case with high specialisation and low competition. An extreme case would be when the regions are dissimilar but perfectly symmetric (e.g. the MNC of type  $a$  produces 40 in region 1 and 0 in region 2 and the MNC of type  $b$  produces 0 in region 1 and 40 in region 2).

In the following subsection we show some empirical implications, which can be used to make comparisons with alternative models.

### 3.0.8. Empirical implications

**What determines the magnitude of the subsidy?** From the specification of our model it is obvious that, when the outside option is not binding, the subsidy obtained by the MNC is positively related to the difference between the surplus in the winning region and the surplus in the losing one. However, this relation does not exist if the outside option is binding. Furthermore, *ceteris paribus*, profits and externalities in the winning region will have the contrary effect on subsidies<sup>14</sup>. That is, other things equal, we would expect that the higher is, in the winning region, the ratio between profit of the MNC and externality the lower the subsidy. This is an important point for empirical research because it warns us not to omit the MNC's profit at the time of looking at the relationship between subsidies and externalities.

This implication will be present with or without central government intervention. However, in the case with central government intervention, the subsidy will also depend on whether the central government tax is on the MNC or on the region. That is, it will be positively related to the part of the central government tax charged on the MNC relative to the one charged on the region. As an example assume that there is only one MNC that produces 100 externality. Thus, without central government intervention the subsidy would be 50. However, if the central government intervenes by charging a tax of 100 on the MNC (on the region) the region would end up giving a subsidy of zero (100).

**Relationship between region and MNCs' net profits** Another interesting empirical implication appears when we look at the relationship between the net

---

<sup>14</sup>Because we assume that the regions and MNCs have perfect information the magnitude of these effects will be the same. We recognise however that this does not need to be the case if we allow for private information in the profits and/or externalities.

profit of both the MNC and the winning region. Thus, we find that the net profit of the MNC (profit after the tax and subsidy) is positively related to the region's profit (equal to the externality minus the subsidy)<sup>15</sup>. This is an interesting empirical implication that comes from the fact that in the bargaining process the region and the MNC share the after-tax surplus. However, this result is not always true when there is no central government intervention. A clear example is when the two regions are equal and the MNC gets the full surplus, leaving nothing for the winning region.

---

<sup>15</sup>This result also would hold if the federal government tax is on the region and not on the MNC.

## 4. Conclusion

With the aim of analysing a very important aspect of the last 20 years we have developed a simple model where an MNC bargains with two local governments to decide the location of its new production plant. The creation of positive surplus to the host site induces the local governments to get involved in subsidy (tax) competition. It is clear that this competition reduces the benefits of the winning region in favour of higher profits for the MNC, with the consequent reduction in the country's welfare. Thus, it is natural to ask: Why the central government does not eliminate or limit this competition? The lack of appropriate answers to this question in the literature was the main motivation for the present paper.

In our model an imperfectly informed government moves first by setting the taxes that the MNCs have to pay in each region. Then, at the time a particular MNC has to decide where to build a new production plant, it bargains with the two regions the amount of subsidy to be paid. We have solved the model and found some interesting results. Not surprisingly we find that it is optimal for the central government to give relative advantages to some regions in order to reduce the inter-region competition and to increase the country's welfare. As we have already mentioned, this can be seen as an explanation of the existence of the so called special economic zones or other economic regimes that create asymmetries between the regions of a particular country.

Indeed, we find out that under some particular conditions an asymmetric treatment of similar regions is the only optimal policy. It seems quite striking that a symmetric treatment of similar regions is not an optimal policy. This is the case because when there are two types of MNCs and it is optimal for the country to attract both of them, a similar tax treatment will make the losing region a binding outside option for the high type MNC, increasing in this way the subsidy paid by winning region.

We also find that in several occasions the central government intervention generates a mismatch between region and MNC. This mismatch can be produced by the fact that one MNC does not come to the country even though it has the potential of producing a positive surplus there. Indeed, it can also appear when, even though one MNC is absolutely more productive in one region, it is optimal for the country to make it go to the other one. The existence of mismatches is an interesting result that contrasts with the solution without central government intervention, where they never happen.

Furthermore, we find some empirical implications, which can be used to make

comparisons with alternative models. First, we find that the winning region after-tax surplus must be lower in those cases with high specialisation and low competition. Second, given the surpluses in the winning and losing regions, the subsidy of the winning region will be higher the lower is the ratio between profit of the MNC and externality in the winning region. This is an important point for empirical research, because it warns us not to omit the MNC's profit at the time of looking at the relationship between subsidies and externalities. Finally, we find that the net profit of the MNC must be positively related to the region net profit. Interestingly, this last result is not always true when there is no central government intervention.

Let's look now at what drives the results of the present model. At first we can say that they are driven by the facts that the central government has imperfect information and that it does not see the regions' subsidies. However, it is not so obvious that they also depend, as we have assumed, on the fact that the central government has less information than the regions. It is possible to think of situations where this last assumption would not hold. Then, what would the optimal policy be in a setting where, even though the central government has imperfect information, it is more informed than the regions? It would be interesting to see whether or not the results still apply, and/or under what conditions, in this new and less restrictive setting. However, to make this model work a three-player bargaining framework with imperfect information is needed, what demands an adaptation of Bolton and Winston's bargaining approach.

Another possible extension to the present model comes out by allowing tax pre-commitment capability, not only to the central government, but also to the regions. In the case that this last setting is the appropriate one, it could be modelled by the use of a three stage game. In the first stage the central government pre-commits to taxes and in the second one the regions, which have the same information as the central government, decide whether to pass or not a law to pre-commit to subsidies (taxes). In the third stage, the regional governments, which now have perfect information, are bounded to their commitment or use bargaining. It seems worth doing this and the previous extension, but this should be combined with some empirical research to find out which one is the most appropriate setting.

Finally, two main contributions of the present paper are worth mentioning. The first one is the inclusion of the central government intervention in the inter-region competition process. The second one is the use of a bargaining framework as the tool chosen by the MNC to stimulate the inter-region competition. Contrary to the main tradition in this literature, it seems apparent that the most appropriate

framework for this particular setting is bargaining and not auction.

## 5. Bibliography

Adams, L. and P. Régibeau (2001). "Optimal Trade Policy in the Presence of DFI and Internal Subsidy Competition."

Barros, P. P. and L. Cabral (2000). "Competing for Foreign Direct Investment." *Review of International Economics* 8(2): 360-371.

Bolton, P. and M. D. Whinston (1993). "Incomplete Contracts, Vertical Integration, and Supply Assurance." *The Review of Economic Studies* 60(1): 121-148.

Bond, E. W. and L. Samuelson (1986). "Tax Holidays as Signals." *The American Economic Review* 76(4): 820-826.

Chandler, M. and M. Trebilcock (1986). Comparative survey of industrial policies in selected OECD countries. *Economics of industrial policy and strategy*. D. C. McFetridge. Toronto, Royal Commission on Economic Union and Development Prospects for Canada. 5.

Doyle, C. and S. V. Wijnbergen (1984). "Taxation of Foreign Multinationals: A Sequential Bargaining Approach to Tax Holidays." *Institute for International Economic Studies*(Seminal Paper No. 284).

Easson, A. (2001). "Tax Incentives for Foreign Direct Investment Part II: Design Considerations." *Bulleting for International Fiscal Documentation* 55(8): 365.

Huizinga, H. (1995). "Foreign investment incentives and international cross-hauling of capital." *Canadian journal of economics* XXIV(3): 711-716.

King, I., P. McAfee, et al. (1993). "Industrial blackmail: Dynamic tax competition and public investment." *Canadian journal of economics* 26: 590-608.

King, I. and L. Welling (1992). "Commitment, efficiency and footloose firms." *Economica* 59: 63-73.

**6950 words plus 793 in the footnotes**