ISSN 2079-7141

UAEU Faculty of Business and Economics

UAEU-FBE-Working Paper Series

Title: **Inter-region competition for multinationals when they can choose between firm-specific and non-firm-specific policies: a characterization of the equilibrium**

Author(s): Osiris J. Parcero

Department: Economics and Finance

No. 2011-02

Inter-region competition for multinationals when they can choose between firm-specific and non-firm-specific policies: a characterization of the equilibrium

Osiris J. Parcero*†

Abstract

This paper characterizes the equilibrium taxes and payoffs for two identical local regions in their competition for the attraction of footloose multinationals to their sites and where the considered multinationals strictly prefer the two regions instead of the rest of the world (i.e., the regions have some advantage in terms of strategic location, productivity etc.). In setting their taxes the regions contemplate the existence of previously determined central government taxes to be paid by the MNC in each of the regions. For the sake of reality the model allows the local regions to choose between the implementation of firm-specific and non-firm-specific policies.

JEL Classification: F23, H25, H71.

Keywords: FDI, regional, tax competition, concurrent taxation, bargaining, tax posting, footloose multinational.

*Contact details: Department of Economics and Finance, Faculty of Business and Economics, United Arab Emirates University, PO BOX 17555, Al Ain, UAE. Tel: +971501122648, osirisparcero@uaeu.ac.ae

†I would like to thank Paul Grout, James R. Hines Jr., Oliver Kirchkamp, Carlos Ponce, Helmut Rainer, Tobias Regner, Wendelin Schnedler, Mariano Selvaggi and Michael Whinston.

1 Introduction

It is well known that countries compete for the attraction of 'footloose multinationals'; i.e., mobile multinationals facing a discrete location choice. Moreover, the sub-national governments' role in the competition for footloose multinationals is of great important.

For instance, in the United States the incentive competition among states and cities has increased since the 1960s. "Bidding wars" for specific plants have become widespread, with incentive packages escalating in total worth (see LeRoy 2005 and Chirinko and Wilson 2008). The same type of regional competition has begun to proliferate in developing countries such as, among others, Brazil (see Versano, Ferriera, and Afonso 2002), China (see Xu and Yeh 2005) and India (see Schneider 2004).

This paper characterizes the equilibrium taxes and payoffs for two identical local regions in their competition for the attraction of footloose multinationals to their sites and where the considered multinationals strictly prefer the two regions instead of the rest of the world (i.e., the regions have some advantage in terms of strategic location, productivity etc.). In setting their taxes the regions contemplate the existence of previously determined central government taxes to be paid by the multinationals in each of the regions.

Two separate pieces of literature have looked at problems which are related to the one studied in this paper.

Firstly, there is a branch of literature that, using different set-ups, models inter-region (country) competition for footloose multinationals. For example, Bond and Samuelson (1986) and Doyle and van Wijnbergen (1994) 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. Barros and Cabral (2000) analyze 'subsidy games' between countries in order to attract foreign direct investment (FDI) from a third country. Han and Leach (2007) develop a general equilibrium model in which there is a bidding war among regions for a continuum of firms. Finally, Haufler and Wooton (2006) consider unilateral and coordinated tax policy in a union of two regions (A and B) that competes with a foreign potential-host region (C) for the location of a monopolistic firm. A recent survey can be found in Dembour (2008). This literature focuses on horizontal tax competition when mobile multinationals face discrete location choices, which is the main feature shared with our paper.

Secondly, our paper is related to the literature on 'concurrent taxation', which looks at the case where several levels of governments independently set their taxes on a common tax base. The concurrent taxation problem has been analyzed by the public finance literature in the framework of the "standard tax competition model" of Zodrow and Mieszkowski (1986); see Keen and Kotsogiannis (2002). Further discussion and references about this problem can be found in Keen (1998) and Madiès et al. (2004). Davies (2005) allows the existence of positive interstate spillovers from FDI.

Finally, Parcero (2007) has looked at the concurrent taxation problem in a setting where two identical local governments bargain with a footloose multinational about the tax to be charged, while the first-moving central government of the country has to set the lump sum tax to be paid by the multinational in each of the two local regions.

The present paper broadens Parcero (2007)'s paper by allowing more flexibility to the local governments at the time of choosing their policies towards footloose multinationals. That is, whether they are firm-specific or non-firm-specific policies. However, it is narrower than that paper in that it only characterize the equilibrium of the regional tax competition by considering the central government taxes in each of the regions as exogenous. That is, the optimal central government taxes are not determined in this paper, which is left for a future research.

It is well known that local governments can choose between a range of policies which differ in terms of how much 'firm-specific' they are. There are many aspects in which 'firm-specific' and 'non-firm-specific' policies may differ, though we will only concentrate in one of them - i.e., how good these policies are in terms of taxing the rents produced by footloose multinationals.

As proxies for the 'firm-specific' and the 'non-firm-specific' policies we will use what we call the 'tax-bargaining' and 'tax-posting' regimes respectively. In the tax posting regime the regional lump-sum taxes on the multinationals have to be set in advance and no tax discrimination can be done between multinationals producing different levels of rent. On the contrary, in the tax-bargaining regime each multinational negotiates with the region the particular lump-sum tax to be paid; hence tax discrimination is the advantage of this regime.

The basic model, which consists of a four stage game, is introduced in section 2. In sections 3, 4 and 5 we respectively look at the equilibrium of the three sub-games, where the regional taxes are determined (stages 3 and 4 of the game). In section 3 we solve the sub-game where, in stage 2, one region has chosen the tax-bargaining regime and the other has chosen the tax-posting one. In section 4 we solve the sub-game where, in stage 2, both regions have chosen the tax-posting regime. In section 5 we solve the sub-game where, in stage 2, both regions have chosen the tax-bargaining regime. Section 6 concludes.

2 The basic model

In modelling inter-region tax competition for footloose multinationals, we follow the standard assumption that the central government moves first and commits itself to particular lump sum taxes to be paid by the multinationals. Then, at the time of setting the local taxes, the local governments take the central government taxes as given. For simplicity we assume that both levels of governments have perfect commitment capability when posting a tax (i.e., the posted taxes are non-negotiable). However, the central government taxes in each of the regions are considered to be exogenous. That is, the optimal central government taxes are not determined in this paper, a task that is left for a future research.

We assume a four-stage game involving the central government, G, two local regions, R_j for $j \in (1, 2)$, and 'a' multinational, M_i,[1] where $i \in (l, h)$ is the multinational's type. M_h and M_l show up with probabilities q and $(1 - q)$ respectively. In the case M_i locates in R_j it produces a rent v_{ij}, with $v_{hj} > v_{lj} > 0$. For simplicity we consider identical regions; so the subscript j in v_{ij} will be omitted hereafter. Finally, all players have complete information at the time of making their decisions.

[1] The results of the paper would not be affected by considering more than one multinational.

The sequence of the game is shown in Figure 1. In the first stage of the game the central government posts a set of lump sum taxes, g_1 and g_2, to be paid by M_i in the case of locating in R_1 or R_2 respectively.[2] Notice that throughout the whole paper we will define the 'favoured region' ('non-favoured region') as the region having a lower (higher) central government tax. Moreover, the favored and non-favored regions will be indicated with the subscripts 1 and 2 respectively.

In the second, third and fourth stages each region has to take decisions in order to maximize its own expected payoff. Thus, in the second stage the two regions simultaneously choose their local-tax regime – i.e., 'tax-bargaining' or 'tax posting'. In the third stage, when the chosen tax regimes are publicly observed, the region which has chosen the 'tax posting' regime (if any) announces its local tax level; if both regions have chosen the 'tax posting' regime, they simultaneously announce their local tax levels, t_1 and t_2. In the forth stage M_i shows up and chooses whether to locate the production plant in one of the regions or not to come to the country at all. In the case M_i establishes in a region it has to pay the central government tax in this region plus the 'winning (i.e., host) region' tax. Depending on which tax regime was chosen by the winning region in stage 2, this last tax would be a posted tax or the result of a bargaining process.

The payoffs for all the players are realized in the fourth stage of the game. Clearly, for a region, say R_1, to become the winner of M_i it is necessary that[3]

$$v_i - g_1 - t_{i1} \geq \max(v_i - g_2 - t_{i2}, 0), \tag{1}$$

where the zero term comes from M_i participation constraint (for simplicity, the payoff that M_i obtains by investing abroad is normalized to zero). On the contrary, in the case that $v_i - g_2 - t_{i2} < v_i - g_1 - t_{i1} < 0$, M_i will not come to the country. Thus, when M_i shows up, R_2 gets an ex-post payoff of zero, while M_i's payoff and R_1's ex-post payoff are respectively given by the following two expressions.[4]

$$\pi_i^M = \max(v_i - g_1 - t_{i1}, 0) \tag{2}$$

$$\pi_{i1} = \begin{cases} t_{i1} & \text{if } v_i - g_1 - t_{i1} \geq 0 \\ 0 & \text{if } v_i - g_1 - t_{i1} < 0 \end{cases}, \tag{3}$$

[2] Notice that, as in Parcero (2007), when the taxes are posted the tax poster (central and/or local government) cannot 'tax discriminate' between the two types of $M_i s$. This can be justified if M_i's type is non-verifiable, which ultimately means that a tax-posting regime conditional on types is unfeasible because it cannot be enforced in a court of law. Consequently, the central government can only set taxes conditional on the region where M_i builds the new plant, but not on M_i's type.

[3] Notice that, to be the 'favored region' does not necessarily mean to be the 'winning region' of M_i $\forall i \in (l, h)$. Also notice that we are using a weak inequality in (1). However, when the equal sign applies it is not clear who is the winner of M_i. For instance when $v_i - g_1 - t_{i1} = v_i - g_2 - t_{i2} > 0$, M_i is indifferent between the two regions. Thus, when necessary we will use specific tie break rules to make it clear which region is the winning one.

[4] For simplicity, we are assuming that the regions do not consider the central government tax revenue in their own payoff functions. Obviously, this is not necessarily a realistic assumption if the way the central government spends this tax revenue results 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. This is because each region would get negligible benefits from this central government tax revenue. Indeed, the central government could expend this tax revenue in a way that only increases the welfare of the regions that are not participating in the competition for M_i.

The subscript i in t_{i1} contemplates the fact that, under the tax-bargaining regime, the local tax paid by M_i depends on its type. The calculation of the expected regional payoffs are straightforward from (3), given that we know that the probabilities of M_h and M_l showing up are q and $(1-q)$.

Given the central government taxes, g_1 and g_2, we need to find out whether the regions choose the tax-bargaining regime or the tax posting one (second stage) as well as their equilibrium taxes and payoffs (third and/or fourth stages). There are three possible sub-games: **a)** sub-game (b,p) or (b,p), where one region is committed to tax-posting while the other is committed to tax-bargaining; **b)** sub-game (p,p), where both regions are committed to tax-posting; and **c)** sub-game (b,b), where both regions are committed to tax-bargaining.

We adopt the convention that the first (second) element of a bracket, say (p,b) or (p,p), refers to the favoured (non-favoured) region. From the results obtained in each of these sub-games the equilibrium regional payoffs are picked up for any parameters' value constellation.

In order to limit the analysis to non-trivial cases the following assumptions are made:

Assumption 1: $v_l + q\frac{v_h - v_l}{2} > qv_h \Leftrightarrow q < \frac{2v_l}{v_h+v_l}$, which implies that $g_j \leq v_l$ for at least one region j.

Assumption 2: $0 \leq g_j \leq v_h$ for $j \in \{1,2\}$.

The following sub-sections characterize the equilibrium regional expected payoffs in each of the three sub-games,

Assumption 1 simply requires the parameter values to be such that it will never be optimal for the central government to set taxes such that the country attracts only M_h.

3 One region implements the tax-bargaining regime and the other the tax-posting regime

In this section we look at the sub-game where (at the second stage of the game) one region implements the tax-bargaining regime and the other implements the tax-posting one. Then, in the third stage of the game the tax-posting region, R_p, chooses the particular level of tax to be imposed on M_i, t_p. Finally, in the fourth stage, when t_p is publicly known, M_i shows up and bargains with the tax-bargaining region, R_b, the amount of tax to be paid in the case of locating in R_b.[5]

We begin solving the fourth stage of the game for which we use a standard Rubinstein's alternating-offer bargaining game with outside option (Osborne and Rubinstein (1990)),[6] where R_b and M_i bargain over a pie of size $s_{ib} = v_i - g_b$ (called surplus) and where M_i can opt out and get an 'outside option' equal to $\max(s_{ip} - t_p, 0)$. That is, M_i's outside option is the maximum between what

[5] Notice that by now we are not specifying whether R_p or R_b is the favored region.

[6] As it is clearly shown by Binmore et al (1989) the axiomatic Nash bargaining solution does not provide the right way to deal with outside options. They rightly claim that the way to deal with outside options in bargaining is by applying an analysis of optimal strategic behavior in a game-theoretic model like the one proposed by Osborne and Rubinstein (1990). Besides, this bargaining model provides the same prediction as the Bolton and Whinston (1993) three-party bargaining game used in section 5.

M_i obtains by locating in R_p and its participation constraint, which requires M_i not to get a negative payoff.[7] R_b has no outside option.

Lemma 1 *This bargaining game gives the following results, a summary of which are reported in Table 1.*

1) Conditions under which M_i ***locates in*** R_b ***or*** R_p***: i)*** *When the conditions in row* R_p *and columns 5 and 6 of Table 1 are satisfied,* M_i *locates in* R_p *and* ***ii)*** *when the conditions in row* R_b *and columns 5 and 6 of Table 1 are satisfied,* M_i *locates in* R_b*.*

2) *In case (i) the equilibrium payoffs' functions for* M_i*,* R_p *and* R_b *are respectively* $\pi_{ib}^M = s_{ip} - t_p$*,* $\pi_{ip} = t_p$ *and* $\pi_{ib} = 0$*.*

3) *In case (ii) the following three cases apply.*

3.a) *If* $s_{ip} - t_p < s_{ib}/2$ *the game has a unique sub-game perfect equilibrium, in which* M_i *never opts out and agreement is reached immediately on the payoff function vector* $(\pi_{ib}, \pi_{ib}^M) = (s_{ib}/2, s_{ib}/2)$ *and* R_p *gets* $\pi_{ip} = 0$*.*

3.b) *If* $s_{ip} - t_p > s_{ib}/2$ *the game has a unique sub-game perfect equilibrium, in which* M_i *never opts out and agreement is reached immediately on the payoff function vector* $(\pi_{ib}, \pi_{ib}^M) = (t_p + g_p - g_b, s_{ip} - t_p)$ *and* R_p *gets* $\pi_{ip} = 0$*.*

3.c) *If* $s_{ip} - t_p = s_{ib}/2$ *in every sub-game perfect equilibrium the outcome is an immediate agreement on the payoff function vector* $(\pi_{ib}, \pi_{ib}^M) = (t_p + g_p - g_b, s_{ip} - t_p)$ *and* R_p *gets* $\pi_{ip} = 0$*.*

Proof. See appendix A. ■

The previous lemma was expressed in terms of the players' payoffs. However, a by-product of it is the tax (reaction function) that R_b sets for M_i. It is obvious that this tax must be such that M_i gets the payoff in Table 1. Thus, the equilibrium tax is:[8]

$$t_{ib} = \begin{cases} \underset{R_b \text{ gets } M_i}{\min\left(\frac{s_{ib}}{2}, t_p + g_p - g_b\right)} & \text{if} \begin{cases} g_b \leq v_i \ \& \ [t_p > g_b - g_p \text{ or} \\ (t_p = g_b - g_p \ \& \ g_b \leq g_p)] \end{cases} \\ \underset{R_b \text{ does not get } M_i}{0} & \text{if} \begin{cases} g_b > v_i \text{ or } [t_p < g_b - g_p \text{ or} \\ (t_p = g_b - g_p \ \& \ g_b > g_p)]. \end{cases} \end{cases} \quad (4)$$

The reaction function (4) will be needed in stage 3 of the game in order to find R_p's equilibrium tax, t_p^*.

If the parameter values are such that the conditions in the second curly bracket of (4) apply, R_b would set a very low tax, $t_{ib} = 0$, in order to lure M_i, though, it would not be enough to attract it. On the contrary, if the parameter values are such that the conditions in the first curly bracket of (4) apply, and if the outside option is non-binding (i.e., $\min(\frac{s_{ib}}{2}, t_p + g_p - g_b) = \frac{s_{ib}}{2}$) it is as if the winning region (in this case R_b) takes the entire after-tax rent, s_{ib}, from M_i, but then it compensates M_i by giving back the payoff in Table 1, $\pi_{ib}^M = \max(\frac{s_{ib}}{2}, s_{ip} - t_p)$. This guarantees that M_i gets this payoff. A similar reasoning applies when the outside option is binding.

Let us move on now to the third stage of the game where we need to find R_p's equilibrium tax, t_p^*, which together with Table 1 allow us to get R_b's

[7] Hereafter and for simplicity of exposition we use the term 'payoff' to refer to the 'ex-post payoff' and 'expected payoff' for the 'ex-ante payoff'.

[8] We know that the tax-bargainer is able to set a different tax on each M_i. Hence, in t_{ib}, the subscript i $\forall i \in (l, h)$ contemplates for that. On the contrary, the posted tax cannot discriminate between the low and high types and so there is no i subscript in t_p.

equilibrium tax, t^*_{ib}, hence the equilibrium expected payoffs of the sub-game where both regions implement a different tax regime can be obtained. In order to carry out this task two cases have to be considered: **a)** A sub-game where the favored region chooses the bargaining regime (i.e., $g_b \leq g_p$); we refer to it as the sub-game (b, p)[9] and **b)** a sub-game where the favored region chooses the tax-posting regime (i.e., $g_p < g_b$); we refer to it as the sub-game (p, b). However, given assumptions 1 and 2, the two cases can be written as:

$$\textbf{sub-game } (b,p) \quad : \quad g_b \leq \min(v_l, g_p) \text{ and } g_p \leq v_h, \tag{5}$$

$$\textbf{sub-game } (p,b) \quad : \quad g_p < g_b, \ g_p \leq v_l \text{ and } g_b \leq v_h. \tag{6}$$

Lemma 2 *Given (5) (in this case the favored region chooses the bargaining regime), both regions' equilibrium taxes in the sub-game (b, p) are*

$$t^*_p \geq 0 \tag{7}$$

and

$$t^*_{ib} = \min\left(\frac{s_{ib}}{2}, t^*_p + g_p - g_b\right), \tag{8}$$

while the equilibrium regional expected payoffs are the ones reported in row 1 of Table 4. Notice that, to be consistent with the notation in the following subsections, in row 1 of Table 4 we replace the subscripts b and p by the subscripts 1 and 2.

Proof. See appendix B. ■

In the sub-game (b, p), $s_{ip} \leq s_{ib}$ and so R_b always undercut R_p $\forall i \in (l, h)$. Notice that in this case R_p must announce a tax even though it knows it will be unable to lure the foreign firm away from R_b − whenever $s_{ip} \leq s_{ib}$, M_i can always approach R_b and strike a negotiated deal providing M_i the same payoff it would get in the other site, $s_{ip} - t_p$. Thus, as is clear in row 1 of Table 4, R_p expects to get a zero payoff. Moreover, because $t^*_p \geq 0$, there is multiple equilibria in the sub-game (b, p), which is payoff equivalent for R_p, but not for R_b. (see row 1 of Table 4)

We have already found the equilibrium taxes and regional expected payoffs for the sub-game where the favored region chooses the bargaining regime (i.e., sub-game (b, p)), and we look now at the sub-game where the favored region chooses the tax-posting one (i.e., sub-game (p, b)). Contrary to what happened in the previous sub-game, depending on the parameter values, R_p will be the winner of only M_h or both M_i's types. Moreover, the present sub-game is more complex because R_p has to choose between two restricted maximums. That is, for $\iota \in (h \text{ or } lh)$, it can maximize its expected payoff restricted to the use of a posted tax, t_{p_ι}, which attracts the set ι of M_i's types − i.e., when $\iota = h$ only M_h is attracted while when $\iota = lh$ both M_i's types are attracted.[10][11] This results

[9] Notice that we not only need to identify the favored and non-favored regions, but also the tax regime implemented by each of them. This is the reason why, by now, we are adopting the notation b and p instead of 1 and 2. However, because the notation b and p does not specify whether a region is the favored or non-favored one, we rely on the already mentioned convention that the first (second) term inside the brackets (i.e., (b, p)) stands for the regime chosen by the favored (non-favored) region.

[10] It is clear that the attraction of only M_l is a dominated strategy for R_p hence, for the sake of simplicity, we do not consider it.

[11] However, keep in mind that in any of these two cases R_p sets a non-discriminatory tax. Contrast this with the bargaining regime, where the tax paid by the multinational of type i, t_{ib}, depends on its type.

in two R_p's restricted optimal taxes, $t^*_{p_\iota}$ $\forall \iota \in (h \text{ and } lh)$, and the corresponding R_b's optimal taxes, t^*_{ib}[12]. Associated with these two sets of taxes are the two vectors of regional expected payoffs.

Finally, the restricted optimal tax, $t^*_{p_\iota}$, providing the highest expected payoff to R_p is the sub-game's equilibrium tax for R_p, t^*_p. Once t^*_p has been obtained, the calculation of the corresponding sub-game's regional equilibrium taxes for R_b, t^*_{ib}, and the vector of equilibrium expected payoffs, $\left[\Pi^*_{p_\iota}(p_\iota, b), \Pi^*_b(p_\iota, b)\right]$, are straightforward.

Lemma 3 *Given (6) (in this case the favored region chooses the tax-posting regime), we have that the equilibrium regional expected payoffs in the sub-game (p, b) are the ones reported in row 2 of Table 4. Notice that, to be consistent with the notation in the following sub-sections, in row 2 of Table 4 we replace the subscripts p and b by the subscripts* 1 *and* 2.

Proof. See appendix C ■

4 Both regions implement the tax-posting regime

We now look at the case where in the second stage of the game both regions have already committed themselves to implement the tax-posting regime; recall that we refer to it as the sub-game (p, p). Hence, in the third stage of the game the lower-level governments simultaneously announce non-negotiable taxes and then M_i chooses the investment site that maximizes its payoff. This continuation game entails Bertrand-type tax competition.

Lemma 4 *In the sub-game (p, p), R_1 and R_2 equilibrium expected payoffs are the ones reported in row 3 of Table 4, where by definition $s_{ij} = v_i - g_j$, $\forall i \in (l, h)$, $\forall j \in (1, 2)$ and $g_1 \leq g_2$.*

Proof. See Appendix D. ■

On the one hand, in the previous lemma we see that under the symmetric central government tax policy, $g_1 = g_2$, the Bertrand competition results in the local governments competing away the entire surplus, $s_{ij} = v_i - g_j$, hence favoring M_i. On the other hand, in the asymmetric case, $g_1 < g_2$, the final outcome depends more delicately on parameter values. When g_2 is relatively low (i.e., $g_2 \leq v_l$) R_1 attracts both M_i's types and reaps a payoff equal to its competitive advantage. Moreover, it is straightforward to see in row 3 of Table 4 that, given $g_1 \leq v_l$, R_1's sub-game equilibrium payoff, which ultimately depends on whether it intends to attract only M_h or both M_i's types, is weakly increasing in g_2, reflecting the fact that a raise in g_2 lessens the competition effect from R_2.

[12] We recognize that a more appropriate notation for R_b's optimal taxes would have been $t^*_{ib_\iota}(p_\iota, b)$ $\forall \iota \in (h \text{ and } lh)$. This is because, it would make it clear that a particular R_b's tax is the optimal response to a particular $t^*_{p_\iota}$, as well as specifying which M_i would be attracted by R_b. However, for simplicity we prefer to keep the adopted notation.

5 Both regions implement the tax-bargaining regime

We know look at the case where in the second stage of the game both regions have already committed themselves to implement the tax-bargaining regime; recall that we refer to it as the sub-game (b, b). Hence, the tax paid by M_i in the host region stems from multilateral bargaining. To model this negotiation process we adopt the non-cooperative three-party bargaining game developed by Bolton and Whinston (1993). In our context, this is an alternating-offer game where M_i has to make offers to the two regions.

When it is M_i's turn to make an offer, it can talk with a particular region and offer either a particular tax to be paid to this region in the case of agreement or it can make no offer. When it is the regions' turn to make an offer, they simultaneously bid the tax they are willing to charge.

Recall from section 3 that the 'surplus' created by M_i in R_j, for $i \in \{l, h\}$ and $j \in \{1, 2\}$ is defined as $s_{ij} = v_i - g_j$. Again, $g_1 \leq g_2$; i.e., R_1 is the favoured region. Then, the (unique) equilibrium outcome of the Bolton and Whinston model is stated in the following lemma.

Lemma 5 *Agreement is immediate, M_i never takes its outside option and its payoff is the maximum between:*

1. *Half of the surplus it creates in the favoured region, $\frac{s_{i1}}{2}$, and*
2. *M_i's outside option, which is equal to the surplus it creates in the non-favoured region, s_{i2}.*

Proof. See Bolton and Whinston (1993). ■

The results of the Bolton and Whinston bargaining game can also be expressed in terms of the expected regional payoffs, which is what we are particularly interested in. This is done in the following lemma.

Lemma 6 *Given $g_1 \leq g_2$, $g_1 \leq v_l$ (from assumption 1) and $g_2 \leq v_h$ (from assumption 2), the regional equilibrium expected payoffs of the sub-game are the ones reported in row 4 of Table 4.*

Proof. The proof is straightforward from lemma 5. When M_i gets $s_{i1}/2$, R_1 also gets $s_{i1}/2$ and when M_i gets s_{i2}, R_1 gets $s_{i1} - s_{i2} = g_2 - g_1$. ■

In other words, whenever M_i's outside option is non-binding, R_1 and M_i share s_{i1} equally. On the contrary, when M_i's outside option is binding M_i gets the value of its outside option whereas R_1 is the residual claimant.

6 Conclusion

This paper characterized the equilibrium taxes and payoffs for two identical local regions in their competition for the attraction of footloose multinationals to their sites and where the considered multinationals strictly prefer the country where the two regions belong instead of the rest of the world (i.e., the country has some advantage in terms of strategic location, productivity etc.). In setting their taxes the regions contemplate the existence of previously determined central government taxes to be paid by the multinationals in each of the regions.

For the sake of reality we have built a model where the regions were allowed to choose between the implementation of firm-specific and non-firm-specific policies. As proxies for these two types of policies the 'tax-bargaining' and 'tax-posting' regimes were used.

The equilibrium regional taxes and payoffs were obtained for any parameters' value constellation and for each of the subgames. In the particular case of the subgame where the favored regions chooses tax-bargaining and the non-favored one tax-posting we find the existence of multiple equilibria, which is payoff equivalent for the tax-poster, but not for tax-bargainer.

The characterization of the equilibria of the game may be useful in a future research where the aim is to look at the optimal central government taxation in a tax competition setting like the one describe in this paper.

7 Appendix

A

In what follows we sequentially prove points (1) to (3).

Point 1) Let us first explain the fact that when $g_b \leq v_i$ and $t_p > g_b - g_p$, M_i locates in R_b and when $t_p \leq s_{ip}$ and $t_p < g_b - g_p$, M_i locates in R_p (columns 5 and 6 of Table 1). On the one hand, the inequalities $g_b \leq v_i$ and $t_p \leq s_{ip}$ stand for M_i's participation constraints in R_b and R_p respectively. Notice that, for simplicity, when $g_b = s_i$ ($t_p = s_{ip}$) we are imposing the tie break rule that M_i prefers to locate in R_b (R_p) rather than not to come to the country at all. On the other hand, inequality $t_p < g_b - g_p$ (respectively $t_p > g_b - g_p$) is equivalent to $s_{ib} < s_{ip} - t_p$, which compares the surplus produced in the match between M_i and R_b with the value of M_i's outside option in R_p.

Furthermore, notice that in row R_b (row R_p) and column 6 of Table 1 we are also using the tie break rules that when $t_p = g_b - g_p$ & $g_b \leq g_p$ (respectively $t_p = g_b - g_p$ & $g_b > g_p$) M_i prefers R_b to R_p (R_p to R_b). The necessity of the first (respectively second) tie break rule will be clear in lemma 2 below (respectively in expressions (9) and (11) below).

Point 2) In this case M_i locates in R_p because R_b is unable to both lure the foreign firm away from R_p and receive a non-negative payoff. From (2) M_i's payoff is equal to the rent it produces minus the aggregate taxes ($g_p + t_p$) it pays while R_p's payoff is the tax it charges. R_b is the loosing region and gets nothing. See row R_b of Table 1.

Point 3) The proof of this point is straightforward from section 3.12.1 in Osborne and Rubinstein (1990). Notice that in point (3.b) and (3.c) M_i gets its outside option, $\pi^M_{ib} = s_{ip} - t_p$, and R_b's payoff is calculated as follows: $s_{ib} - \pi^M_{ib} = t_p + g_p - g_b$.

B

Let us first show that $t^*_p \geq 0$. Given $g_b \leq g_p$, it is clear from row R_p of Table 1 that if $t_p < g_b - g_p$ **and** $t_p \leq s_{ip}$, R_p would only attract M_i at a loss (because $\pi_{ip} = t_p < 0$) while if $t_p \geq g_b - g_p$ **or** $t_p > s_{ip}$, R_p would not attract M_i.

From (5) we get $g_b \leq v_l$, so we can be certain that $g_b - g_p \leq s_{ip}$ $\forall i \in (l, h)$. Hence, the previous paragraph results simplify to: If $t_p < g_b - g_p$, R_p would attract both M_i's types at a loss while if $t_p \geq g_b - g_p$, R_p would not attract any M_i's type. However, if $g_b - g_p \leq t_p < 0$, R_p would get an expected loss if R_b plays an off-the-equilibrium tax higher than the equilibrium one. That is,

$$\Pi_p = qt_p + (1-q)\, t_p = t_p < 0.$$

Then, $t_p < 0$ would be a weakly dominated strategy for R_p. Hence, by ignoring weakly dominated strategies (see, e.g., Kreps 1990, ch. 12) R_p's equilibrium tax is $t_p^* \geq 0$.

Finally, given (5) and $t_p^* \geq 0$, we get that R_b's equilibrium tax (from the first row of (4)) is $t_{ib}^* = \min\left(\frac{s_{ib}}{2}, t_p^* + g_p - g_b\right)$ while R_b's expected equilibrium payoff (by using the ex-post payoff function from the third column of Table 1) are the ones reported in row 1 of Table 4. Notice that, to be consistent with the notation in the following sub-sections, in row 1 of Table 4 we replace the subscripts b and p by the subscripts 1 and 2; moreover, we are including the restrictions imposed by assumptions 1 and 2.

C

The proof proceeds as follows. First, given (6), we determine each restricted equilibrium tax-poster's tax $t_{p_\iota}^*$ $\forall \iota \in$ (h and lh). Second, for each restricted equilibrium and using (4) we get the corresponding t_{ib}^*. Third, for each restricted equilibrium we get (by using Table 1) the corresponding vector of payoffs, $\left[\Pi_{p_\iota}^*(p_\iota, b), \Pi_b^*(p_\iota, b)\right]$. We have the following two restricted equilibria:

Restricted equilibrium 1: R_p attracts both M_i's types (rows 1a to 2b of Table 2): Given (6), from Table 1 we get that R_p would attract both M_i's types if

$$t_p \leq \min\left[(g_b - g_p;\, v_h - g_p)\,; (g_b - g_p;\, s_{lp})\right] \tag{9}$$

where $s_{lp} = v_l - g_p$ which, given assumption 2, is equivalent to

$$t_p \leq \min\left(g_b - g_p;\; s_{lp}\right). \tag{10}$$

Thus, we can obtain $t_{p_{lh}}^*$ (from (10)), $\Pi_{p_{lh}}^*(p_{lh}, b)$ (using Table 1) and the parameter values under which they apply (using assumptions 1 and 2). They are shown: *i)* In row 1a of Table 2 when in (10) $\min(g_b - g_p; s_{lp}) = g_b - g_p$ (i.e., $g_b \leq v_l$) and *ii)* in row 2a of Table 2 when $\min(g_b - g_p; s_{lp}) = s_{lp}$ (i.e., $v_l < g_b$).

Let us now find the corresponding values for t_{ib}^* and $\Pi_b^*(p_{lh}, b)$. On the one hand, given $t_{p_{lh}}^* = g_b - g_p$ and $g_p < g_b$ from row 1a of Table 2, it is clear from (4) that when M_i shows up $t_{ib}^* = 0$; hence using Table 1 we get $\Pi_b^*(p_{lh}, b) = 0$ (see row 1b of Table 2). On the other hand, given $t_{p_{lh}}^* = s_{lp}$ and $v_l < g_b$ from row 2a of Table 2, we know from (4) that when M_i shows up $t_{ib}^* = 0$ as well; hence using Table 1 we get $\Pi_b^*(p_{lh}, b) = 0$ (see row 2b of Table 2).

Restricted equilibrium 2: R_p attracts only M_h (rows 3a and 3b of Table 2): Given (6), from Table 1 we get that R_p would only attract M_h if

$$\min\left(g_b - g_p;\; s_{lp}\right) < t_p \leq \min\left(g_b - g_p;\; v_h - g_p\right). \tag{11}$$

Given assumption 2, the previous inequality is equivalent to

$$\min\left(g_b - g_p;\; s_{lp}\right) < t_p \leq g_b - g_p, \tag{12}$$

which is satisfied if and only if $v_l < g_b$. Then, if $v_l < g_b$, it is obvious that $t^*_{p_h}$ (from (12)), $\Pi^*_{p_h}(p_h, b)$ (using Table 1) as well as the parameter values under which they apply (using assumptions 1 and 2) are the ones in row 3a of Table 2. Finally, given $t^*_{p_h} = g_b - g_p$ and $g_p < g_b$, it is clear that t^*_{ib} (from (4)) and $\Pi^*_b(p_h, b)$ (from Table 1) are the ones in row 3b of Table 2.

Finally, the sub-game's equilibrium expected payoffs for R_p and R_b are reported in row 2 of Table 4. Notice that, to be consistent with the notation in the following sub-sections, in row 2 of Table 4 we replace the subscripts p and b by the subscripts 1 and 2.

D

Given assumptions 1 and 2 and the fact that R_1 is the favoured region, we have that $g_1 \leq \min(g_2, v_l)$ and $g_2 \leq v_h$. Hence we know from (1) that for R_1 to get M_i it is necessary that M_i's payoff is higher in R_1 than in R_2 and that M_i participation constraint is satisfied. This requires that[13]

$$t_1 \leq \min(t_2 + g_2 - g_1, s_{i1}) \text{ for } i \in (l, h), \tag{13}$$

where by definition $s_{i1} = v_i - g_1 \; \forall i \in (l, h)$.

Notice that in the sub-game (p, p) it can never be the case that both M_i's types go to different regions. This, together with $g_1 < g_2$ guarantees that R_2 will not get any M_i's type in equilibrium.

Let us see what is R_2's equilibrium tax. Notice that a tax $t_2 < 0$ would be a weakly dominated strategy for R_2.[14] Hence, by ignoring weakly dominated strategies (see, e.g., Kreps 1990, ch. 12) and given the fact that R_1 would find it optimal to undercut any tax $t_2 > 0$, R_2's equilibrium tax is

$$t_2 = 0. \tag{14}$$

Then, replacing t_2 from (14) into (13) for $i = l$ we get that in order for R_1 to get M_l it is necessary that

$$t_{1l} \leq \begin{cases} g_2 - g_1 & \text{if } g_2 \leq v_l \\ s_{l1} & \text{if } v_l < g_2. \end{cases} \tag{15}$$

Similarly, replacing t_2 from (14) into (13) for $i = h$ we get that in order for R_1 to get M_h it is necessary that

$$t_{1h} \leq \begin{cases} g_2 - g_1 & \text{if } g_2 \leq v_h \\ s_{h1} & \text{if } v_h < g_2. \end{cases} \tag{16}$$

Furthermore, using (3) and knowing that M_h (M_l) shows up with probability q $(1-q)$, R_1's equilibrium expected payoff when it attracts both M_i's types and when it attracts only M_h are respectively given by the following two expressions

$$\Pi^*_1(p_{lh}, p) = t_1 \tag{17a}$$
$$\Pi^*_1(p_h, p) = qt_1. \tag{17b}$$

[13] For simplicity, in this section we use the tie break rule that in the case of being indifferent between R_1 and R_2 or not coming to the country at all, M_i locates in R_1 with probability 1.

[14] That is, $t_2 < 0$ would give R_2 an expected lost if R_1 plays an off-the-equilibrium tax resulting in R_2 defeating R_1.

Notice that when $v_l < g_2$ we know that $s_{l1} < g_2 - g_1$; hence a tax $t_1 = g_2 - g_1$ would only attract M_h. Furthermore, given assumption 2, the second row in (16) does not need to be considered. This is not a problem because, given $g_2 = v_h$, the tax in the first row of (16) is exactly the same as the one in the second row.

From (15), (16) and (17) we get that R_1's equilibrium taxes (expected payoffs) are the ones reported in the first (second) column of Table 3; the parameter values under which each of the equilibria applies are in the third column.[15] Needless to say that R_2 gets an expected payoff of zero.

Let us now show that, the set of taxes $t_2^* = 0$ and t_1^* in Table 3 are the unique Nash equilibriums for the corresponding parameter values in the third column of Table 3. We know that $t_2 < t_2^*$ is a weakly dominated strategy for R_2 (see, e.g., Kreps 1990, ch. 12). This leaves us with only four possibilities: $(t_1 > t_1^*, t_2 \geq t_2^*)$, $(t_1 \geq t_1^*, t_2 > t_2^*)$, $(t_1 < t_1^*, t_2 \geq t_2^*)$ and $(t_1 \leq t_1^*, t_2 > t_2^*)$. However, on the one hand, $(t_1 > t_1^*, t_2 \geq t_2^*)$ and $(t_1 \geq t_1^*, t_2 > t_2^*)$ are not equilibrium because both regions will have incentives to undercut each other until $(t_1 = t_1^*, t_2 = t_2^*)$ is achieved. On the other hand, $(t_1 < t_1^*, t_2 \geq t_2^*)$ and $(t_1 \leq t_1^*, t_2 > t_2^*)$ are not equilibrium. This is because, given $t_2 \geq t_2^*$, $t_1 = t_1^*$ provides a higher expected payoff to R_1 than $t_1 < t_1^*$ while , given $t_1 = t_1^*$, $t_2 = t_2^*$ provides R_2 a higher payoff than $t_2 > t_2^*$. Thus, the only equilibrium is $(t_1 = t_1^*, t_2^* = 0)$.

Finally, the expected regional payoffs in Table 3 are summarized in row 3 of Table 4.

References

[1] Barros, P. P. and L. Cabral (2000). Competing for foreign direct investment. *Review of International Economics*, 8(2), pp.360-371.

[2] Binmore, K., A. Shaked, and J. Sutton (1989). An ouuside option experiment. The Quarterly Journal of Economics, 104(4), pp.753-770.

[3] Bolton, P. and M. D. Whinston, 1993, Incomplete contracts, vertical integration, and supply assurance, The Review of Economic Studies 60(1), pp.121-148.

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

[5] Chirinko, R. and D.J. Wilson (2008). State investment tax incentives: a zero-sum game? *Journal of Public Economics*, 92(12), pp.2362-2384.

[6] Dembour, C. (2008). Competition for business location: a Survey. *Journal of Industry, Competition and Trade*. 8 (2). pp.89-111.

[7] Davies, R. B. (2005). State tax competition for foreign direct investment: a winnable war. *Journal of International Economics*, 67(2). pp. 498-512.

[15] Notice that assumptions 1 and 2 are imposed in the third column. Moreover, the second condition appearing in the last two rows of Table 3 refer to $\Pi_1^*(p_{lh}, p) \gtreqless \Pi_1^*(p_h, p)$.

[8] 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).

[9] Han, S. and J. Leach (2008). A bargaining model of tax competition. *Journal of Public Economics*, Volume 92 (5-6), pp.1122-1141.

[10] Haufler, A. and I. Wooton (2006). Regional tax coordination and foreign direct investment, *European Economic Review*, 50(2), pp.285-305.

[11] Keen M. (1998). Vertical tax externalities in the theory of fiscal federalism. *IMF Staff Papers*, 45(3), pp.454-485.

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

[13] Kreps, D. (1990). A course in microeconomic theory, Pearson Education Ltd., England.

[14] LeRoy, G. (2005). The great american jobs scam: corporate tax dodging and the myth of job creation. San Francisco: Berrett-Koehler Publishers.

[15] Madiès, T., S. Paty and Y. Rocaboy (2004). Horizontal and vertical externalities: an overview of theoretical and empirical studies. *Urban Public Economics Review*, No. 002, pp.63-93.

[16] Osborne, M. and Rubinstein, A. (1990). *Bargaining and markets*. Academic Press, San Diego, USA.

[17] Parcero, O. J. (2007). Inter-jurisdiction subsidy competition for a new production plant: What is the central government optimal policy? *Regional Science and Urban Economics*. 37(6), pp.688-702.

[18] Schneider, A. (2004). Accountability and capacity in developing country federalism. *Forum for Development Studies*, 31(1), pp.33-56.

[19] Versano, R., S. Guimaraes Ferreira, and J. R. Afonso (2002). Fiscal competition: a bird's eye view. Discussion paper no. 887. Rio de Janeiro, Brazil: Instituto de Pesquisa Economica Aplicada.

[20] Xu, J. and A. Yeh (2005). City repositioning and competitiveness building in regional development: new development strategies in Guangzhou, China. *International Journal of Urban and Regional Research*, 29(2), pp.283-308.

[21] Zodrow, G. R. and P. Mieszkowski (1986). Pigou, Tiebout, property taxation and the under-provision of local public goods. *Journal of Urban Economics*, 19(3), pp.356-370.

Figure 1: Sequence of events

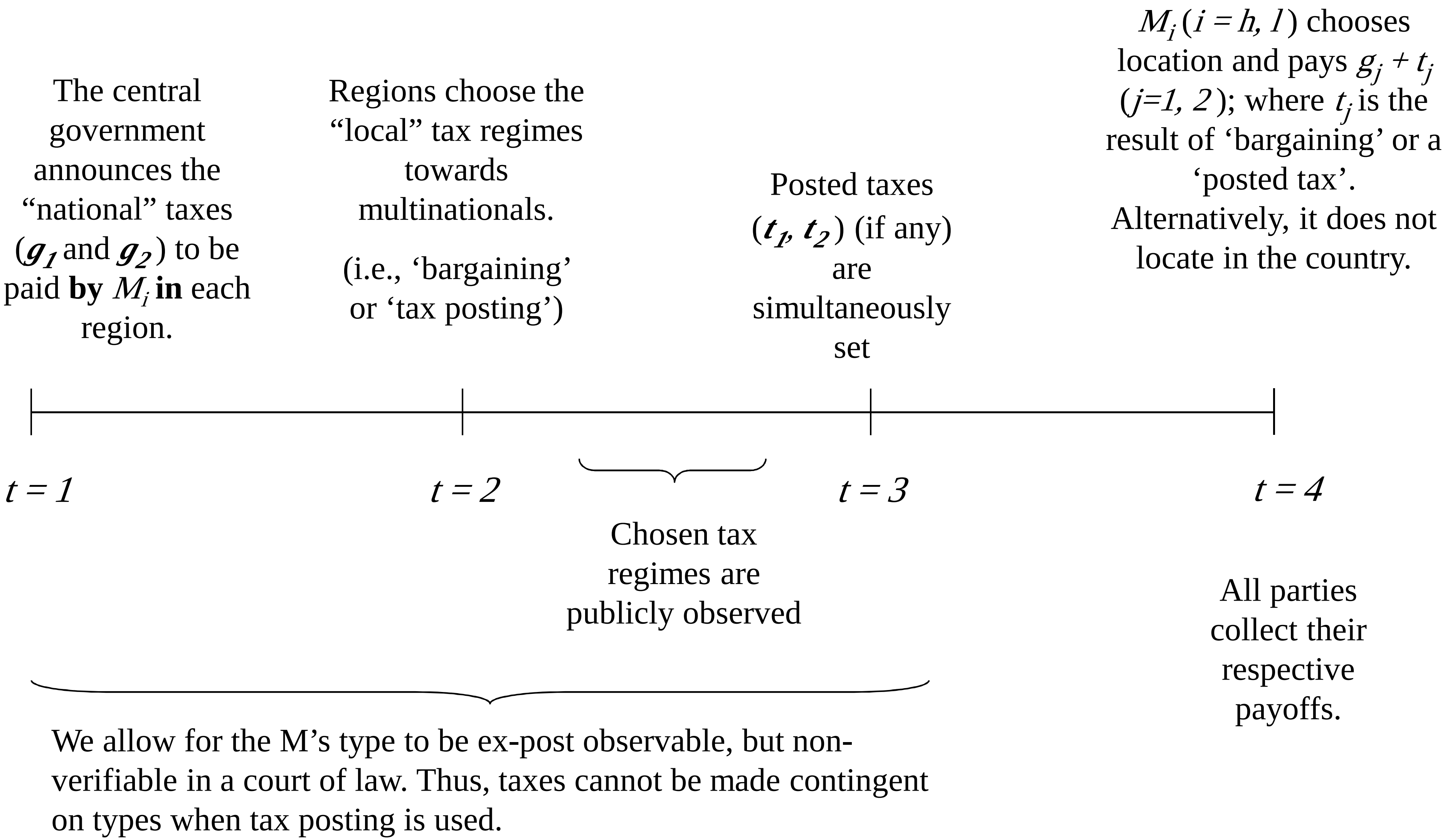

Table 1 : **Ex – post payoffs for M_i and the regions in the sub – game (b, p) when $g_b \leq \min(v_l,\ g_p)$ and $g_p \leq v_h$.**

Winning region	π_i^M	π_{ib}	π_{ip}	**M_i's participation constraint**	**Conditions for the winning region to beat the loosing one**
R_b	$\max\left(\frac{s_{ib}}{2}, s_{ip} - t_p\right)$	$\min\left(\frac{s_{ib}}{2}, t_p + g_p - g_b\right)$	0	$g_b \leq v_i$	$t_p > g_b - g_p$ or $(t_p = g_b - g_p$ & $g_b \leq g_p)$
R_p	$s_{ip} - t_p$	0	t_p	$t_p \leq s_{ip}$	$t_p < g_b - g_p$ or $(t_p = g_b - g_p$ & $g_b > g_p)$

Table 2 : **Sub – game equilibrium taxes and expected payoffs functions in the sub – game (p, b) restricted to R_p attracting both M_i's types or only M_h (when $g_p < g_b$, $g_p \leq v_l$, and $g_b \leq v_h$).**

Equilibrium taxes	**Regional expected payoffs**	**Parameter values for which each equilibrium applies**
1a) $t^*_{p_{lh}} = g_b - g_p$ **1b)** $t^*_{ib} = 0$	$\Pi^*_{p_{lh}}(p_{lh}, b) = g_b - g_p$ $\Pi^*_b(p_{lh}, b) = 0$	**1a)**, **1b)** $\}$ $g_p < g_b \leq v_l < v_h$
2a) $t^*_{p_{lh}} = s_{lp}$ **2b)** $t^*_{ib} = 0$	$\Pi^*_{p_{lh}}(p_{lh}, b) = v_l - g_p$ $\Pi^*_b(p_{lh}, b) = 0$	**2a)**, **2b)** $\}$ $g_p \leq v_l < g_b \leq v_h$
3a) $t^*_{p_h} = g_b - g_p$ **3b)** $t^*_{ib} = 0$	$\Pi^*_{p_h}(p_h, b) = q\,(g_b - g_p)$ $\Pi^*_b(p_h, b) = 0$	**3a)**, **3b)** $\}$ $g_p \leq v_l < g_b \leq v_h$

Table 3 : Sub – game equilibrium taxes and expected payoffs for R_1 in the sub – game (p, p).

	t_1^*	**R_1's expected payoff**	**Parameter values for which each equilibrium applies**
1	$g_2 - g_1$	$\Pi_1^*(p_{lh}, p) = g_2 - g_1$	$0 \le g_1 \le g_2 \le v_l$
2	s_{l1}	$\Pi_1^*(p_{lh}, p) = s_{l1}$	$0 \le g_1 \le v_l < g_2 \le v_h$ & $s_{l1} \ge q(g_2 - g_1)$
3	$g_2 - g_1$	$\Pi_1^*(p_h, p) = q(g_2 - g_1)$	$0 \le g_1 \le v_l < g_2 \le v_h$ & $s_{l1} < q(g_2 - g_1)$

Table 4 : Regional expected equilibrium payoffs for each of the sub – games.[(1)]

1	$\begin{pmatrix} \Pi_1^*(b,p) \\ \Pi_2^*(b,p) \end{pmatrix} = \begin{pmatrix} q\min\left(\frac{s_{h1}}{2}, g_2 - g_1 + t_2^*\right) + (1-q)\min\left(\frac{s_{l1}}{2}, g_2 - g_1 + t_2^*\right) \\ 0 \end{pmatrix}$
2	$\begin{pmatrix} \Pi_1^*(p,b) \\ \Pi_2^*(p,b) \end{pmatrix} = \begin{cases} \begin{pmatrix} g_2 - g_1 \\ 0 \end{pmatrix} & \text{if } g_1 \le g_2 \le v_l < v_h \quad \textbf{(a)} \\ \begin{pmatrix} \max(s_{l1}; q(g_2 - g_1)) \\ 0 \end{pmatrix} & \text{if } g_1 \le v_l < g_2 \le v_h \quad \textbf{(b)} \end{cases}$
3	$\begin{pmatrix} \Pi_1^*(p,p) \\ \Pi_2^*(p,p) \end{pmatrix} = \begin{cases} \begin{pmatrix} g_2 - g_1 \\ 0 \end{pmatrix} & \text{if } g_1 \le g_2 \le v_l < v_h \quad \textbf{(a)} \\ \begin{pmatrix} \max(s_{l1}; q(g_2 - g_1)) \\ 0 \end{pmatrix} & \text{if } g_1 \le v_l < g_2 \le v_h \quad \textbf{(b)} \end{cases}$
4	$\begin{pmatrix} \Pi_1^*(b,b) \\ \Pi_2^*(b,b) \end{pmatrix} = \begin{pmatrix} q\min\left(\frac{s_{h1}}{2}, g_2 - g_1\right) + (1-q)\min\left(\frac{s_{l1}}{2}, g_2 - g_1\right) \\ 0 \end{pmatrix}$

(1) Notice that $0 \le g_1 \le v_h$ and $0 \le g_2 \le v_h$ (from assumption 2), $g_1 \le v_l$ (from lemma 1), and $t_p^* \ge 0$ (from lemma 3). Recall also that $g_1 \le g_2$.